

IDENTIFICATION OF NYMPHS AND ADULTS OF THE
COMMON GRASSHOPPERS (ACRIDIDAE) INHABITING THE FLINT
HILLS NATIVE TALLGRASS PRAIRIE NEAR MANHATTAN, KANSAS

by

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**THIS BOOK
CONTAINS
NUMEROUS PAGES
WITH MULTIPLE
PENCIL AND/OR
PEN MARKS
THROUGHOUT THE
TEXT.**

**THIS IS THE BEST
IMAGE AVAILABLE.**

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INTRODUCTION

Grasshopper species vary in host plant preference; some feed on economically desirable plants and others on undesirable plants; some feed on both to various degrees. Control recommendations thus require not only knowledge of the classical number of grasshoppers per unit area, but also recommendations based on whether the species is actually beneficial or harmful before applying control measures. This knowledge minimizes the use of insecticides, which is particularly important when considering treatment of pastures and rangelands where livestock is likely to be present at all times. Furthermore, control, when needed, should be initiated early in the growing season when the grasshopper is still a nymph to (1) minimize use of insecticides because nymphs are killed easier, (2) takes less insecticide to be lethal, (3) minimizes destruction, (4) achieve better coverage with the insecticide because of the advantage of less vegetation present, and (5) attack the grasshopper species before dispersal.

A limited number of keys are available for identification of grasshopper nymphs, but these have often been restricted to a few species not found in this study area, or have included only one group of

grasshoppers, or have substandard illustrations. Studies by Criddle (1926) in Canada; Handford (1946) on the Melanoplus of Manitoba and adjacent area; Brusven (1967) on the slant-faces near Manhattan, Kansas; Brusven (1972) on the grasshoppers in parts of Idaho; and Scoggan and Brusven (1972) on certain grasshoppers of Idaho and adjacent areas represent most of the identification studies.

This study provides identification of common grasshoppers of the Flint Hills Native tallgrass prairie near Manhattan, Kansas using colored photographs and block keys. Furthermore, the morphological structures and other identification characteristics of nymphs need to be recorded purely from the standpoint of contributing to scientific knowledge.

MATERIALS AND METHODS

Twenty-one of the common Acridid species from the Flint Hills native tallgrass prairie near Manhattan, Kansas were studied. Both adult and nymphs were collected in the field at 5 sites in the Manhattan area: (1) "Knob Hill", a mile west of the entrance to Marlatt Park; (2) around Tuttle Creek Road; (3) the Stockdale area; (4) the KSAC radio tower; and, (5) in one of the KSU pastures near the radio tower. Field-collected species were transported alive to the laboratory in glass jars with screen tops. They were either killed by freezing (to keep their color), sorted to species, photographed, and then refrozen; or were immobilized with carbon dioxide, separated to species, and kept in rearing cages till adulthood for verification of identification.

A single lens 35mm Nikkormat camera body fitted with a Nikon Bellows using a Micro-Nikkor Auto 55mm f/3.5 lens with Nikon M-rings was used for photographing the nymphs and adults, using Kodachrome II, ASA 25 speed color slide film, which resulted in magnification from .8 to 5. Two Vivitar 151 electronic flash units were used for the light source. The units were attached to the bellows by brackets so that the flashes would move with the bellows to keep the light constant. A lab jack was used as the base

for the specimen and was moved up and down for focusing.

The specimens were mounted on minuten nadeln to keep the specimens above the surface to eliminate shadows. Colored acetate paper was used for background, each color representing a different instar: light yellow represented 1st instar; green background, 2nd; blue, 3rd; red, 4th; and white (no acetate background, only styrofoam) 5th instar and adult. Two photos were taken of each instar, dorsal and lateral view.

Brusven (1967) pointed out that the older the nymphs, the easier to use adult characters for identification. Structural characteristics provide the basis for most identification, but color patterns are also very important for species differentiation.

In a few species a single character is sufficient for identification while in most others a combination of characters are used. Principal characters appear at the top of the block key, these include the antenna, eye, head, pronotum, lateral carina, median carina, outer and inner face of the hind femur, hind tibia, spine on hind tibia, tegmen and hind wing, general body color, and the male cerci and furcula in the Catantopinae subfamily. Color is important in the identification to some extent, but is generally limited in use, particularly when identifying specimens from different localities. Structures, color markings and

patterns on the eye, head, pronotum, inner and outer face of hind femur, hind tibia, and spine on the hind tibia are generally the most nearly consistent characteristics.

Brusven (1967) included notes on distribution, food habits, soil relationships, and seasonal occurrence because they provide additional aids for identification. Although taxonomists are generally reluctant to admit that ecological information may play a supplementary role in identification, the author and many others use this as supporting evidence in identification. The principal host plants and their seasonal occurrence are listed from Campbell et al. (1974) to aid the collector in locating the most likely places to find grasshoppers

RESULTS AND DISCUSSION

My main objective is 99% positive identification which is sufficient for virtually all ecological, economic, and other generalized field studies. There is much variation within a species and only approximately typical specimens are used in the photographs. When a taxonomist or systematist describes a new species, he often describes every part of the body, using as a basis only one male or female or one of each.

Some of the species undergo 6 instars, but generally the 6th is very similar to the 5th instar.

In some of the photographs the characteristic of the eye may change or be plain with freezing, because the surface layer separates from the remainder of the eye.

The color plates and block keys are placed together for better comparison. The block key uses 4 or 5 main characters that differentiate the species; some have an asterisk to indicate that it is generally the most outstanding.

The best method of using this presentation is first to determine the instar. The next step is to examine the plates and compare the color photographs to the specimen which it most resembles. Then turn

to the corresponding pages in the tables of the block key and check the characters against the other species. Seasonal occurrence and plant preference (appendix) also may aid in identification.

General Method of Determining Nymphal Instar

First Instar: wing pads directed downward, minute or absent.

Second Instar: wing pads directed downward, few veins indicated.

Third Instar: wing pads directed downward and noticeably backward, showing more venation.

Fourth Instar: wing pads turned upward, usually short, not extending beyond first abdominal segment.

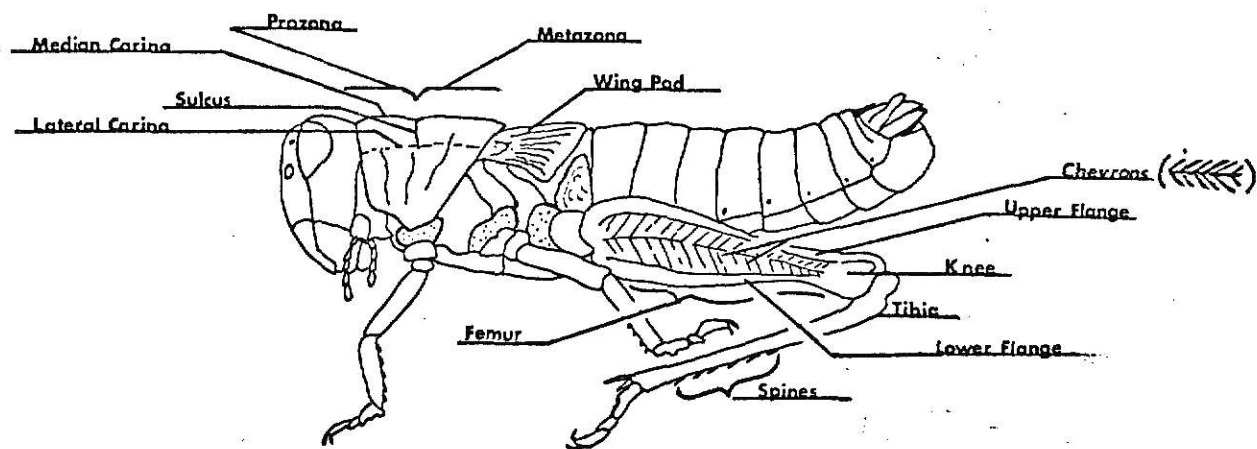
Fifth Instar: wing pads turned upward and more elongate and extending farther back.

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NUMEROUS PAGES
WITH DIAGRAMS
THAT ARE CROOKED
COMPARED TO THE
REST OF THE
INFORMATION ON
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Plate I

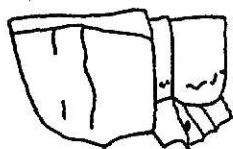
Nymph Profile



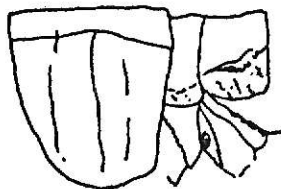
Developmental Instars of Grasshopper

Lateral view of pronotum, wing pads, and other portions of thorax and anterior abdominal segments

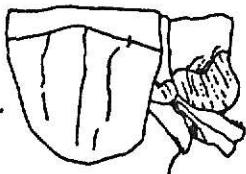
First Instar



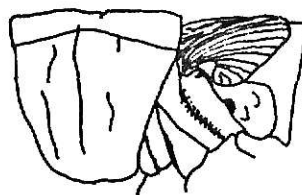
Second Instar



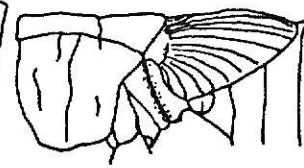
Third Instar



Fourth Instar



Fifth Instar



from Brusven (1967)

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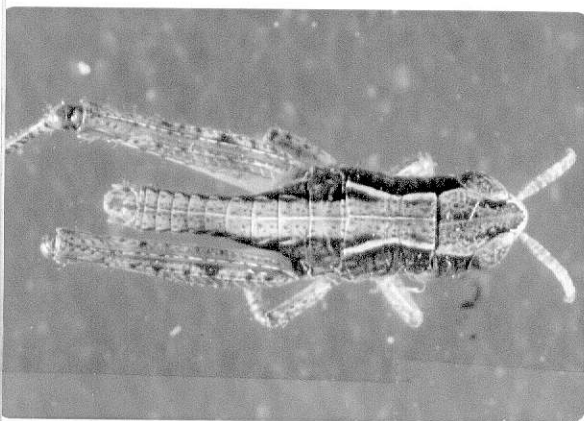
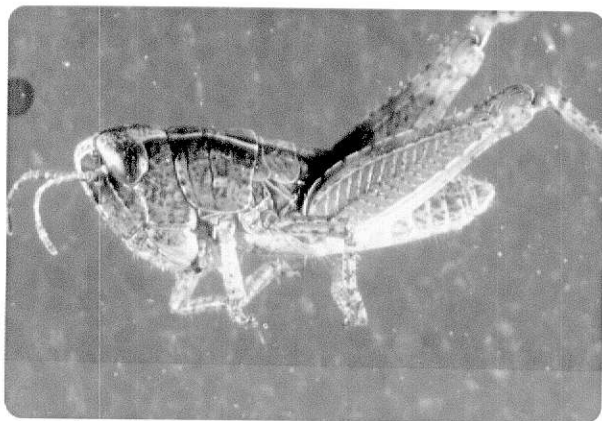
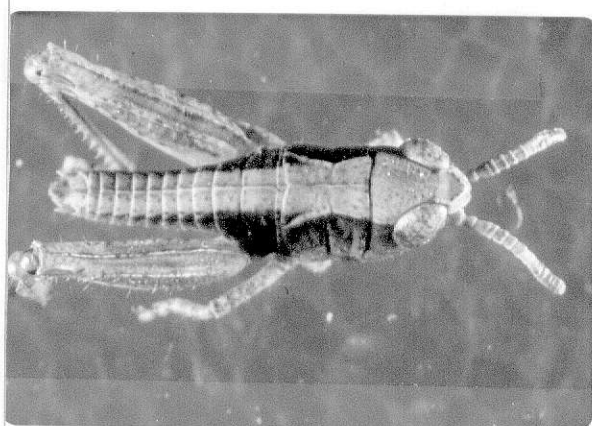
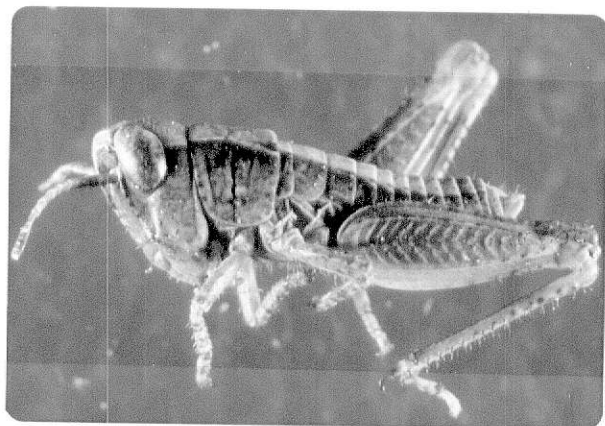
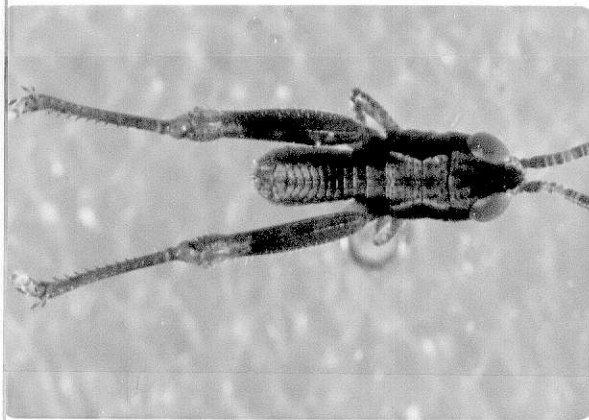
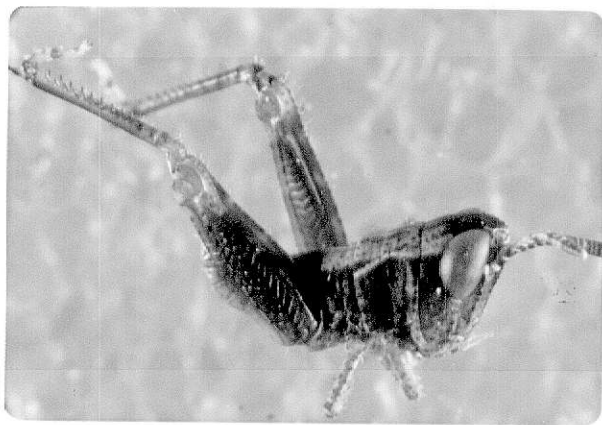
Explanation of Plate II

Ageneotettix deorum (Scudder)

Upper Left lateral view	First Instar p. 103, 104	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 107, 108	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 113, 114	Lower Right dorsal view

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QUALITY DUE TO
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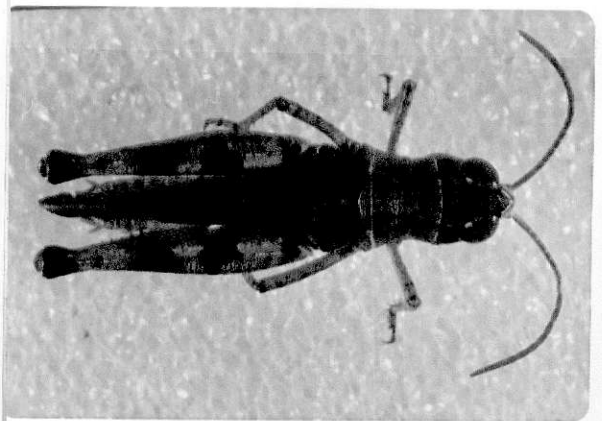
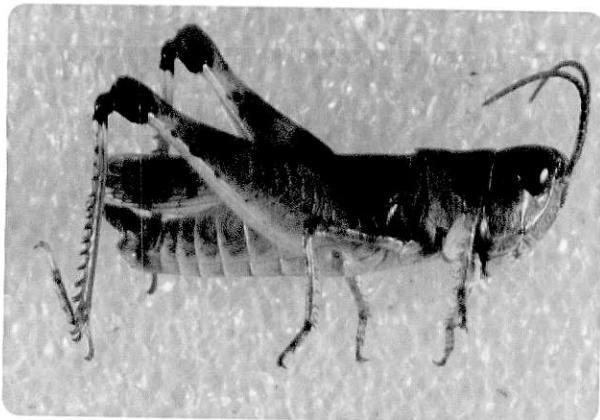
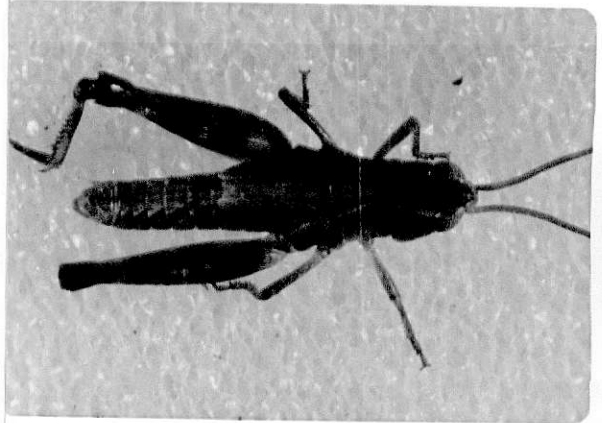
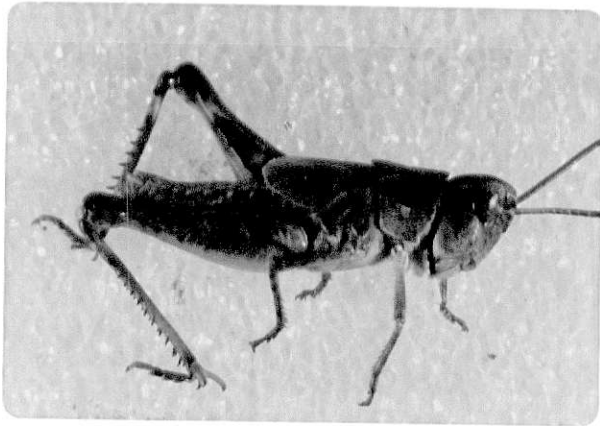
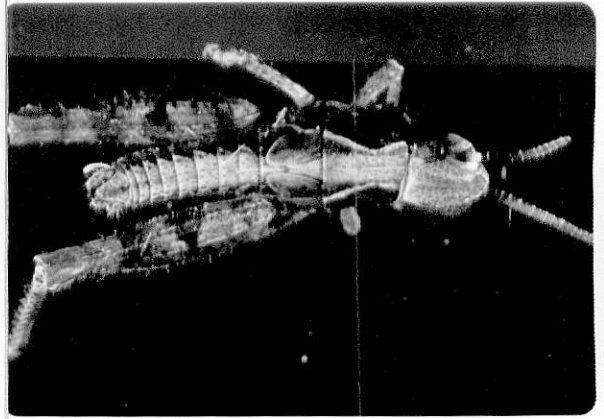
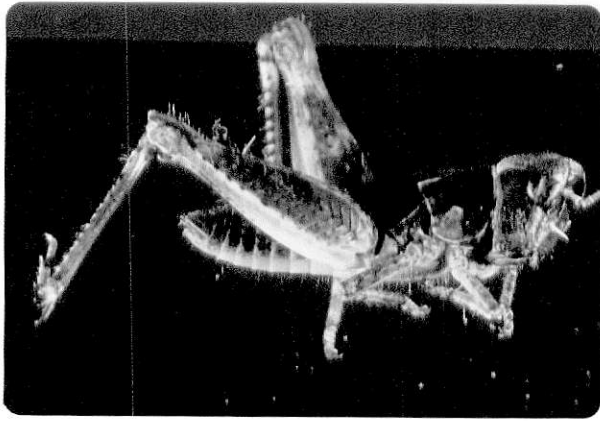
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Explanation of Plate IIA

Ageneotettix deorum (Scudder)

Upper Left lateral view	Fourth Instar p. 119, 120	Upper Right dorsal view
Middle Left lateral view	Fifth Instar p. 125, 126	Middle Right dorsal view
Lower Left lateral view	Adult p. 131, 132	Lower Right dorsal view



Explanation of Plate III

Boopedon auriventris McNeill

Upper Left
lateral view

First Instar
p. 103, 104

Upper Right
dorsal view

Middle Left
lateral view

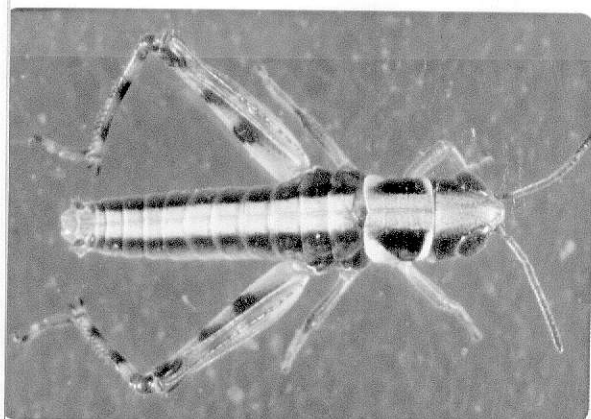
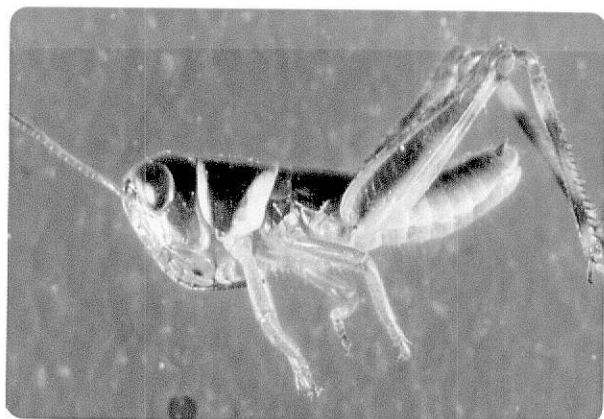
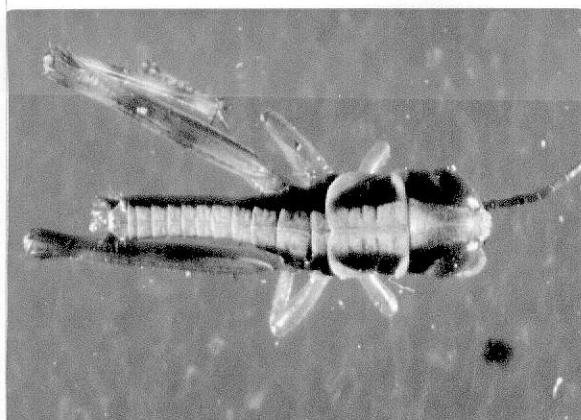
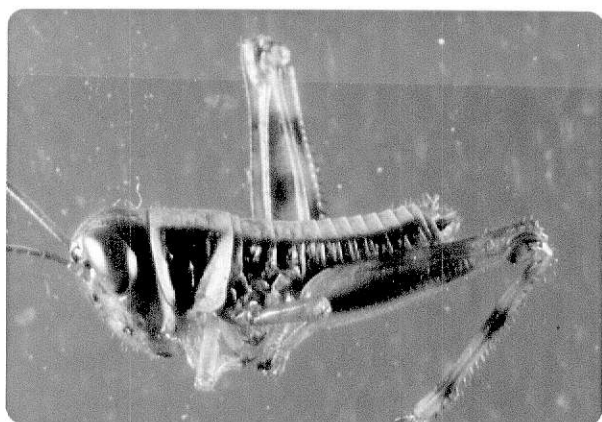
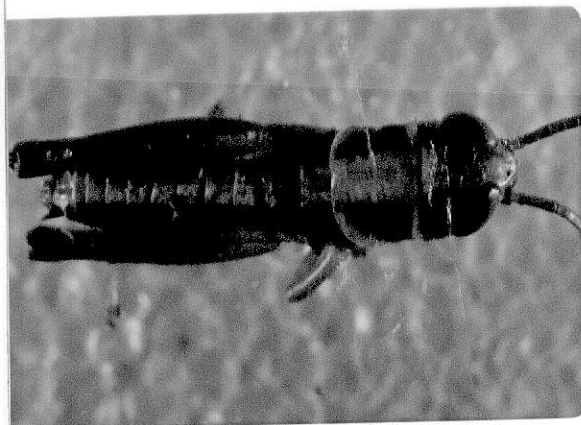
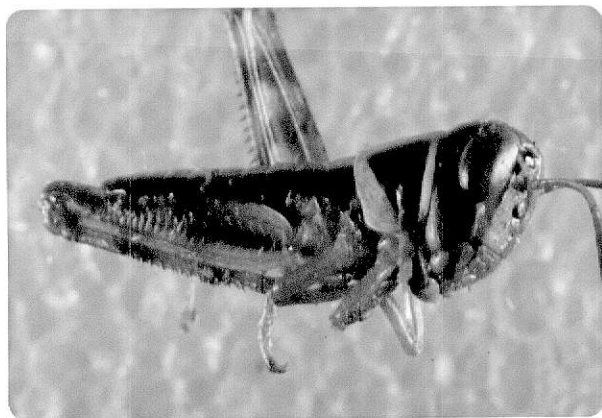
Second Instar
p. 107, 108

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 113, 114

Lower Right
dorsal view



Explanation of Plate IIIA

Boopedon auriventris McNeill

Upper Left
lateral view

Fourth Instar
p. 119, 120

Upper Right
dorsal view

Middle Left
lateral view

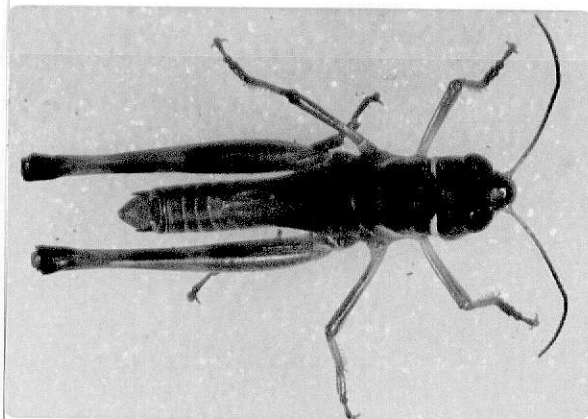
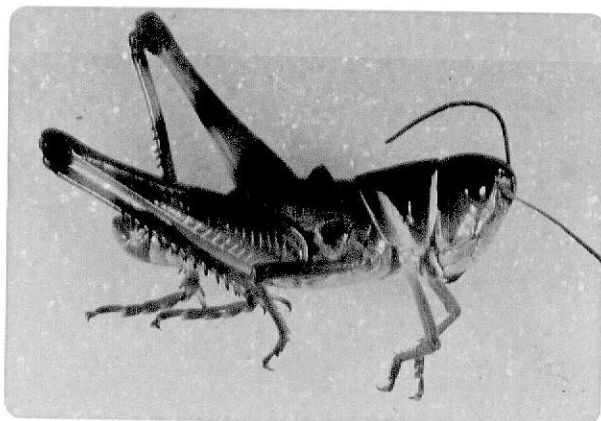
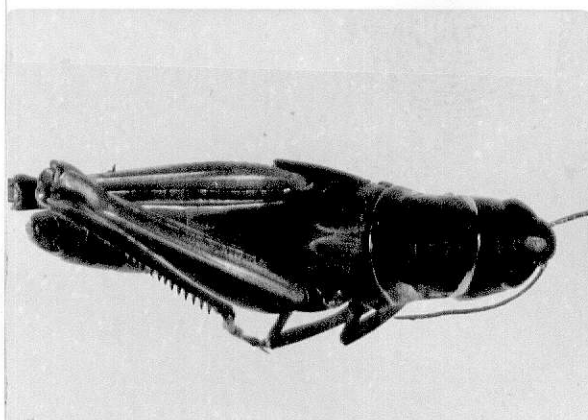
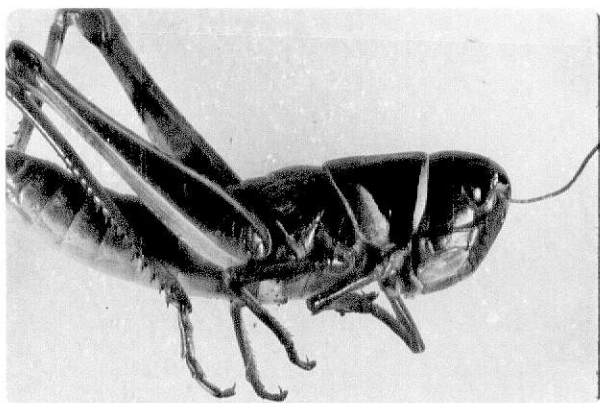
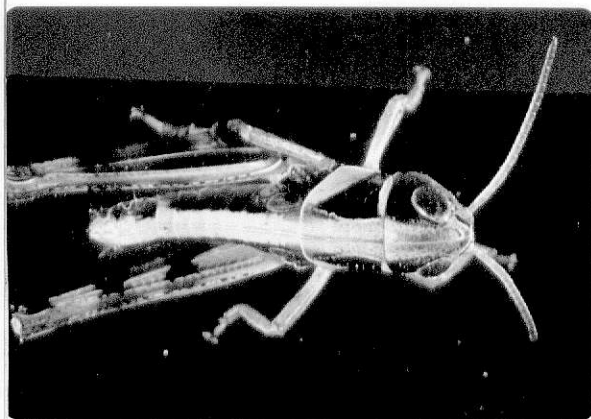
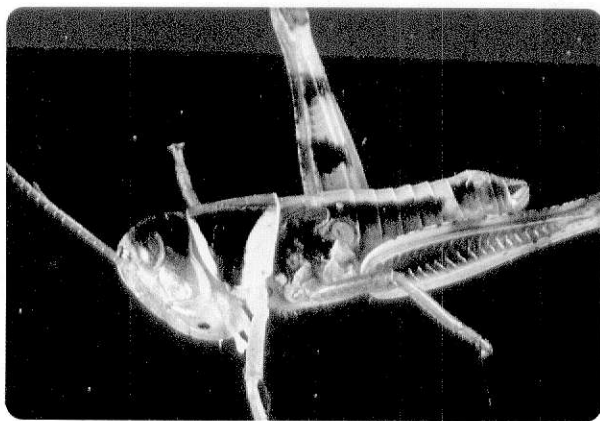
Fifth Instar
p. 125, 126

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 131, 132

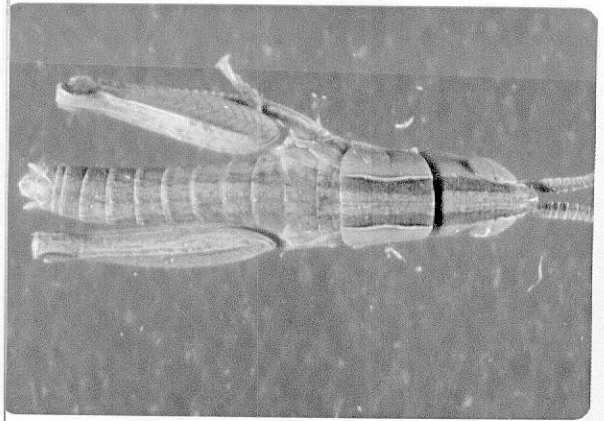
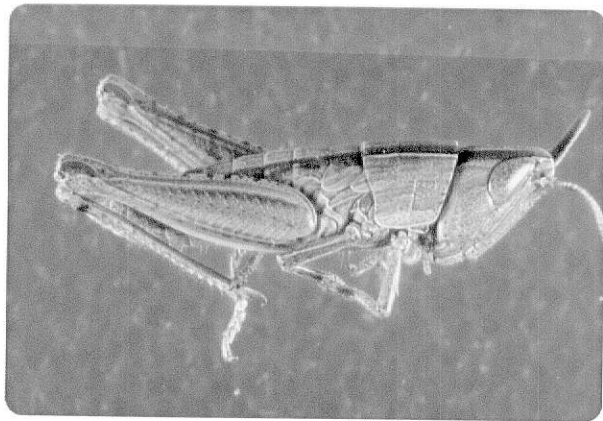
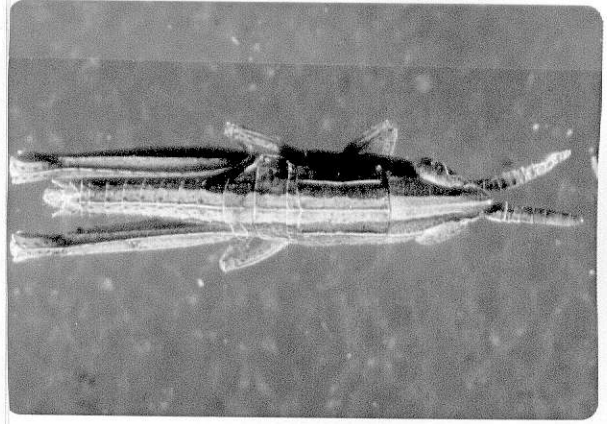
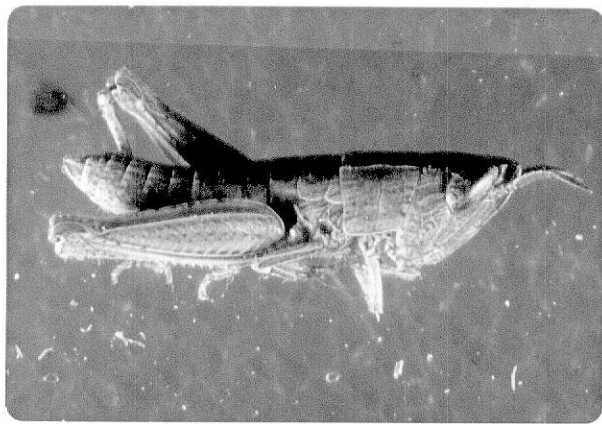
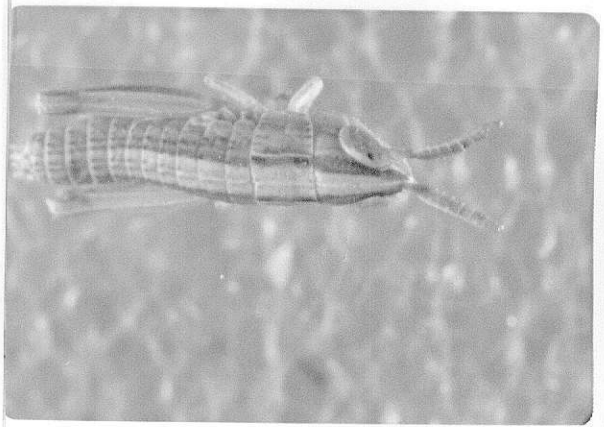
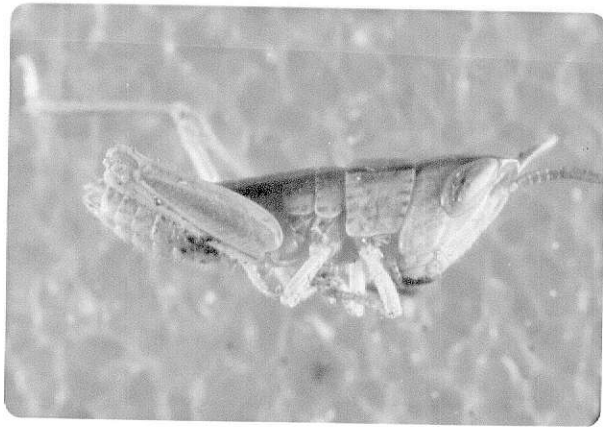
Lower Right
dorsal view



Explanation of Plate IV

Eritettix simplex (Scudder)

Upper Left lateral view	First Instar p. 103, 104	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 109, 110	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 115, 116	Lower Right dorsal view



Explanation of Plate IVA

Eritettix simplex (Scudder)

Upper Left
lateral view

Fourth Instar
p. 121, 122

Upper Right
dorsal view

Middle Left
lateral view

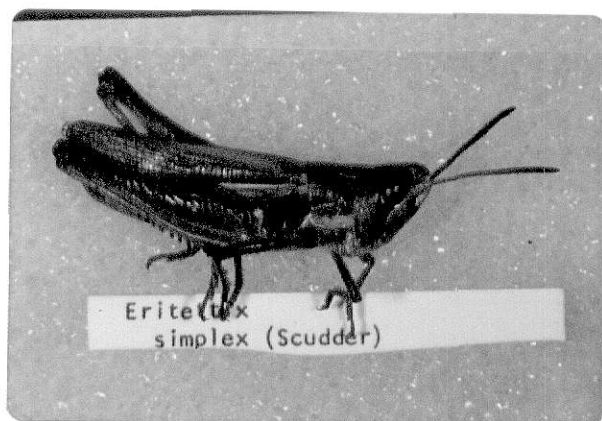
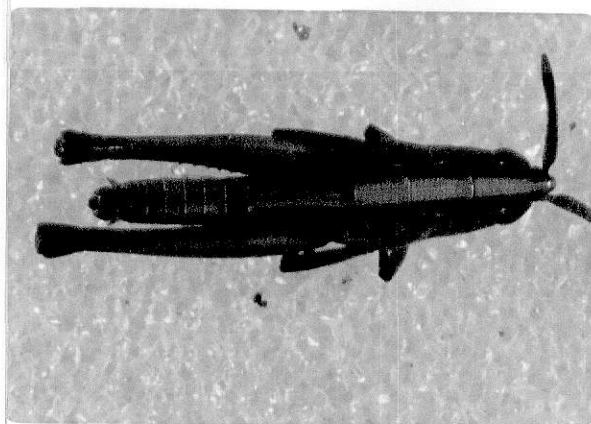
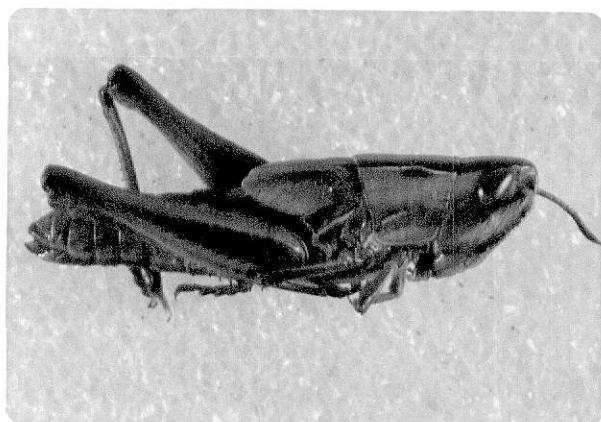
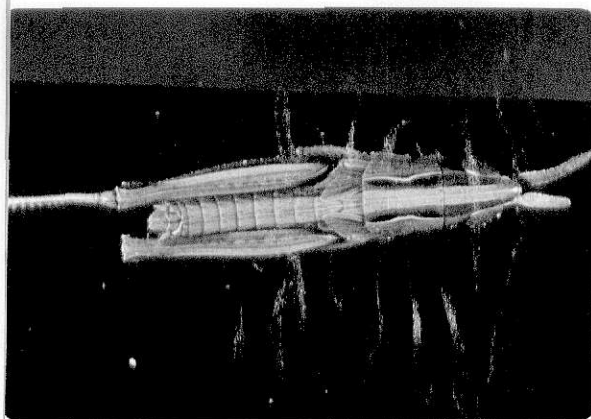
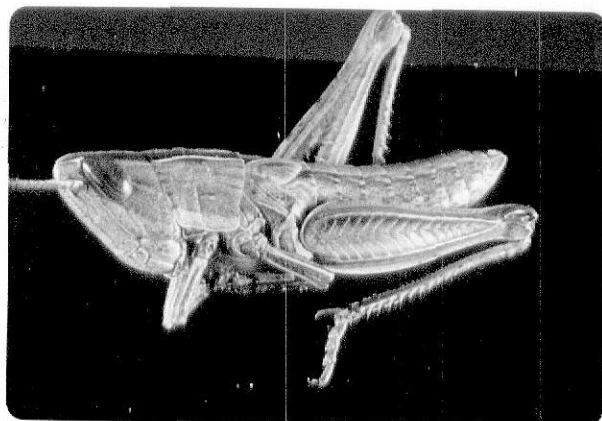
Fifth Instar
p. 127, 128

Middle Right
dorsal view

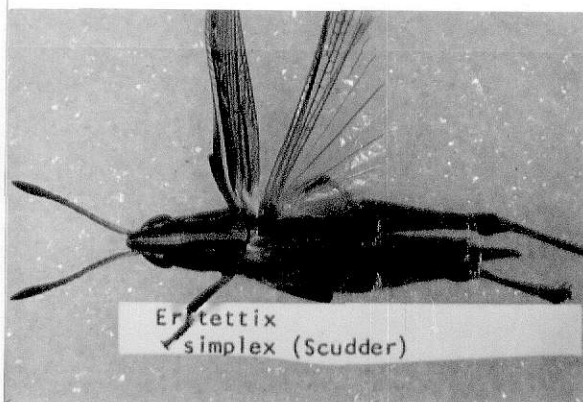
Lower Left
lateral view

Adult
p. 133, 134

Lower Right
dorsal view



Erioptera
simplex (Scudder)



Erioptera
simplex (Scudder)

Explanation of Plate V

Mermeria bivittatus maculipennis Bruner

Upper Left
lateral view

First Instar
p. 105, 106

Upper Right
dorsal view

Middle Left
lateral view

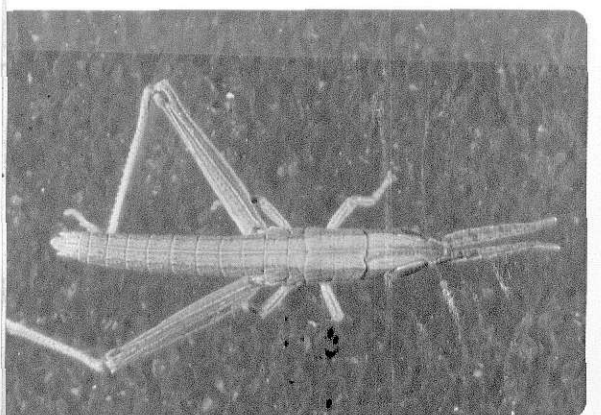
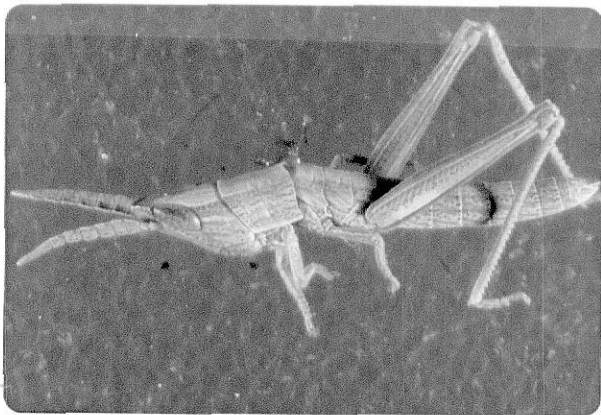
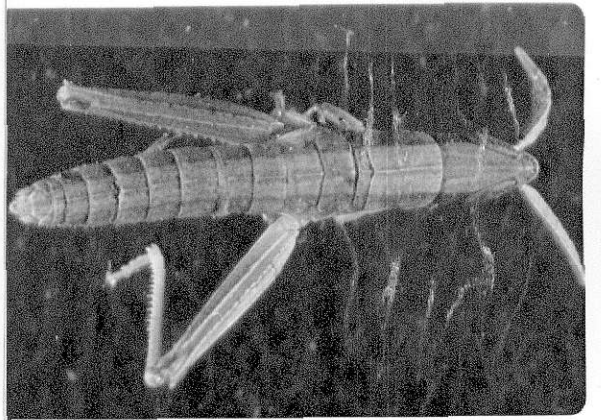
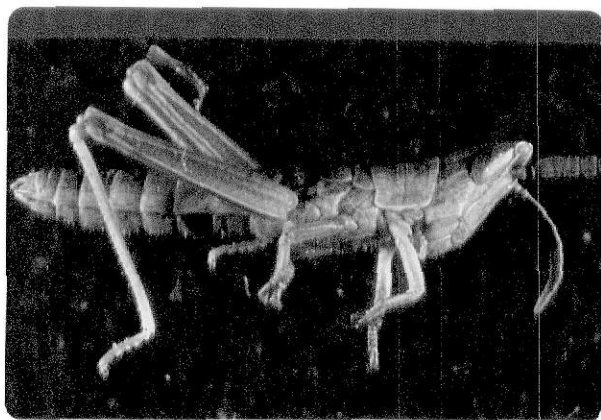
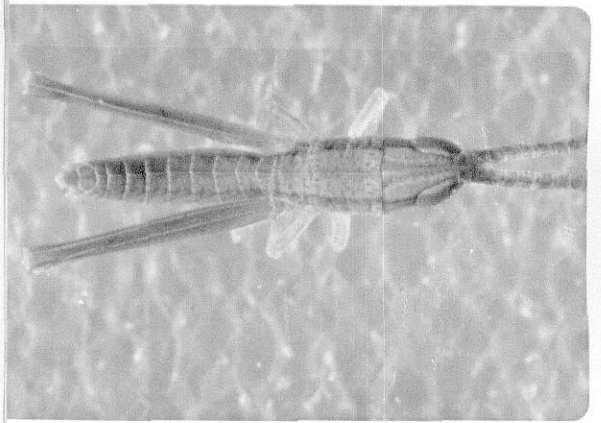
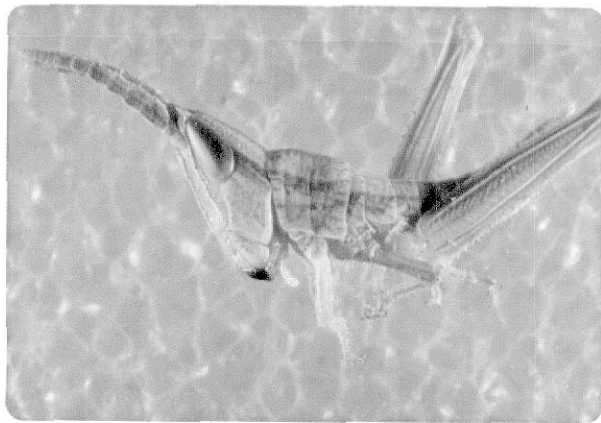
Second Instar
p. 109, 110

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 115, 116

Lower Right
dorsal view



Explanation of Plate VA

Mermeria bivittatus maculipennis Bruner

Upper Left
lateral view

Fourth Instar
p. 121, 122

Upper Right
dorsal view

Middle Left
lateral view

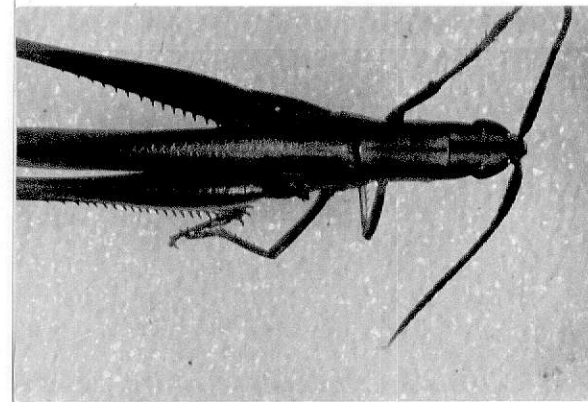
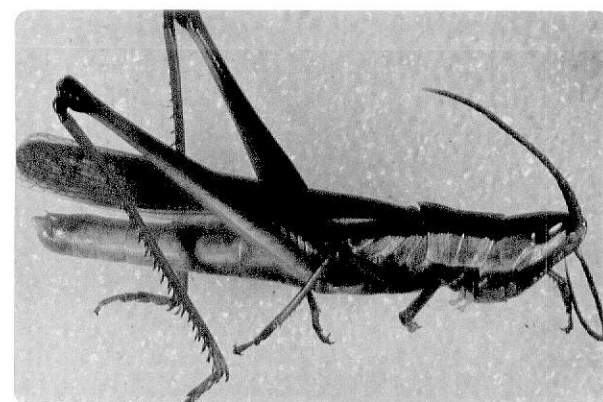
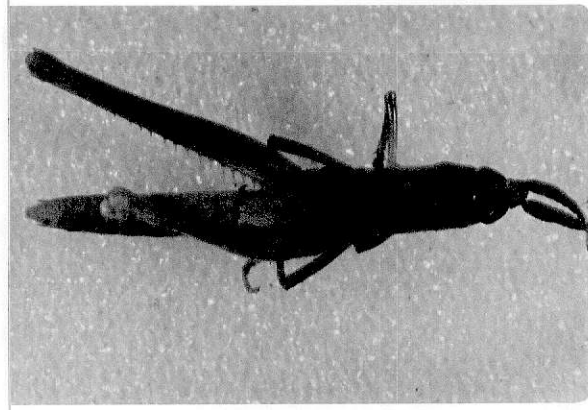
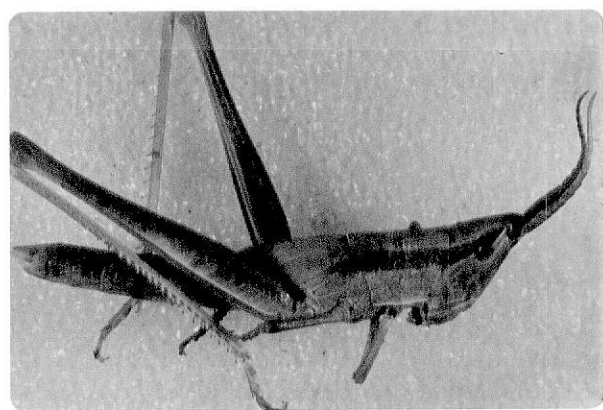
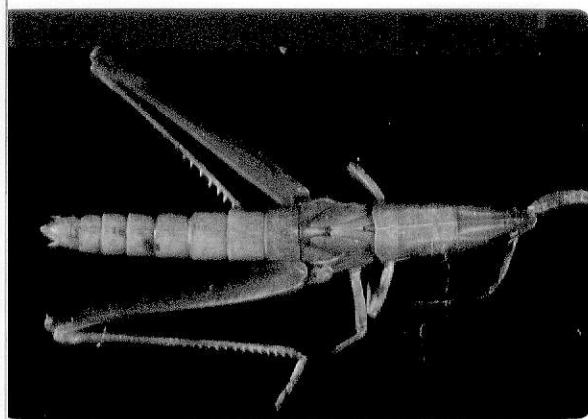
Fifth Instar
p. 127, 128

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 133, 134

Lower Right
dorsal view



Explanation of Plate VI

Mermeria picta neomexicana (Thomas)

Upper Left
lateral view

First Instar
p. 105, 106

Upper Right
dorsal view

Middle Left
lateral view

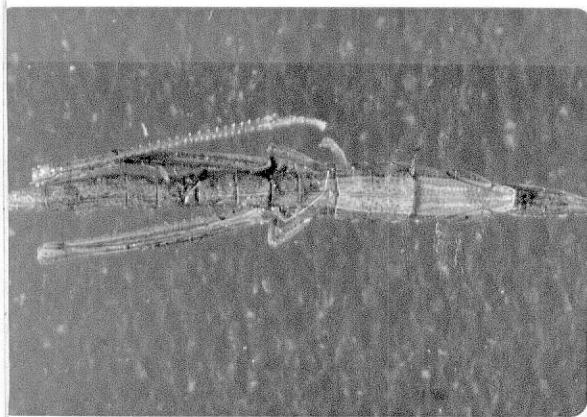
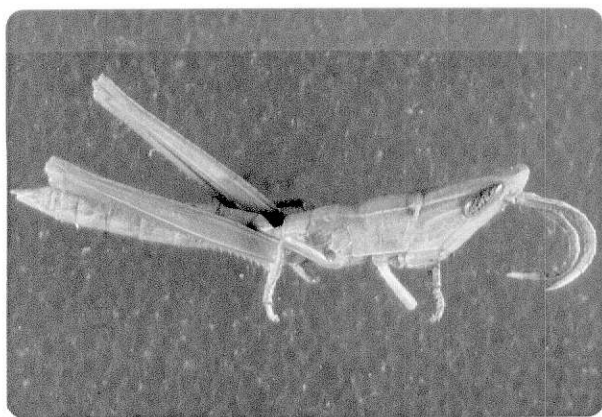
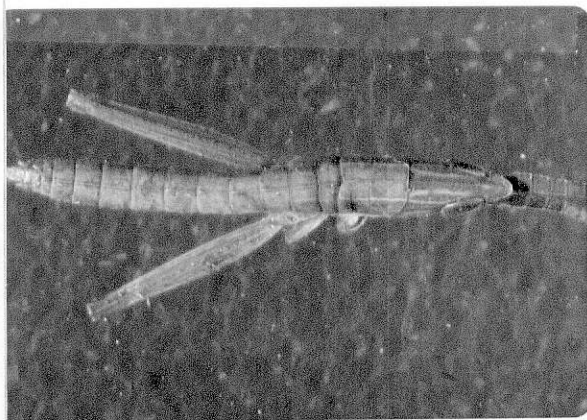
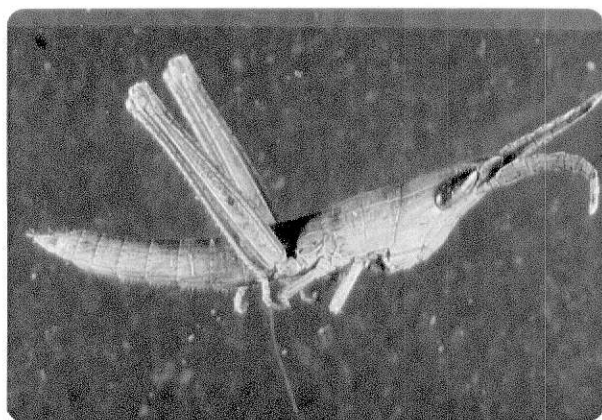
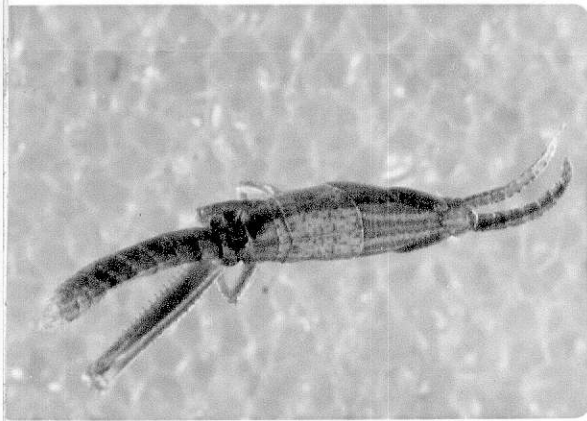
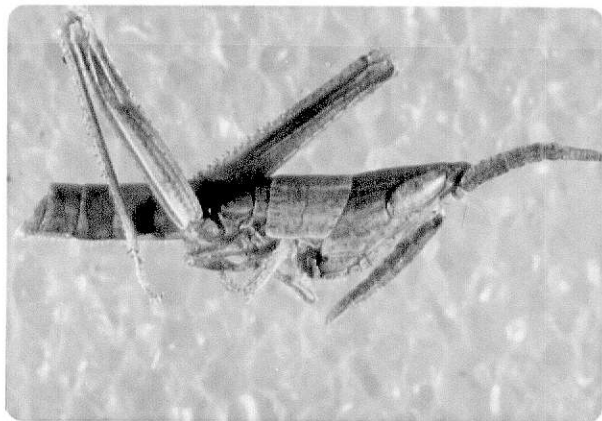
Second Instar
p. 109, 110

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 115, 116

Lower Right
dorsal view



Explanation of Plate VIA

Mermeria picta neomexicana (Thomas)

Upper Left
lateral view

Fourth Instar
p. 121, 122

Upper Right
dorsal view

Middle Left
lateral view

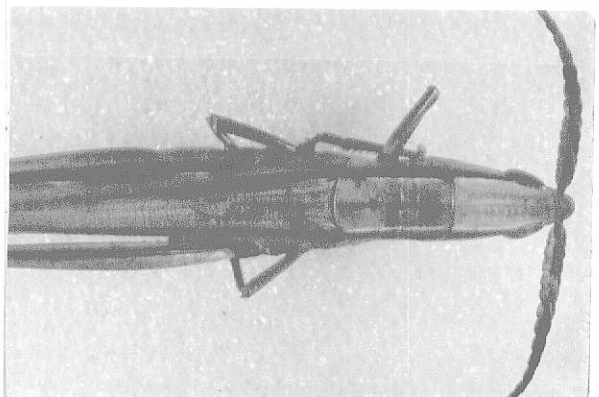
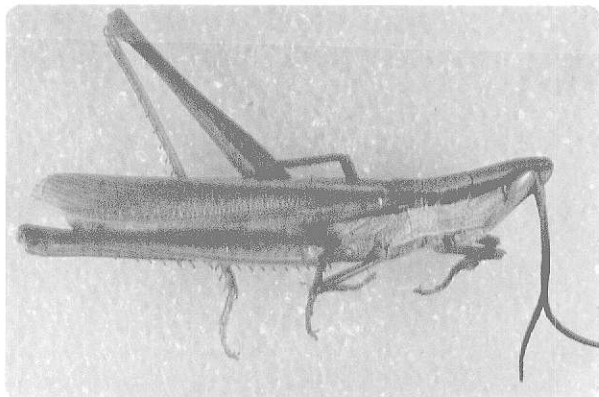
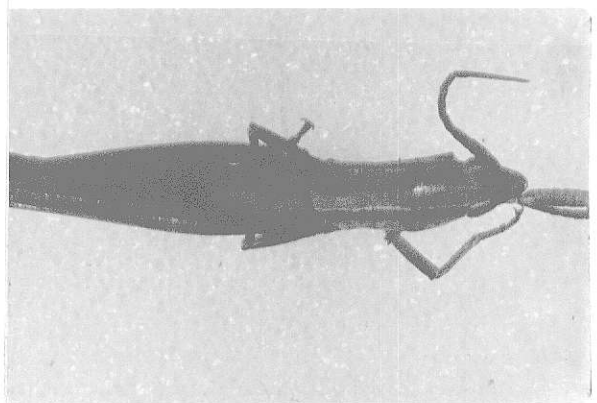
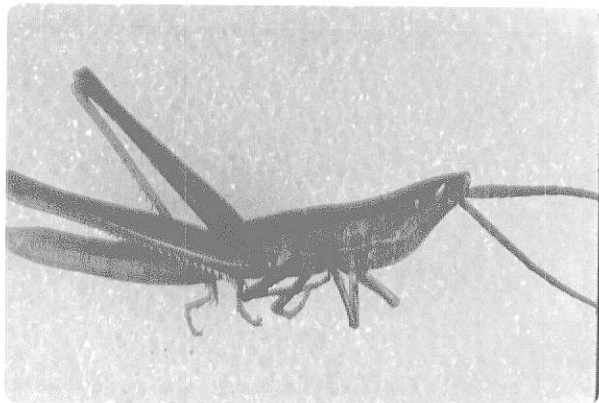
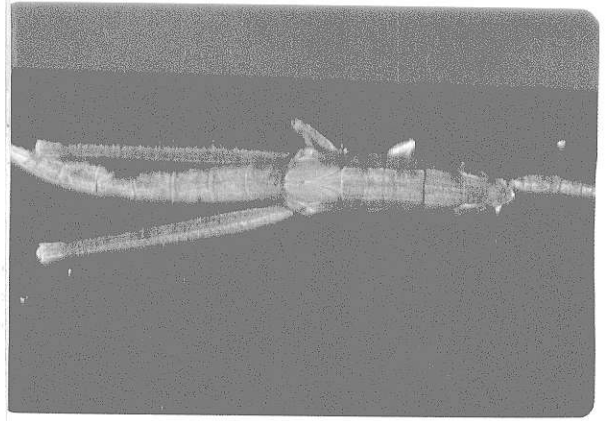
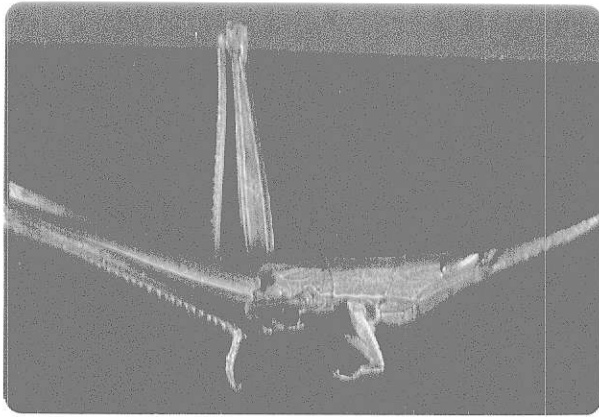
Fifth Instar
p. 127, 128

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 133, 134

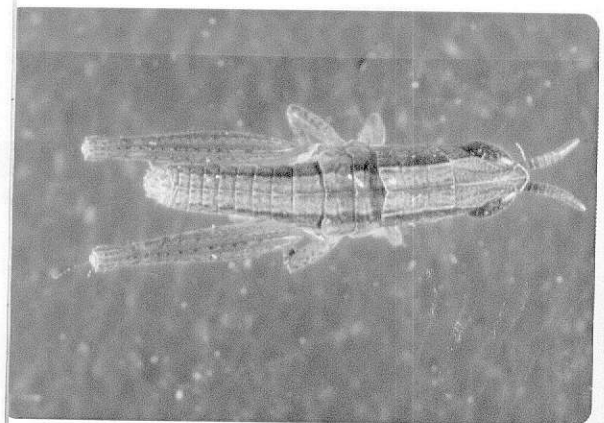
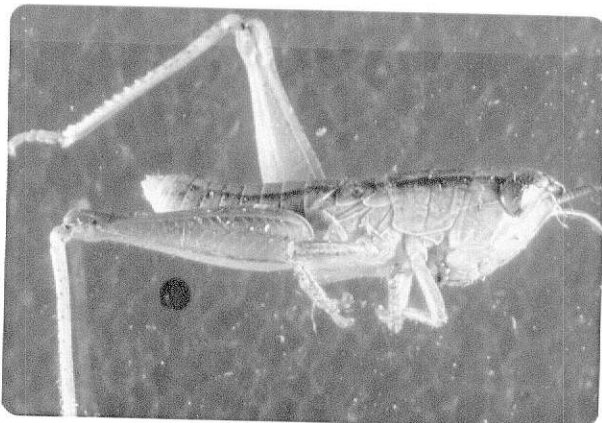
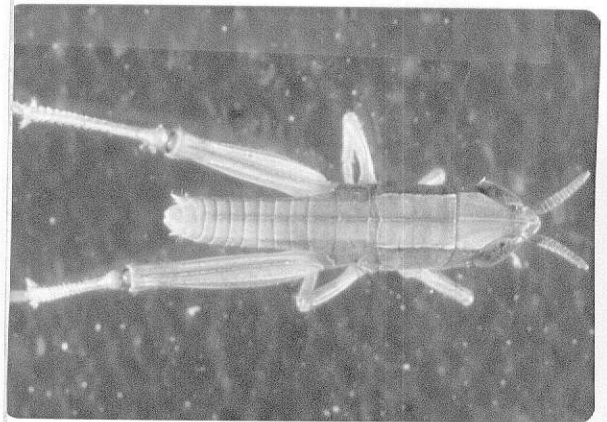
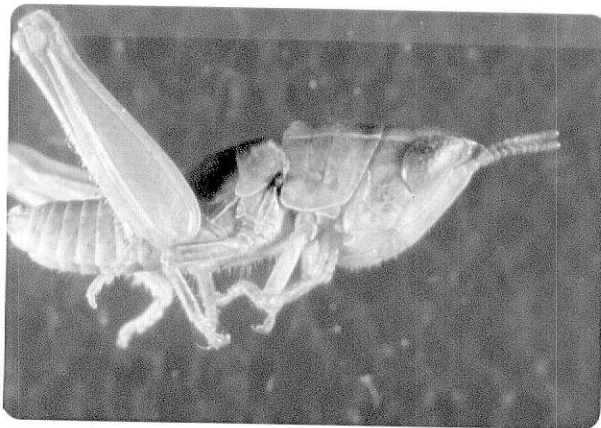
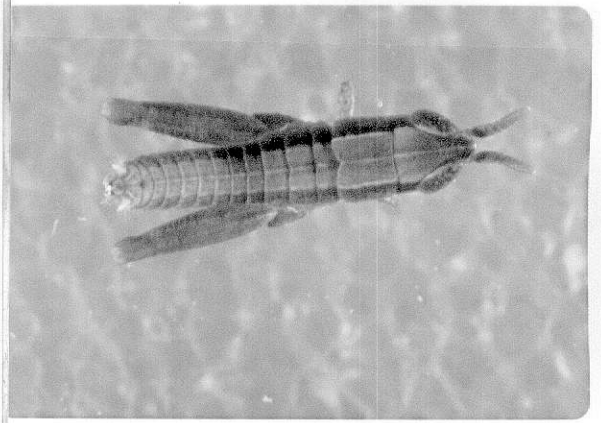
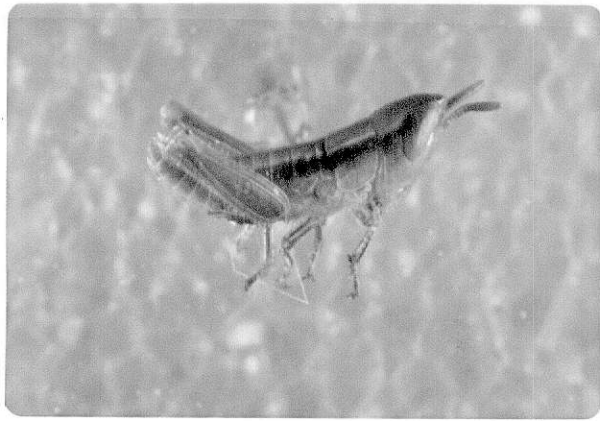
Lower Right
dorsal view



Explanation of Plate VII

Orphulella speciosa (Scudder)

Upper Left lateral view	First Instar p. 105, 106	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 111, 112	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 117, 118	Lower Right dorsal view



Explanation of Plate VIIA

Orphulella speciosa (Scudder)

Upper Left
lateral view

Fourth Instar
p. 123, 124

Upper Right
dorsal view

Middle Left
lateral view

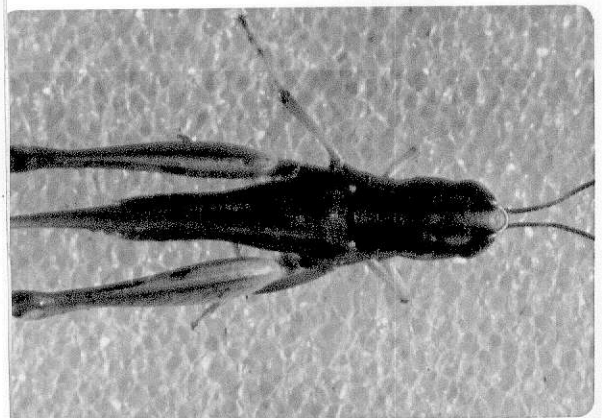
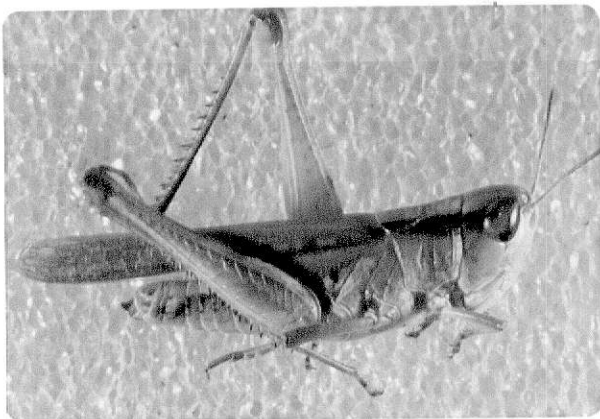
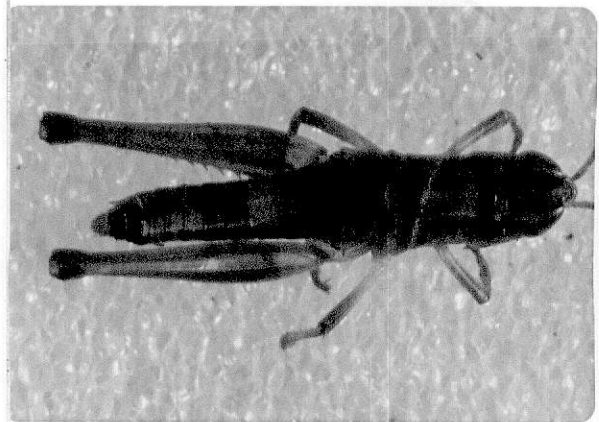
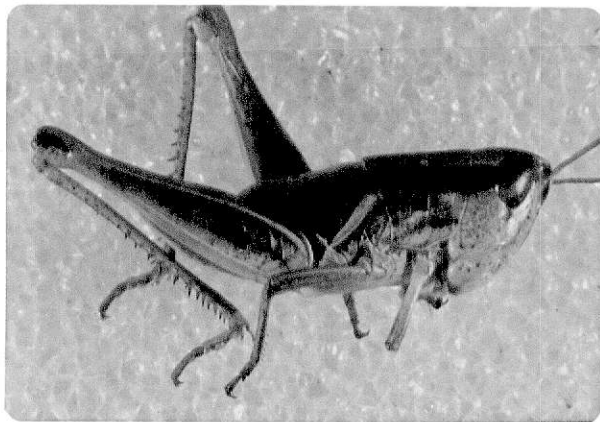
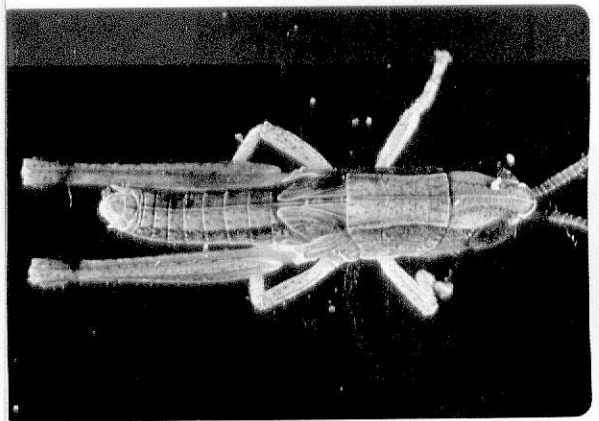
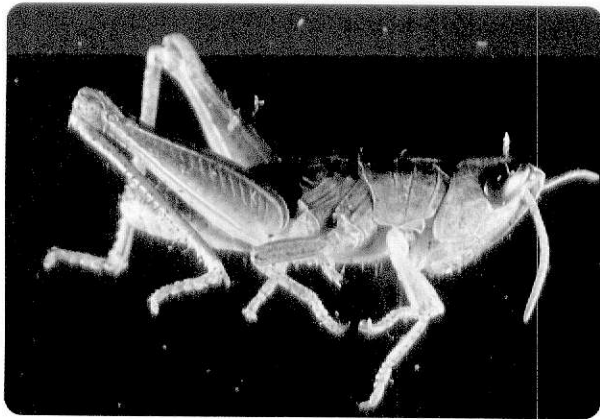
Fifth Instar
p. 129, 130

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 135, 136

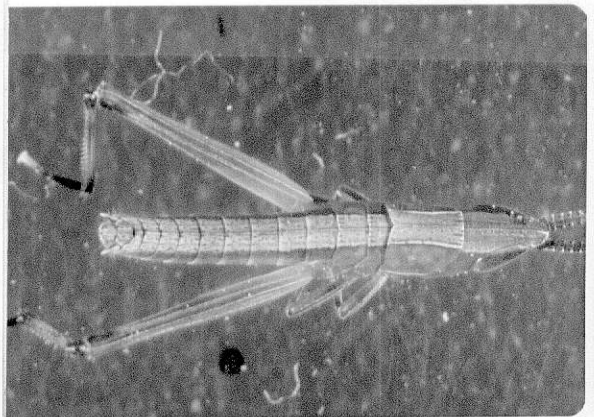
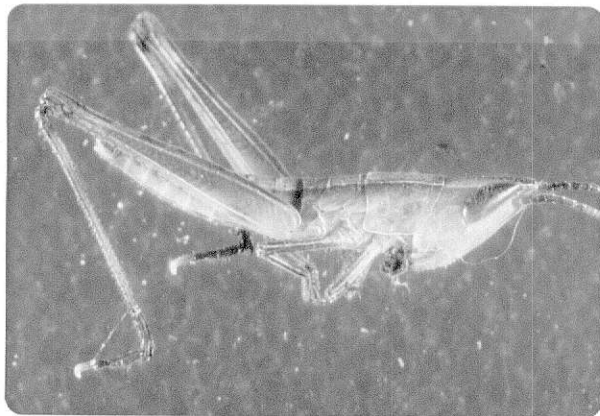
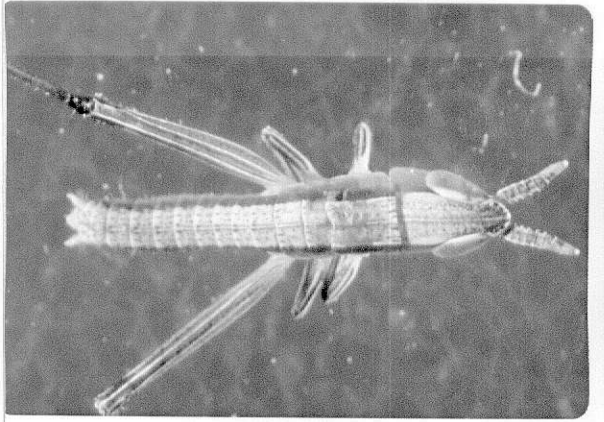
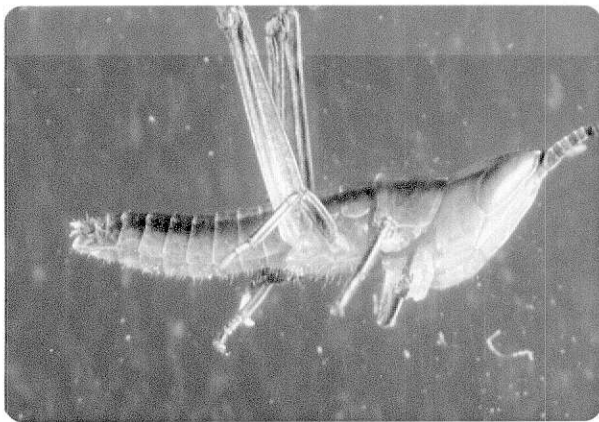
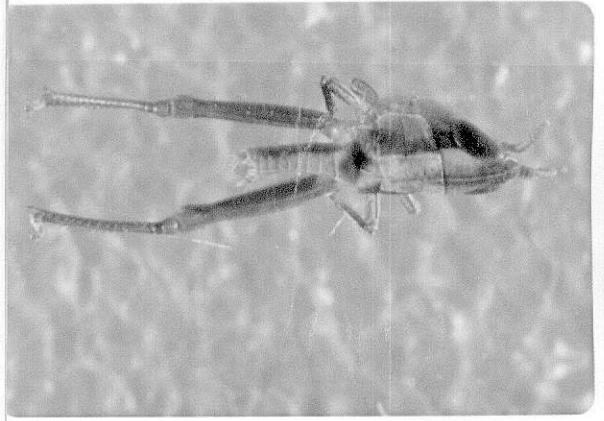
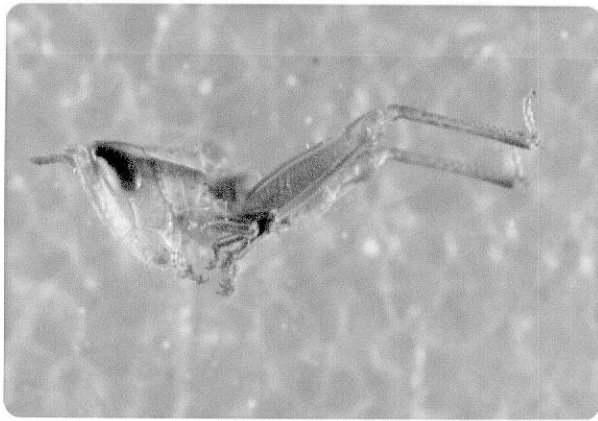
Lower Right
dorsal view



Explanation of Plate VIII

Syrbula admirabilis (Uhler)

Upper Left lateral view	First Instar p. 105, 106	Upper Right dorsal view
Middle Left lateral view	Second Instar. p. 111, 112	Middle Right dorsal view
Lower left lateral view	Third Instar p. 117, 118	Lower Right dorsal view



Explanation of Plate VIIIA

Syrbula admirabilis (Uhler)

Upper Left
lateral view

Fourth Instar
p. 123, 124

Upper Right
dorsal view

Middle Left
lateral view

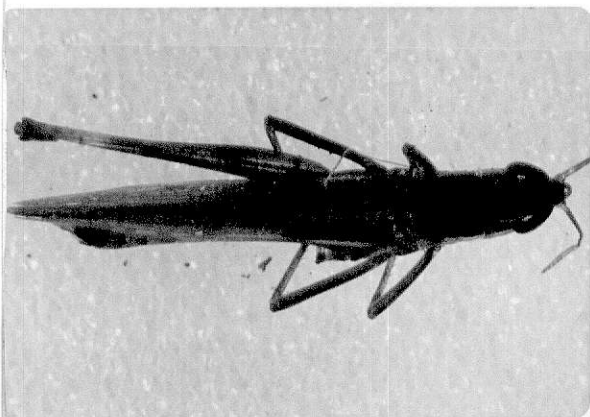
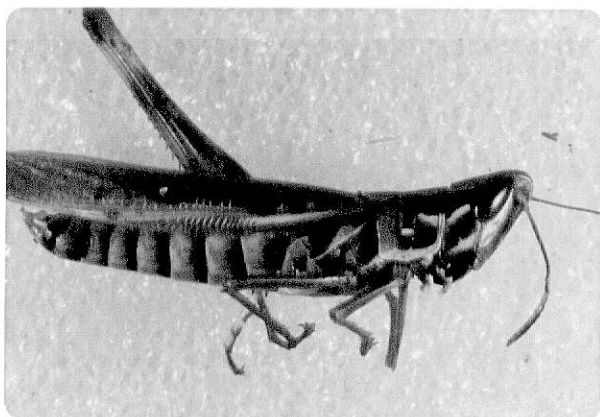
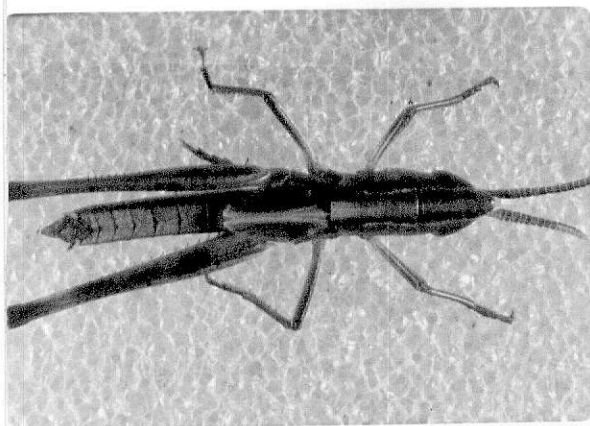
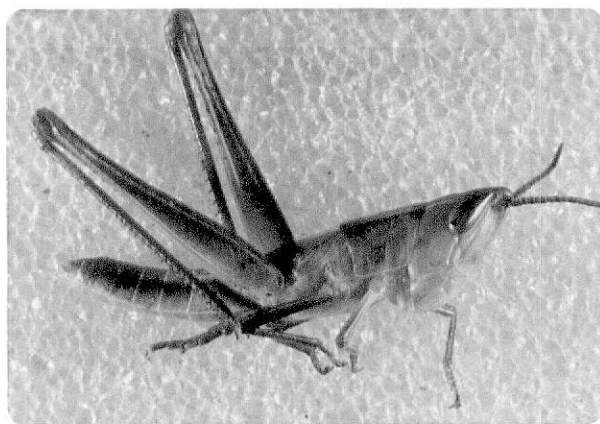
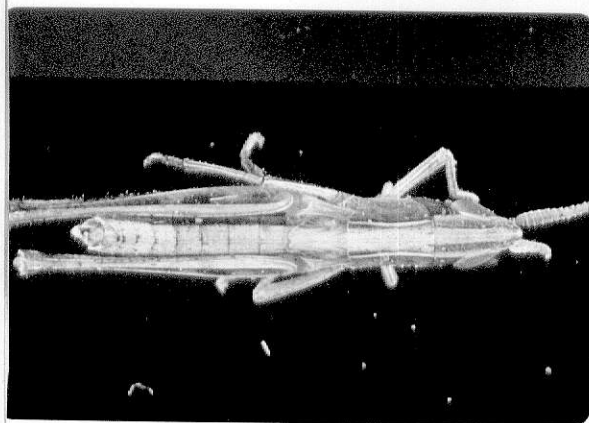
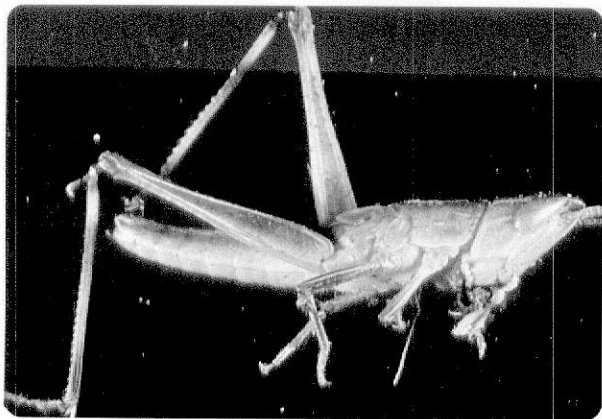
Fifth Instar
p. 129, 130

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 135, 136,
137, 138

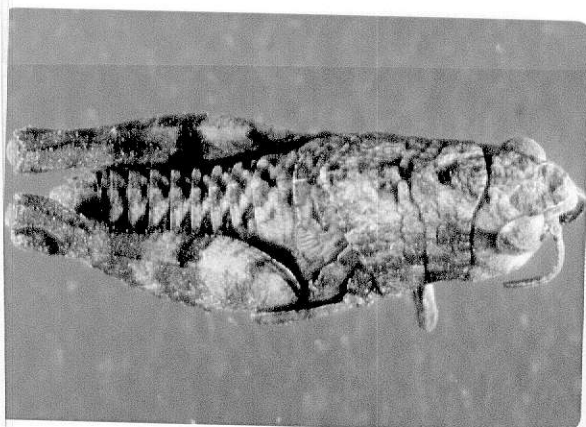
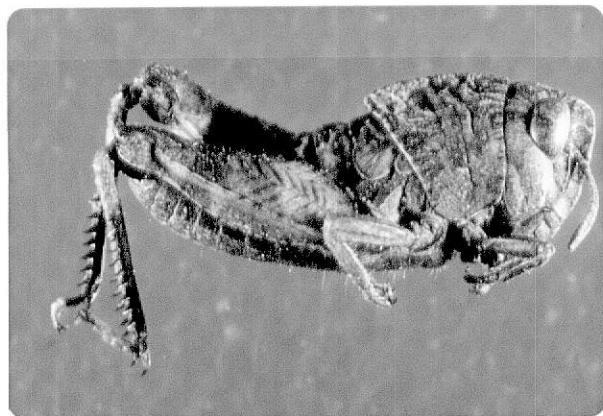
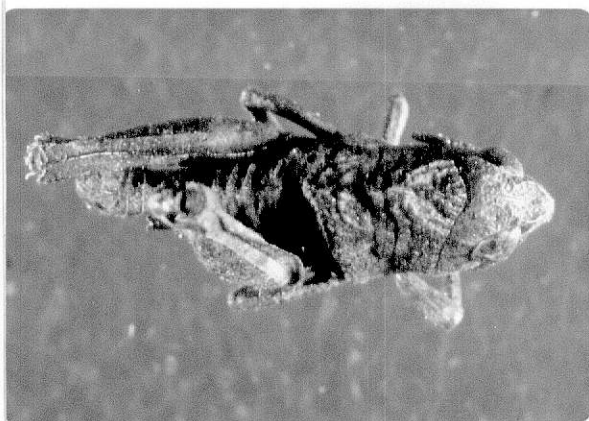
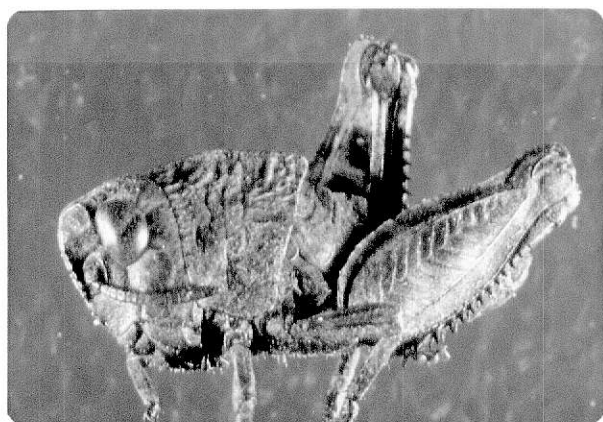
Lower Right
dorsal view



Explanation of Plate IX

Arphia spp.

No Picture	First Instar p. 139, 140	No picture
Middle Left lateral view	Second Instar p. 141, 142	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 145, 146	Lower Right dorsal view



Explanation of Plate IXA

Arphia spp.

Upper Left
lateral view

Fourth Instar
p. 149, 150

Upper Right
dorsal view

Middle Left
lateral view

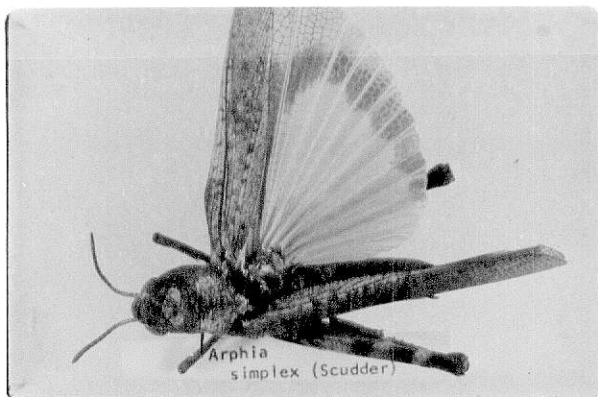
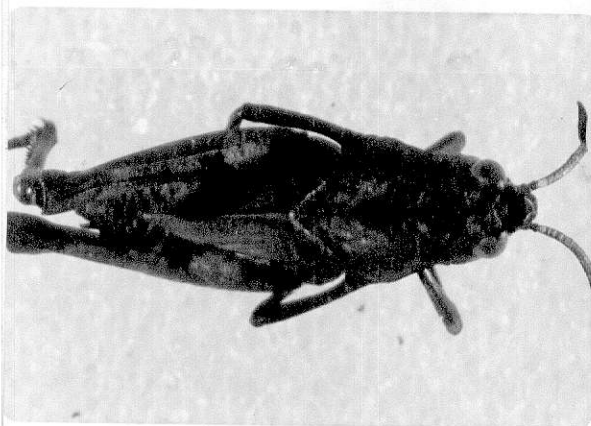
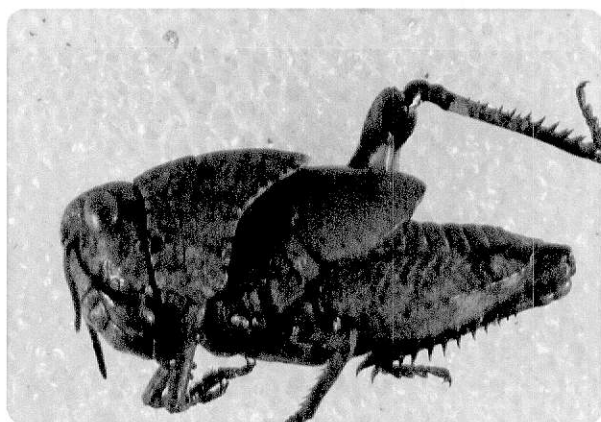
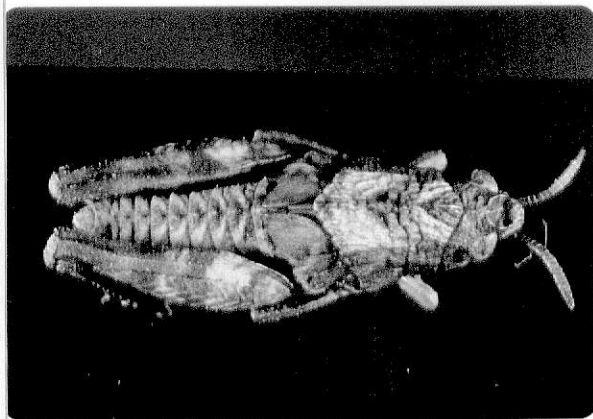
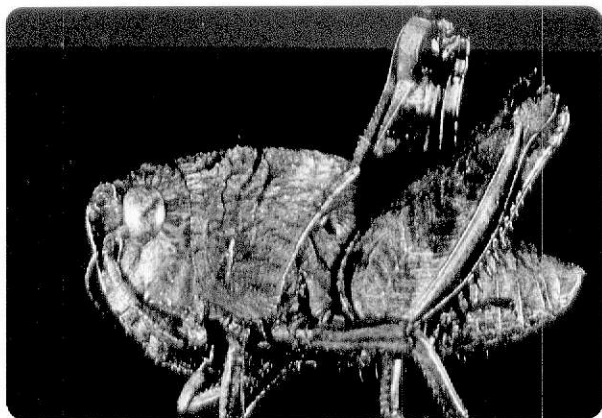
Fifth Instar
p. 153, 154

Middle Right
dorsal view

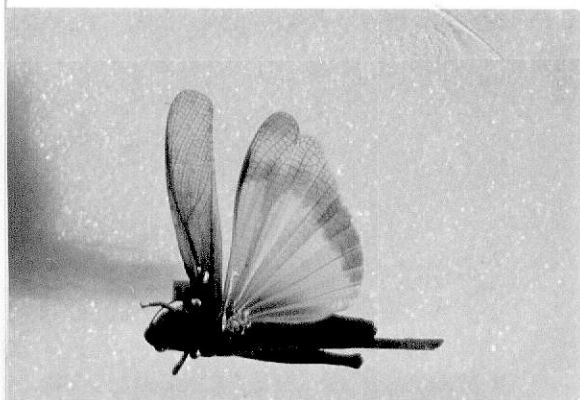
Lower Left
lateral view

Adult
p. 157, 158

Lower Right
dorsal view



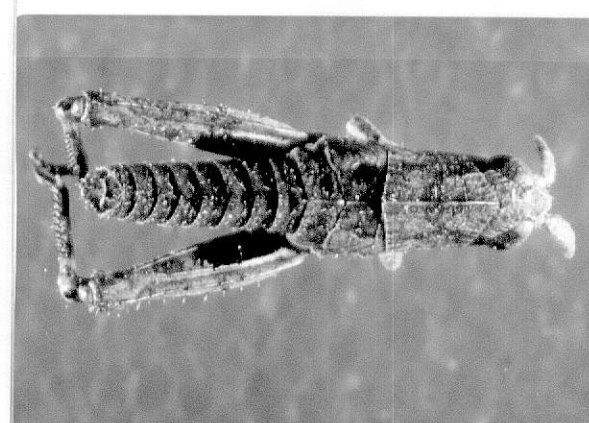
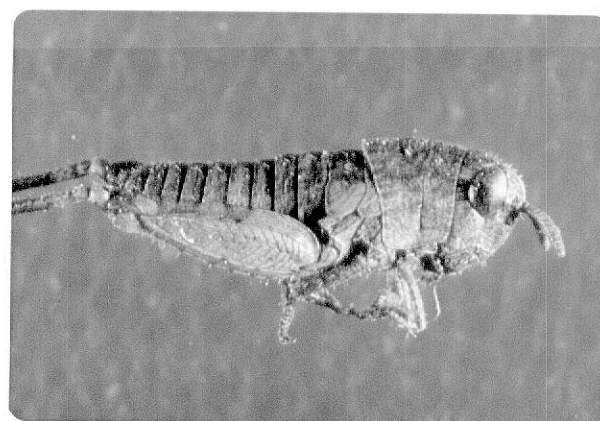
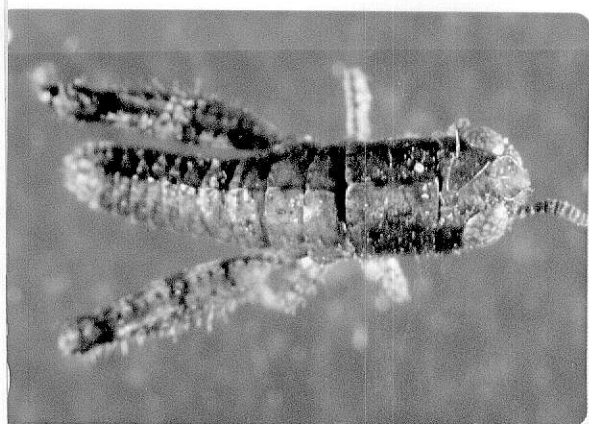
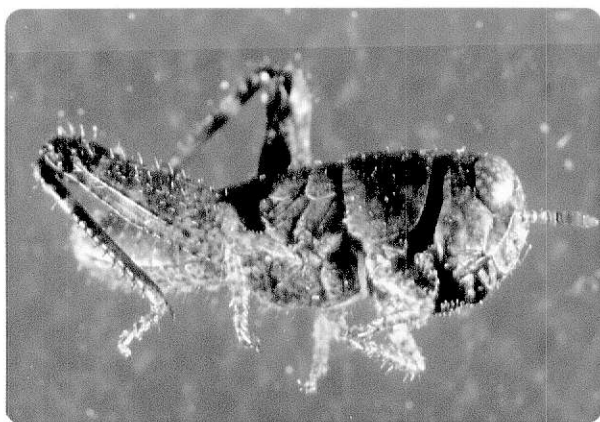
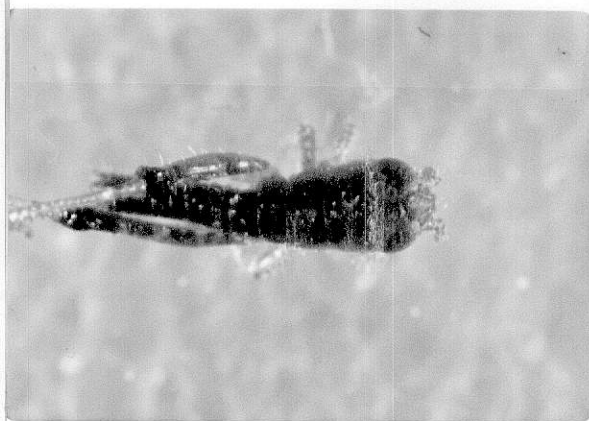
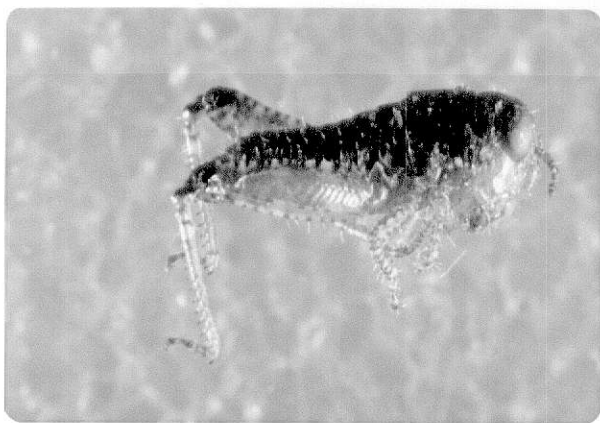
Arphia simplex (Scudder)



Explanation of Plate X

Chortophaga virdifasciata (DeGeer)

Upper Left lateral view	First Instar p. 139, 140	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 141, 142	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 145, 146	Lower Right dorsal view



Explanation of Plate XA

Chortophaga viridifasciata (DeGeer)

Upper Left
lateral view

Fourth Instar
p. 149, 150

Upper Right
dorsal view

Middle Left
lateral view

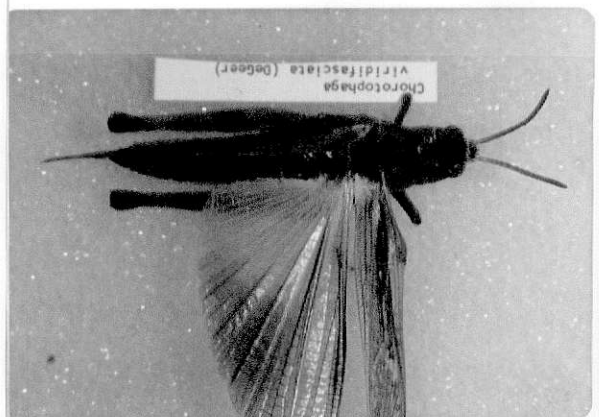
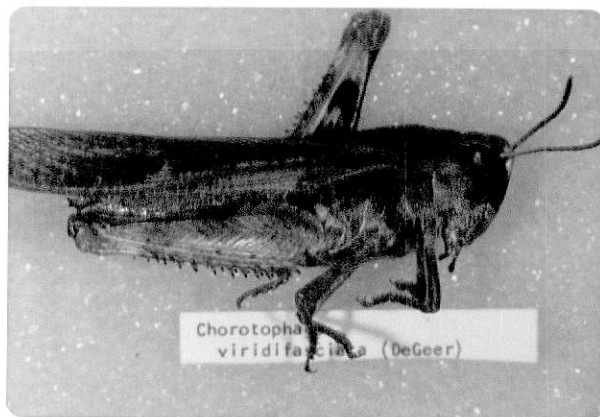
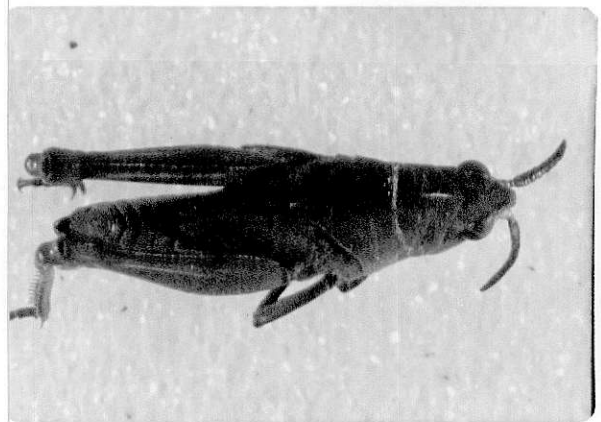
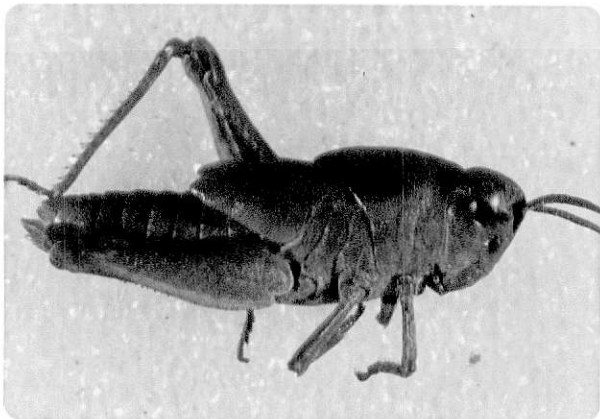
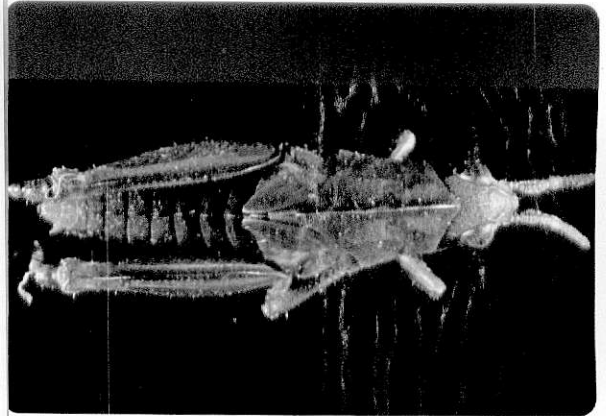
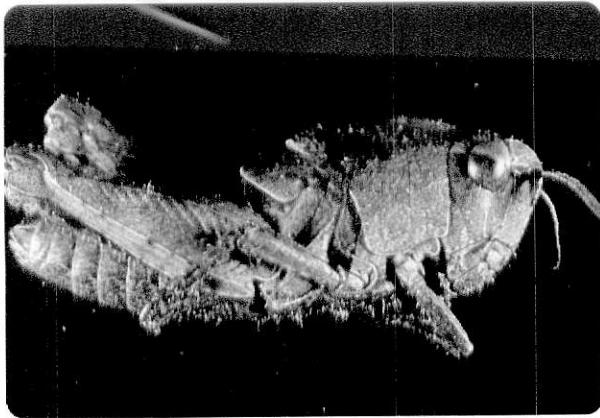
Fifth Instar
p. 153, 154

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 157, 158

Lower Right
dorsal view



Explanation of Plate XI

Dissosteira carolina (Linnaeus)

Upper Left
lateral view

First Instar
p. 139, 140

Upper Right
dorsal view

Middle Left
lateral view

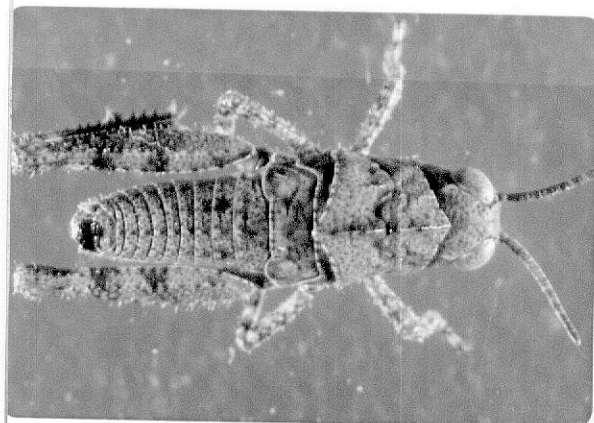
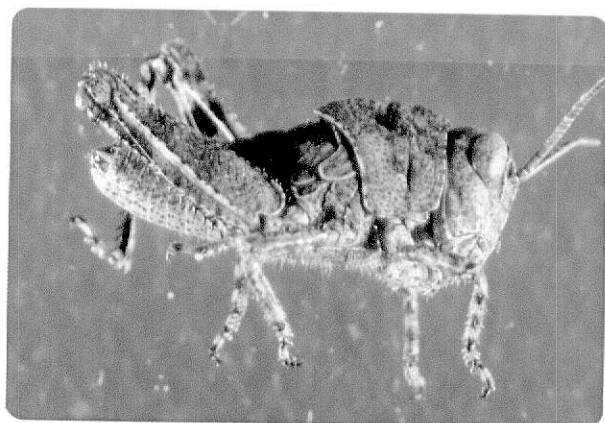
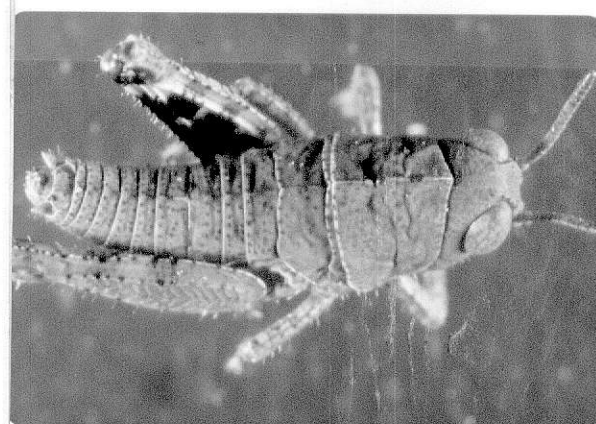
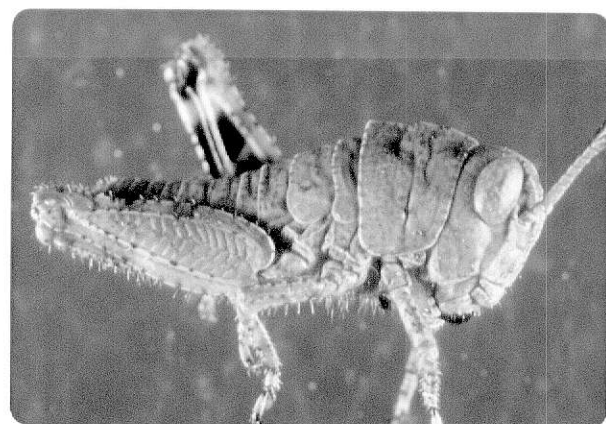
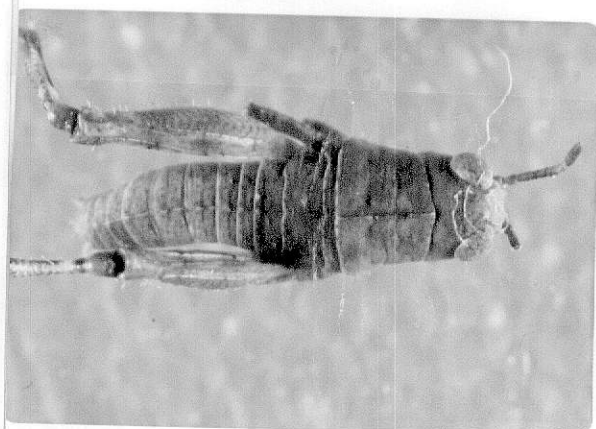
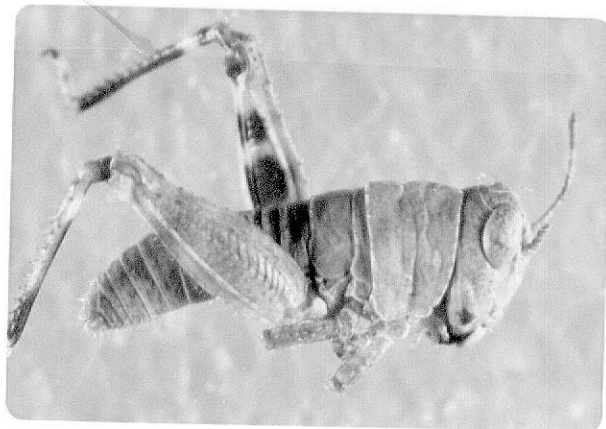
Second Instar
p. 141, 142

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 145, 146

Lower Right
dorsal view



Explanation of Plate XIA

Dissosteira carolina (Linnaeus)

Upper Left
lateral view

Fourth Instar
p. 149, 150

Upper Right
dorsal view

Middle Left
lateral view

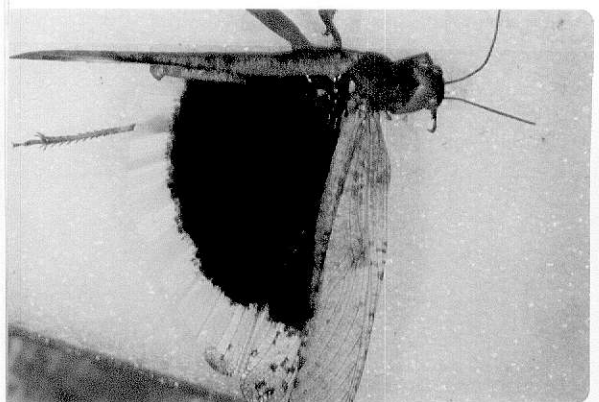
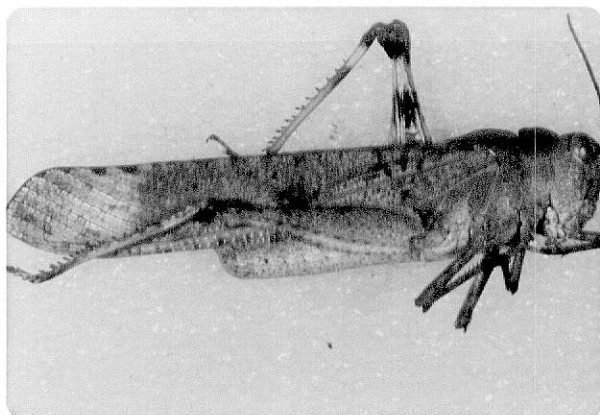
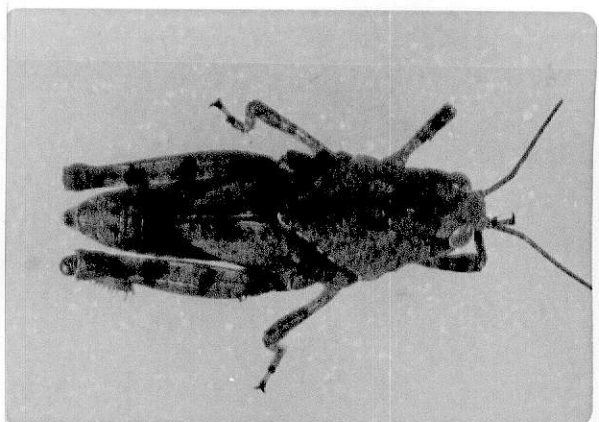
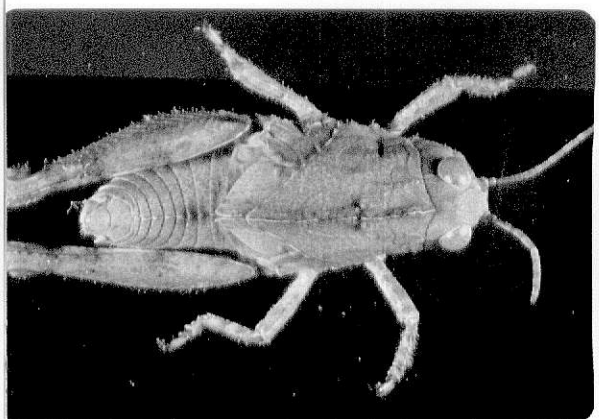
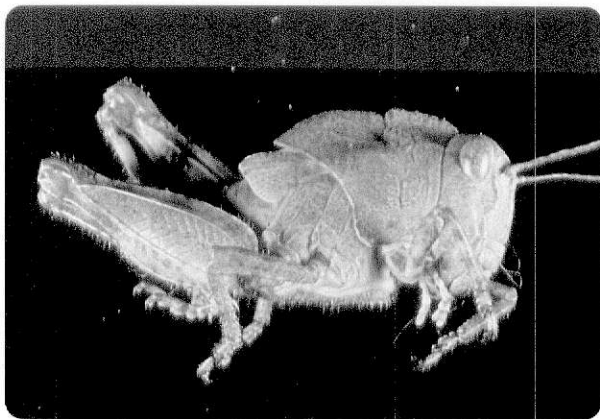
Fifth Instar
p. 153, 154

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 157, 158

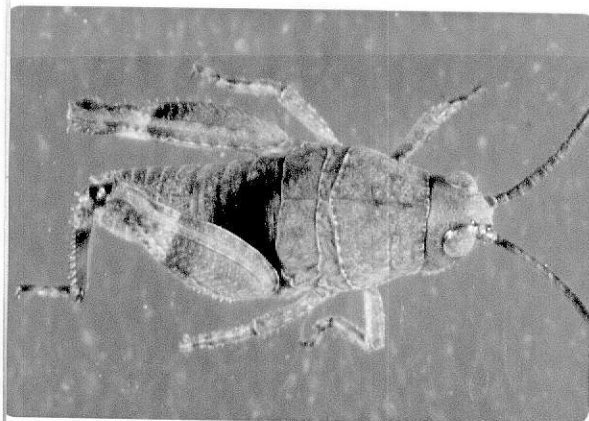
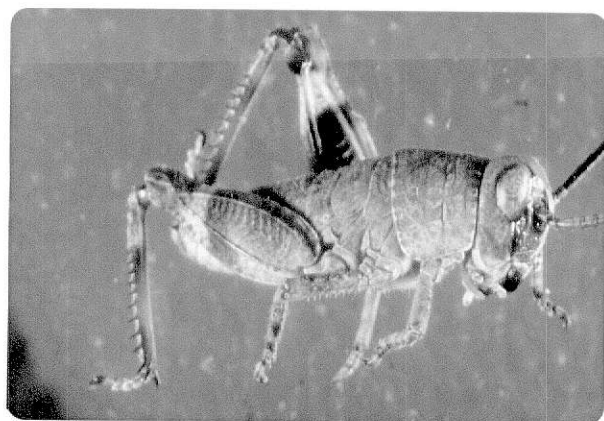
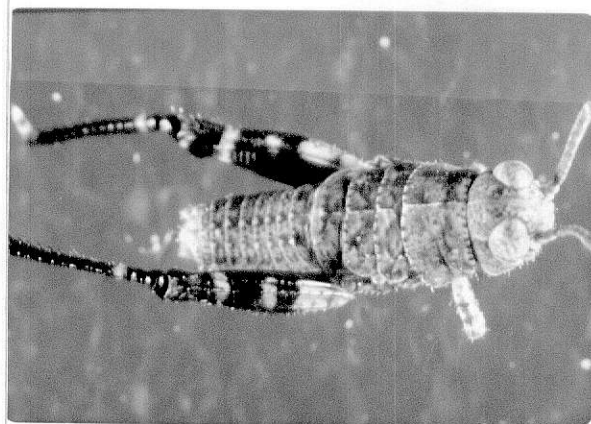
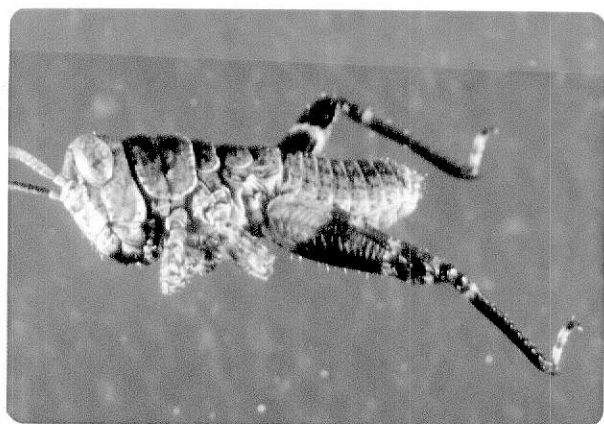
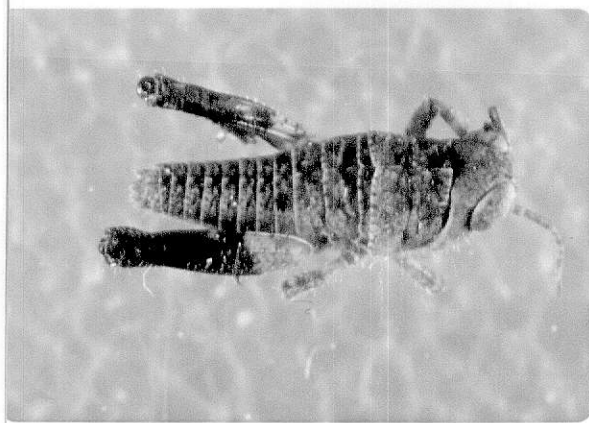
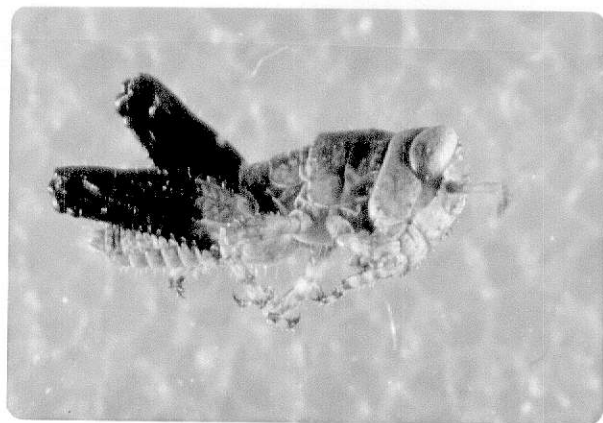
Lower Right
dorsal view



Explanation of Plate XII

Hadrotettix trifaciatus (Say)

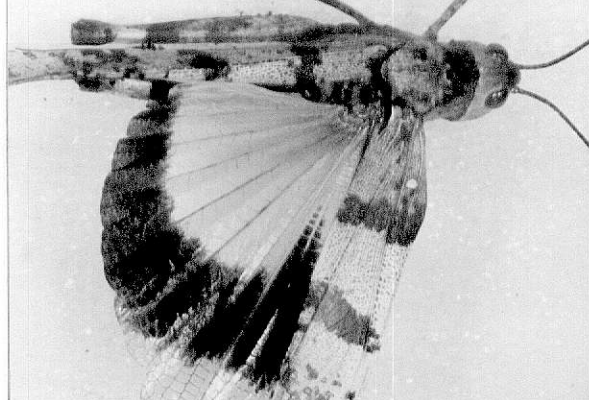
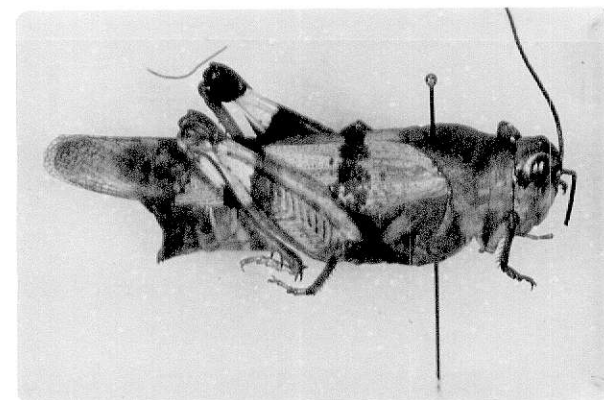
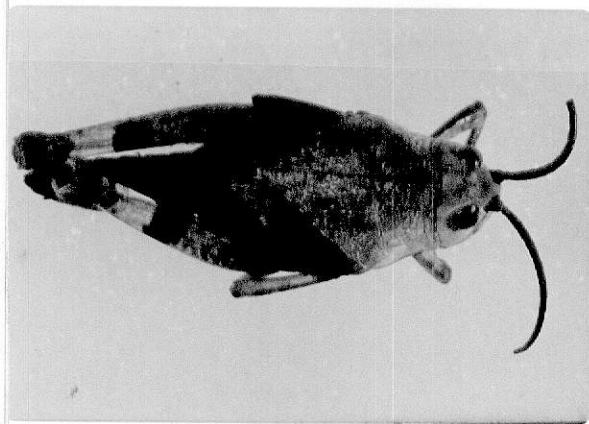
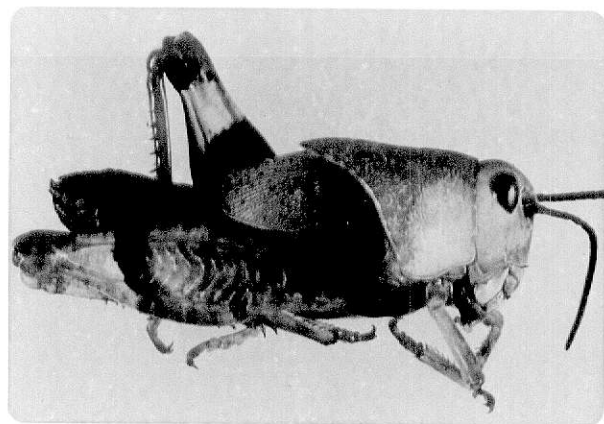
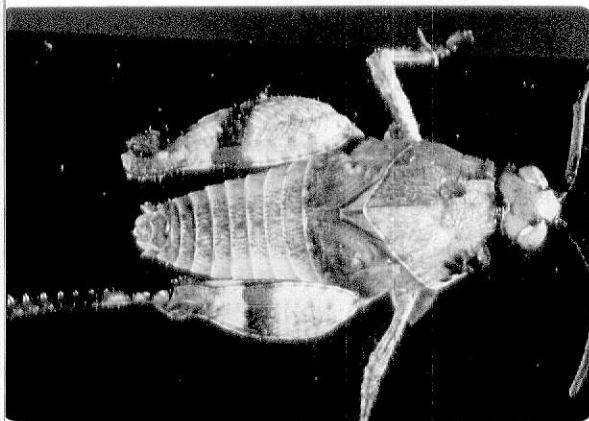
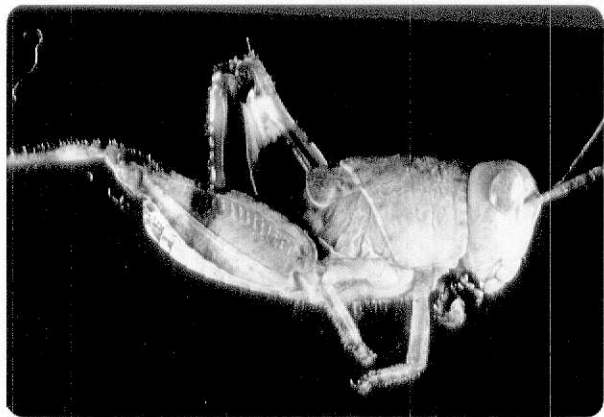
Upper Left lateral view	First Instar p. 139, 140	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 143, 144	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 145, 146	Lower Right dorsal view



Explanation of Plate XIIA

Hadrotettix trifaciatus (Say)

Upper Left lateral view	Fourth Instar p. 151, 152	Upper Right dorsal view
Middle Left lateral view	Fifth Instar p. 155, 156	Middle Right dorsal view
Lower Left lateral view	Adult p. 159, 160	Lower Right dorsal view



Explanation of Plate XIII

Pardalophora haldemanii (Scudder)

Upper Left
lateral view

First Instar
p. 139, 140

Upper Right
dorsal view

Middle Left
lateral view

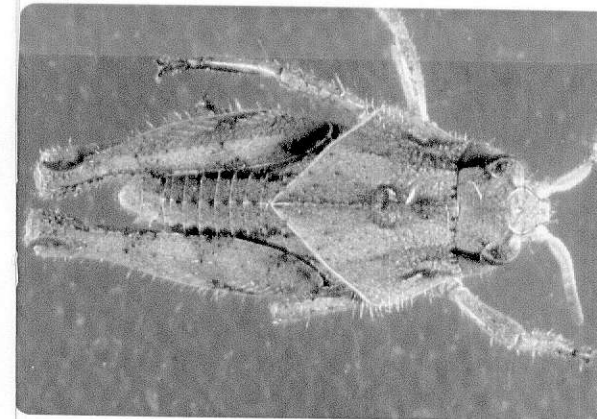
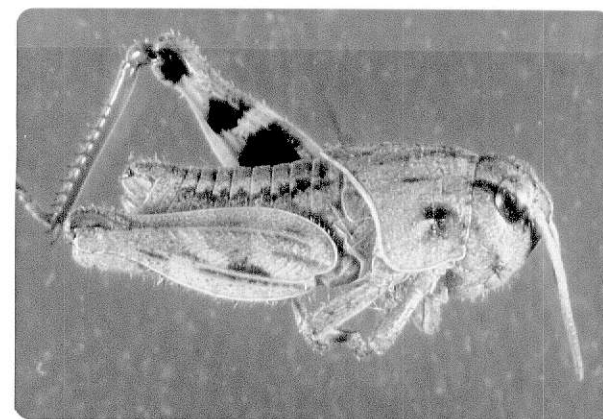
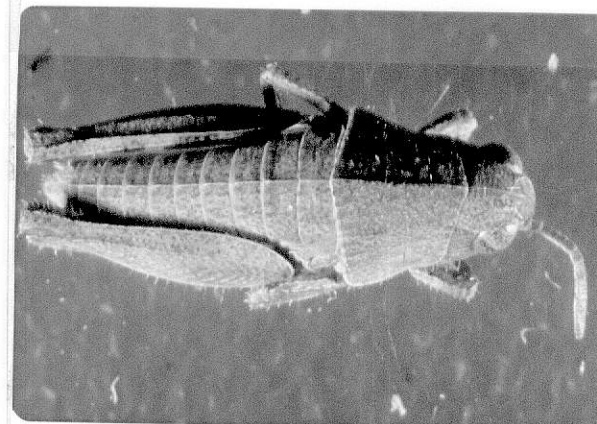
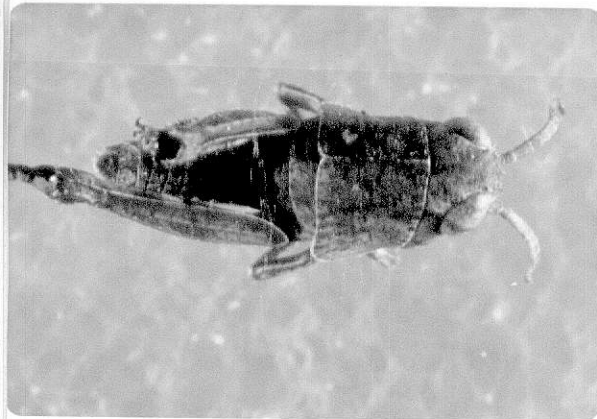
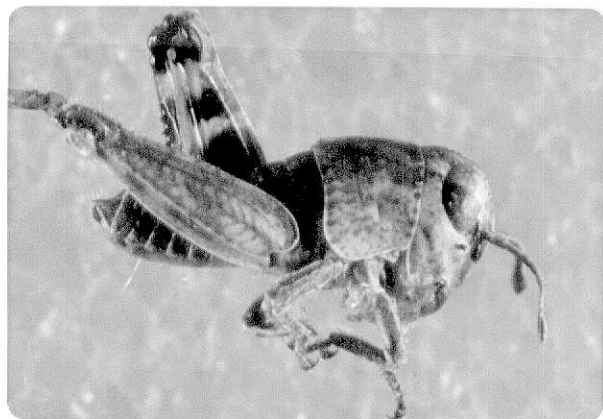
Second Instar
p. 143, 144

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 147, 148

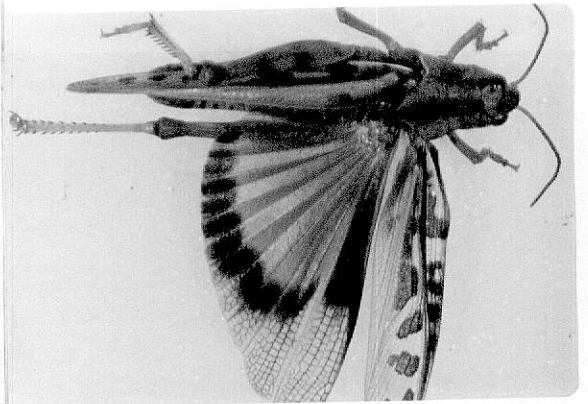
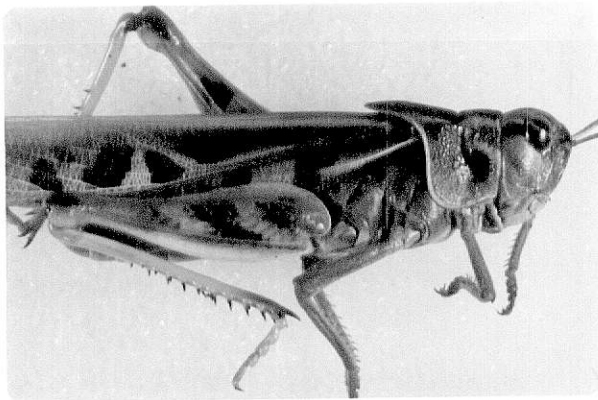
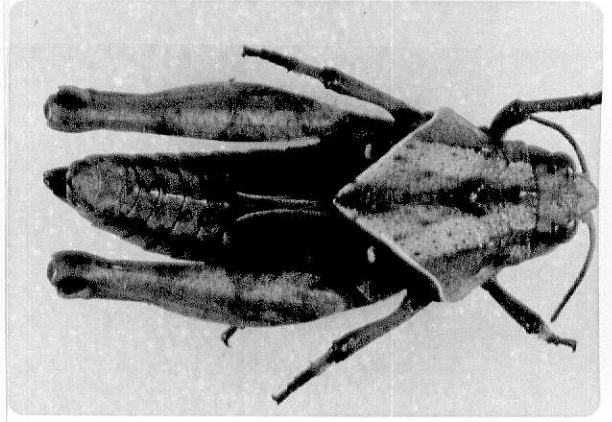
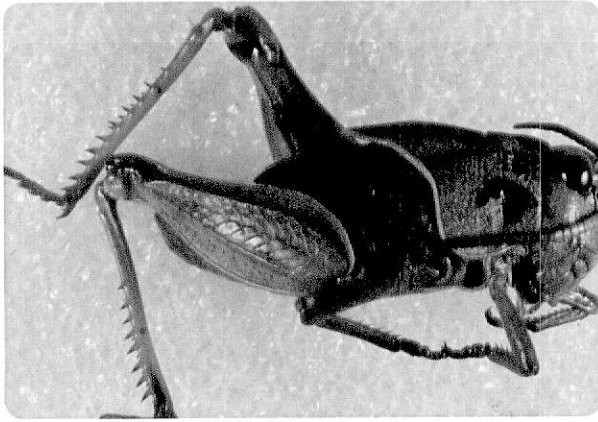
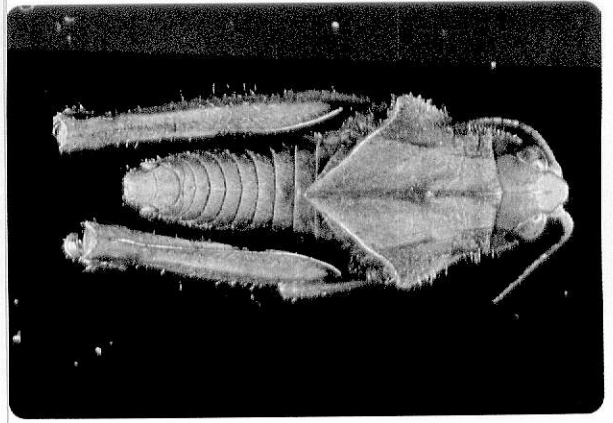
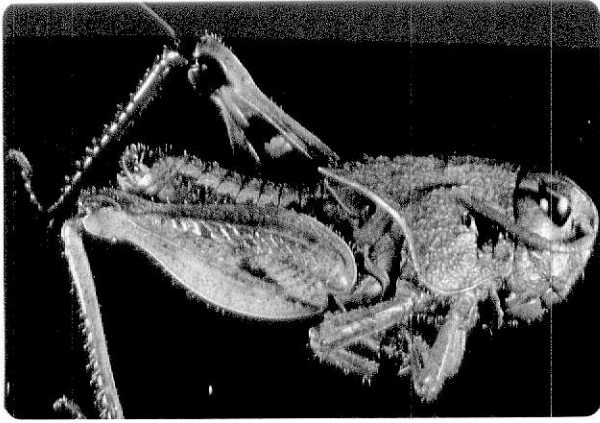
Lower Right
dorsal view



Explanation of Plate XIIIA

Pardalophora haldemanii (Scudder)

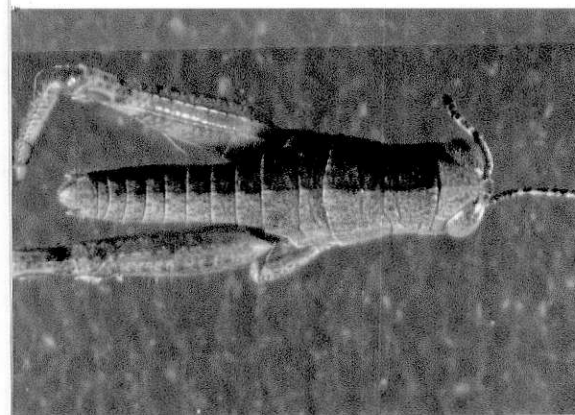
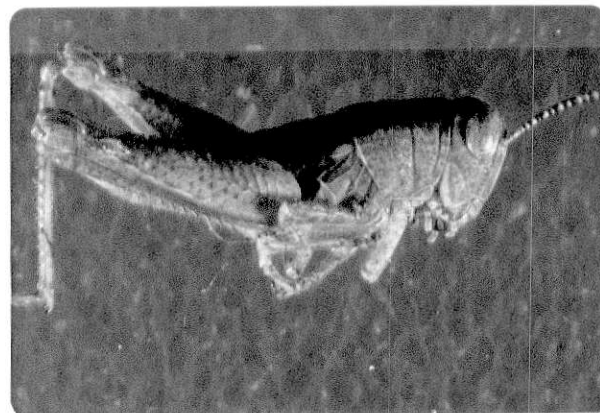
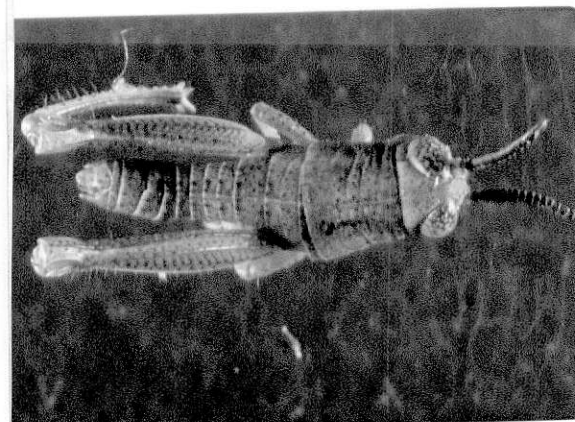
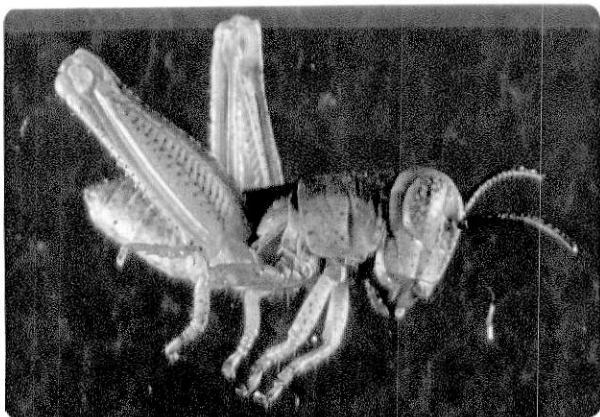
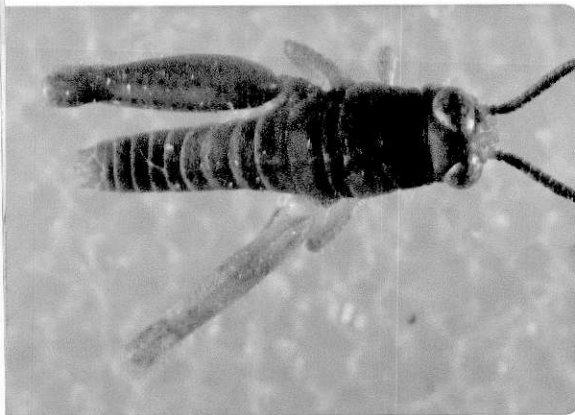
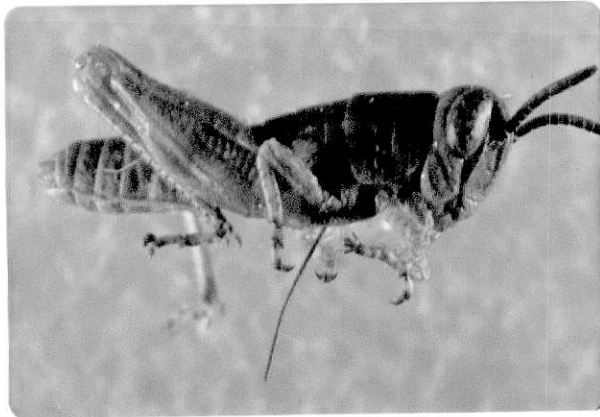
Upper Left lateral view	Fourth Instar p. 151, 152	Upper Right dorsal view
Middle Left lateral view	Fifth Instar p. 155, 156	Middle Right dorsal view
Lower Left lateral view	Adult p. 159, 160	Lower Right dorsal view



Explanation of Plate XIV

Campylacantha olivacea olivacea (Scudder)

Upper Left lateral view	First Instar p. 161, 162	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 167, 168	Middle Left dorsal view
Lower Left lateral view	Third Instar p. 173, 174	Lower Right dorsal view



Explanation of Plate XIVA

Campylacantha olivacea olivacea (Scudder)

Upper Left
lateral view

Fourth Instar
p. 179, 180

Upper Right
dorsal view

Middle Left
lateral view

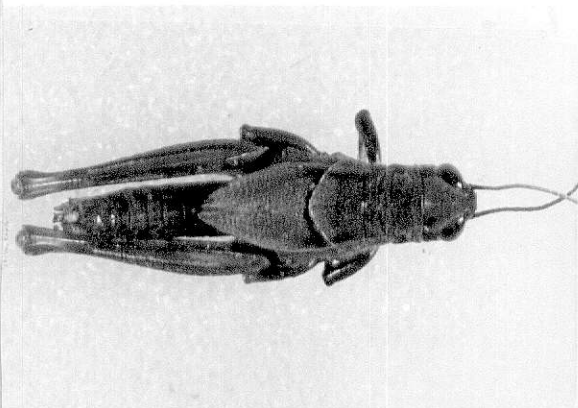
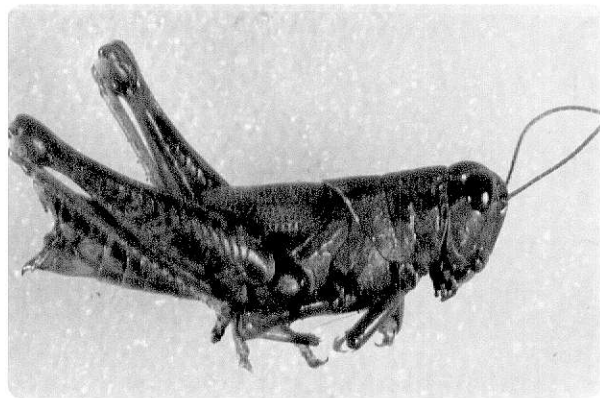
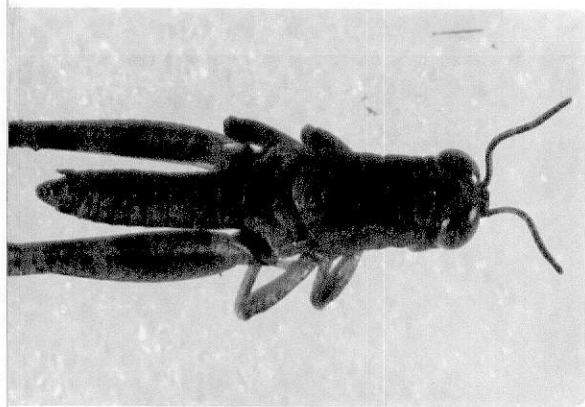
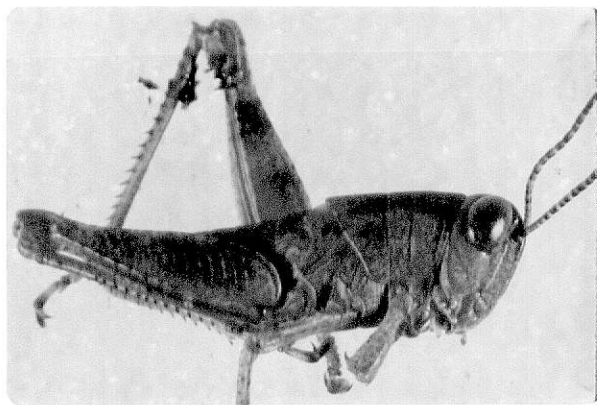
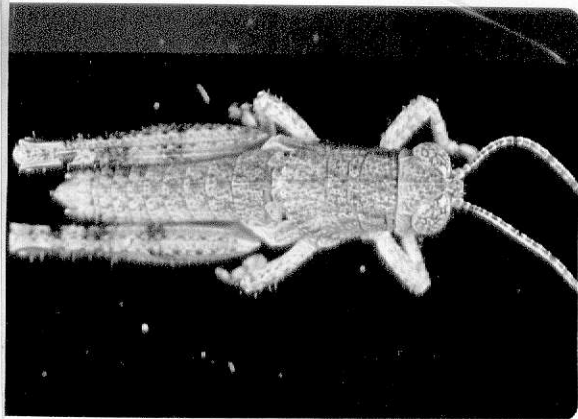
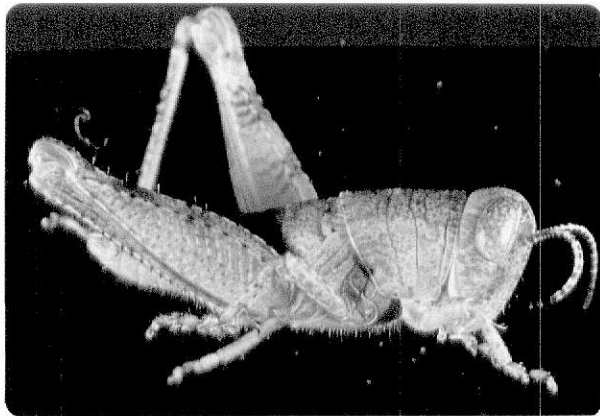
Fifth Instar
p. 185, 186

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 191, 192

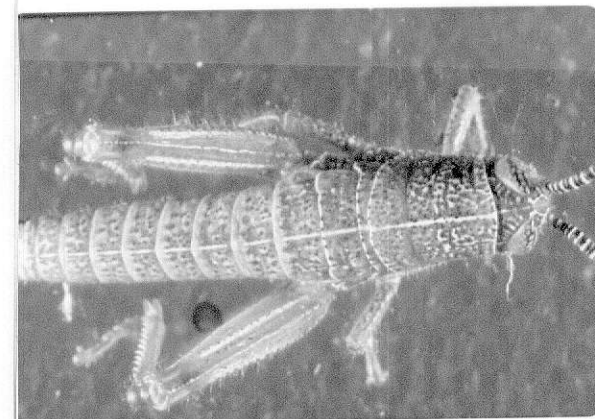
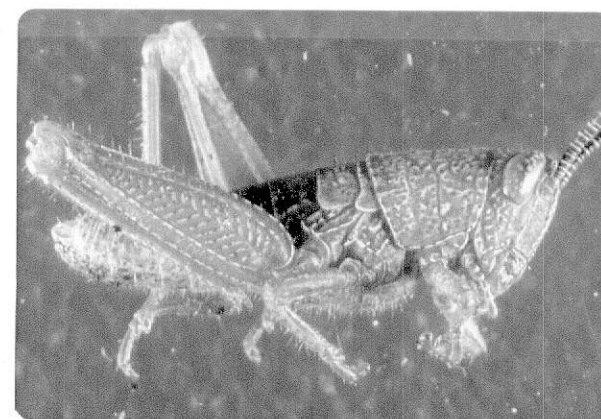
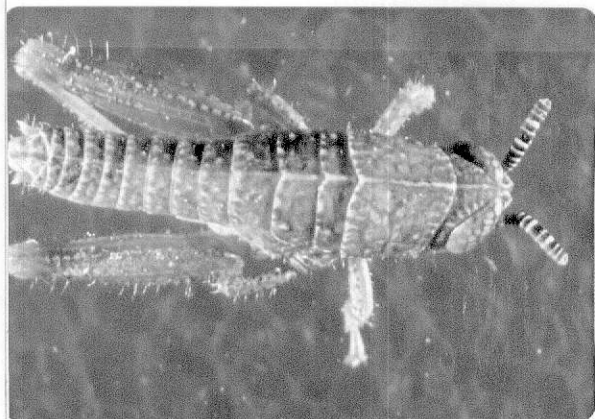
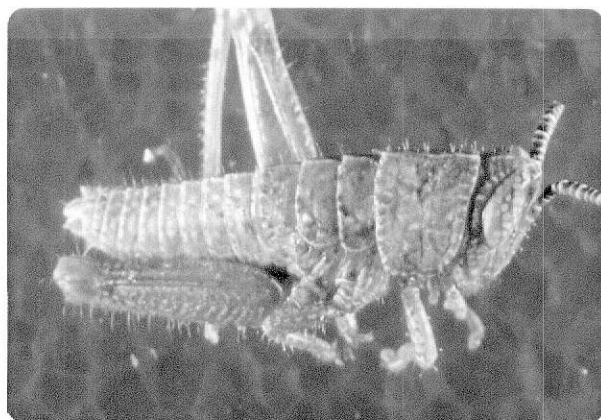
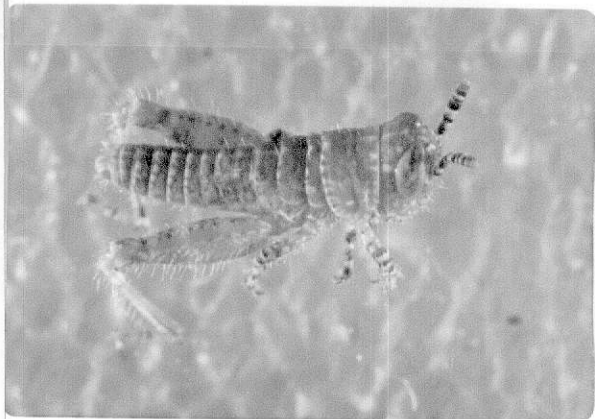
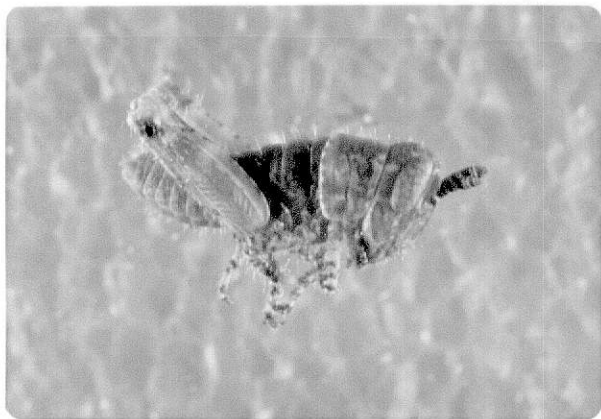
Lower Right
dorsal view



Explanation of Plate XV

Hesperotettix speciosus (Scudder)

Upper Left lateral view	First Instar p. 161, 162	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 167, 168	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 173, 174	Lower Right dorsal view



Explanation of Plate XVA

Hesperotettix speciosus (Scudder)

Upper Left
lateral view

Fourth Instar
p. 179, 180

Upper Right
dorsal view

Middle Left
lateral view

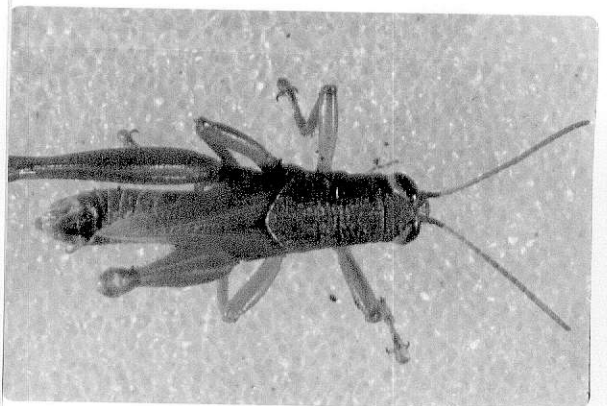
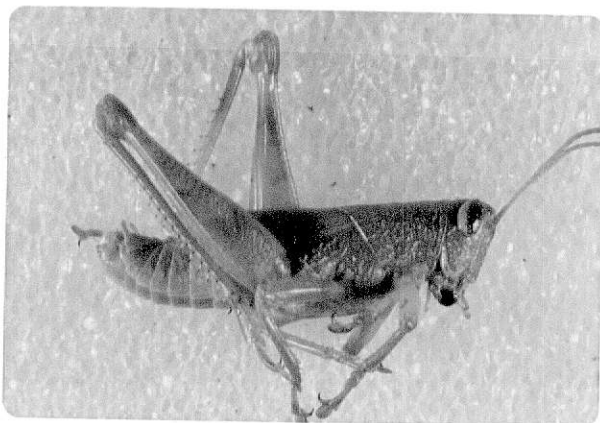
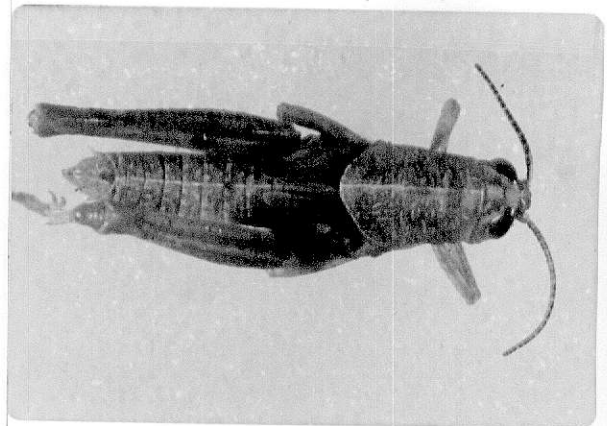
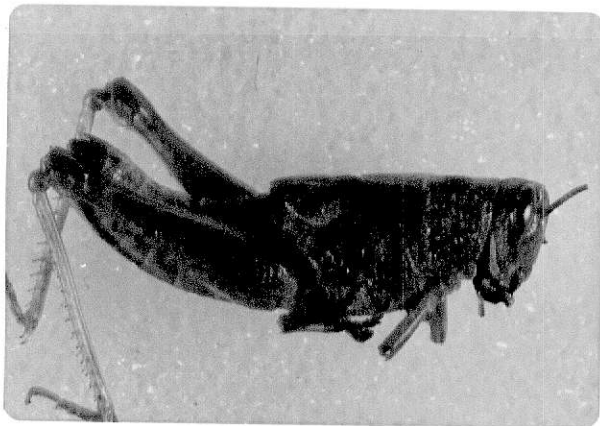
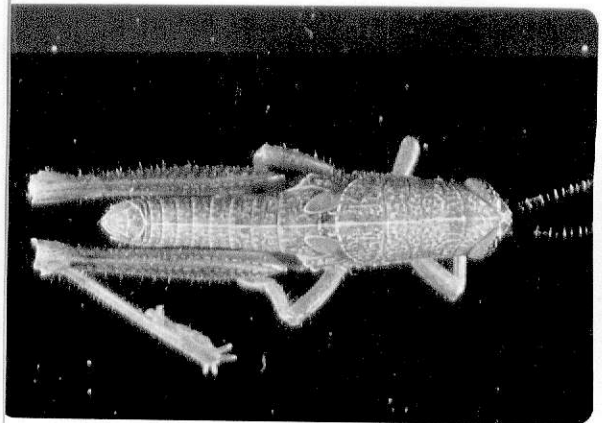
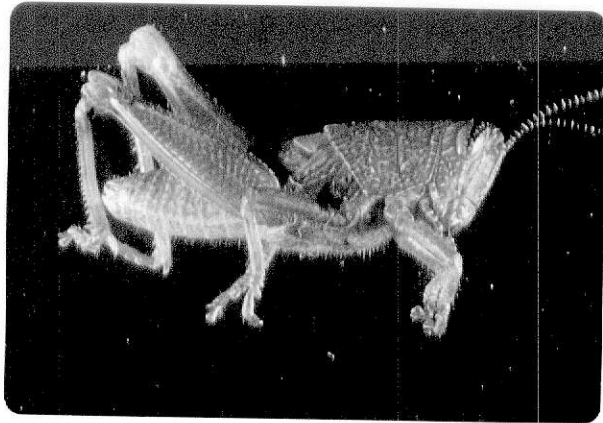
Fifth Instar
p. 185, 186

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 191, 192

Lower Right
dorsal view



Explanation of Plate XVI

Hypochlora alba (Dodge)

Upper Left
lateral view

First Instar
p. 161, 162

Upper Right
dorsal view

Middle Left
lateral view

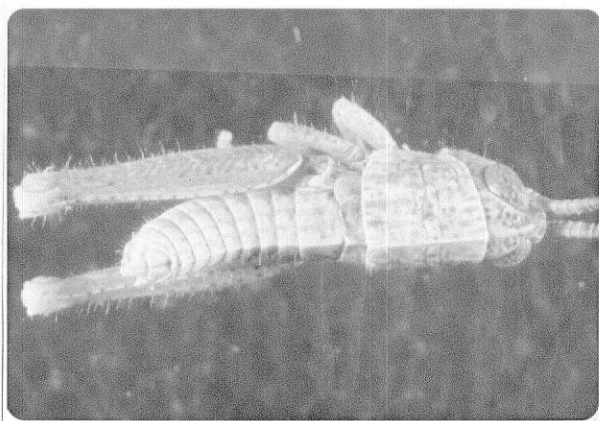
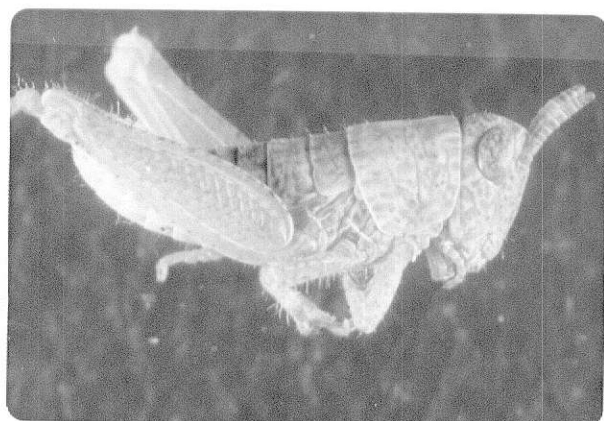
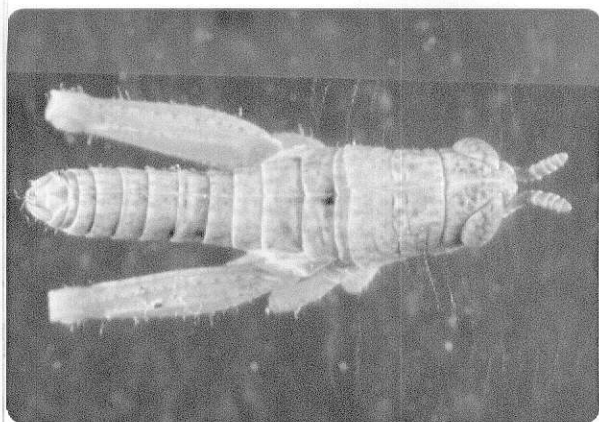
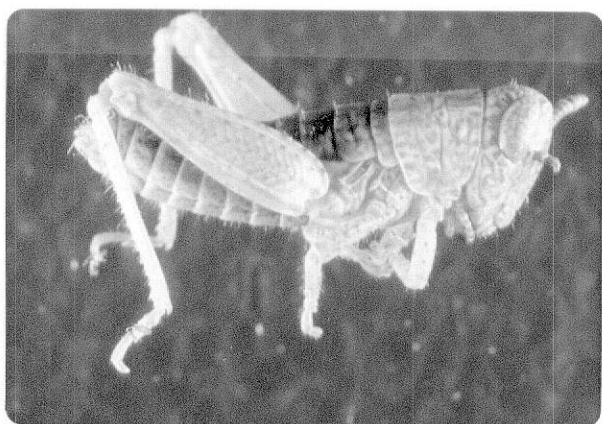
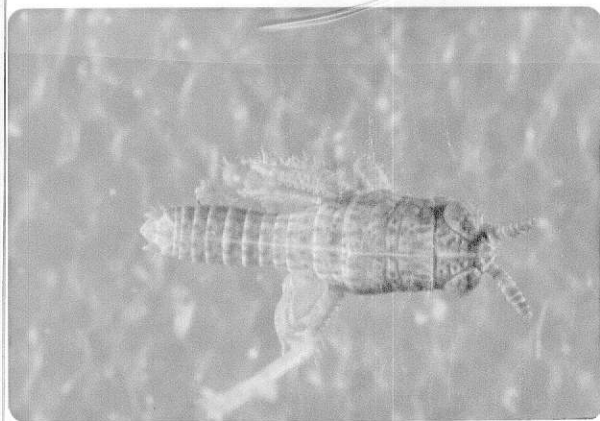
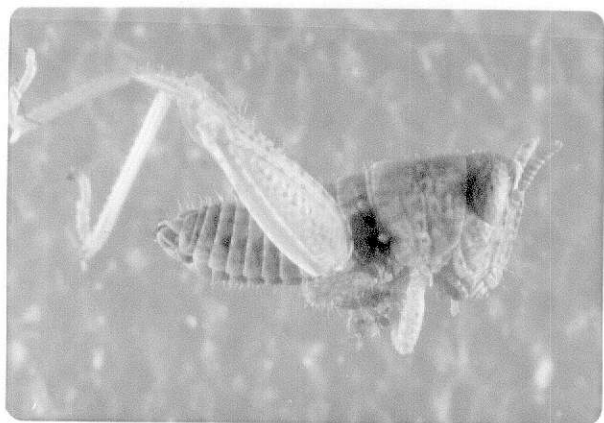
Second Instar
p. 167, 168

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 173, 174

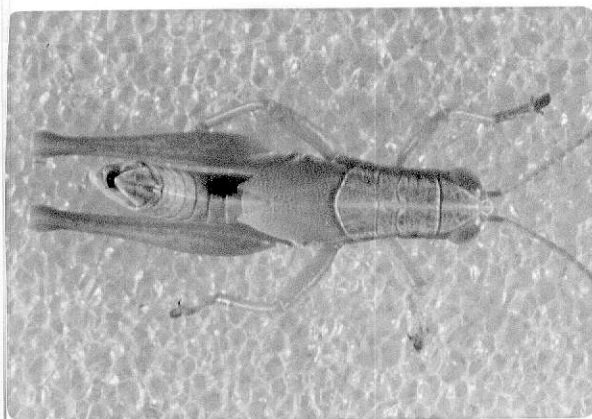
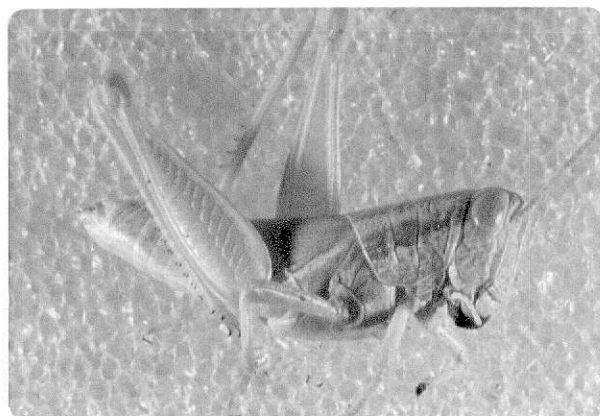
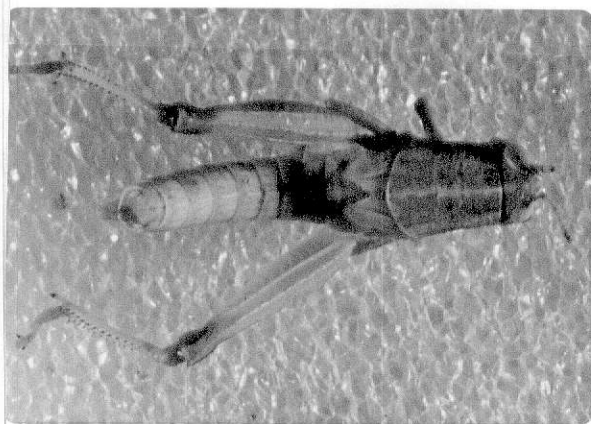
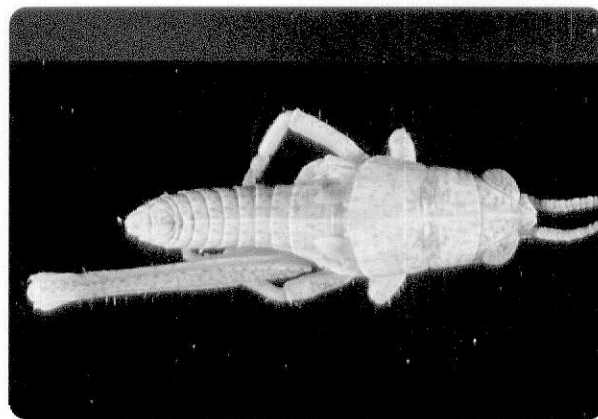
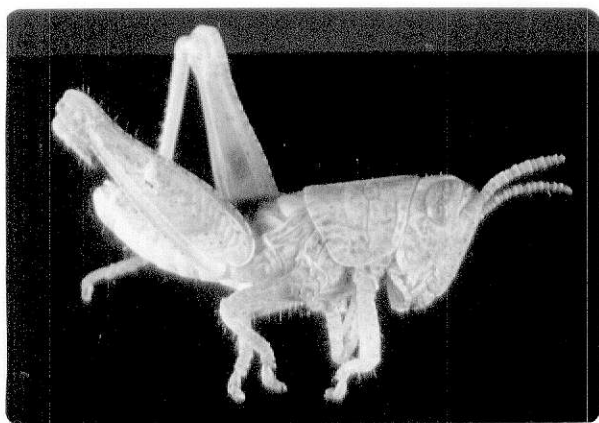
Lower Right
dorsal view



Explanation of Plate XVIA

Hypochlora alba (Dodge)

Upper Left lateral view	Fourth Instar p. 179, 180	Upper Right dorsal view
Middle Left lateral view	Fifth Instar p. 185, 186	Middle Right dorsal view
Lower Left lateral view	Adult p. 191, 192	Lower Right dorsal view



Explanation of Plate XVII

Melanoplus bivittatus (Say)

Upper Left
lateral view

First Instar
p. 161, 162

Upper Right
dorsal view

Middle Left
lateral view

Second Instar
p. 167, 168

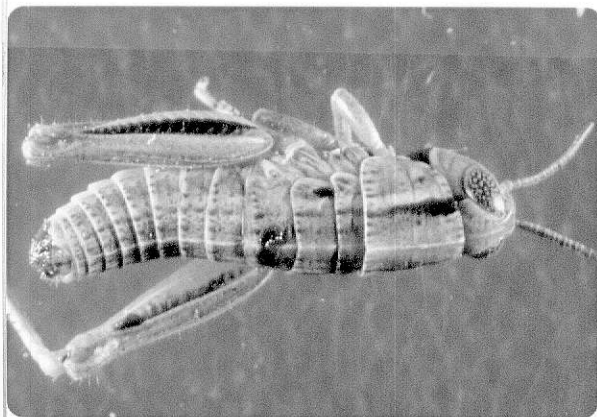
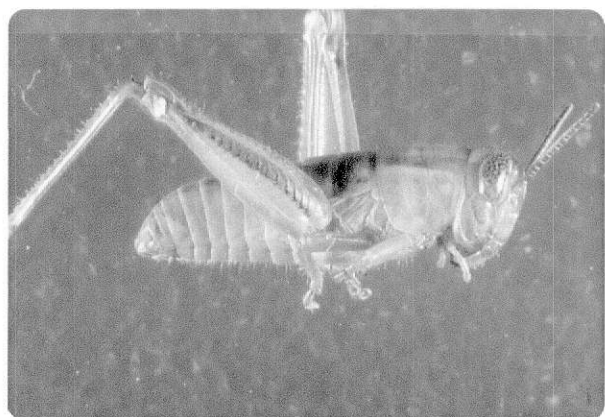
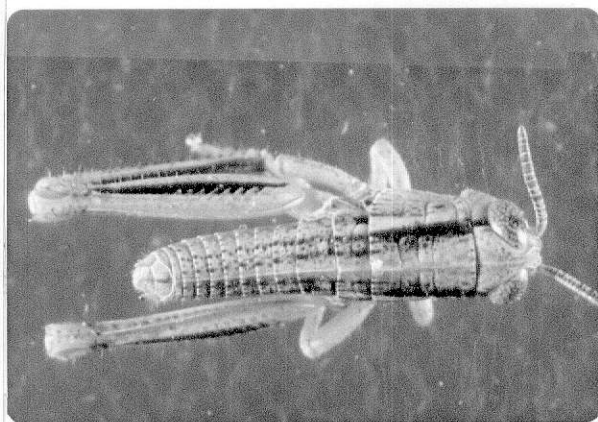
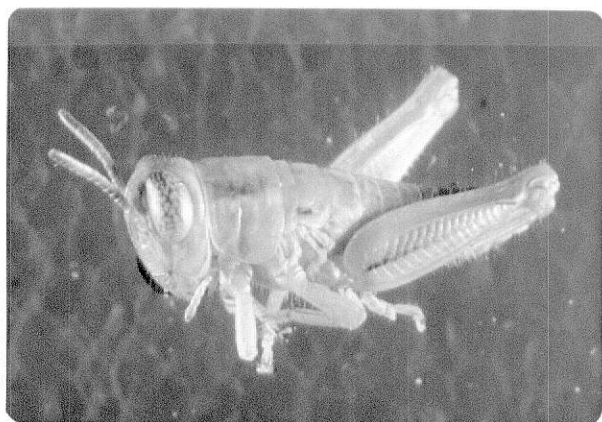
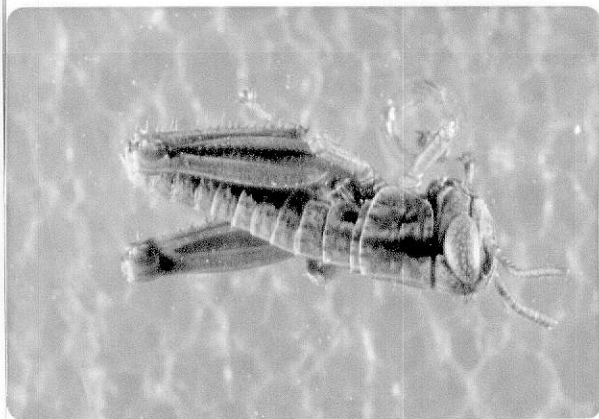
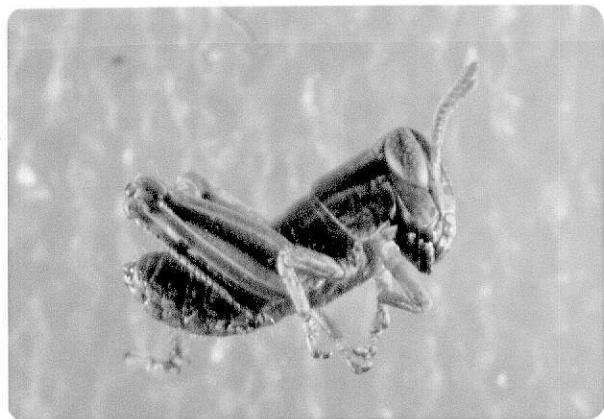
Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 173, 174

Lower Right
dorsal view

71 B2, B4, 5, 1, 10
2C done



Explanation of Plate XVIIIA

Melanoplus bivittatus (Say)

Upper Left
lateral view

Fourth Instar
p. 179, 180

Upper Right
dorsal view

Middle Left
lateral view

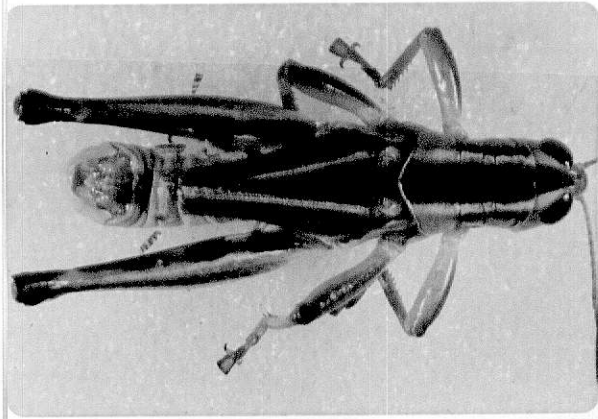
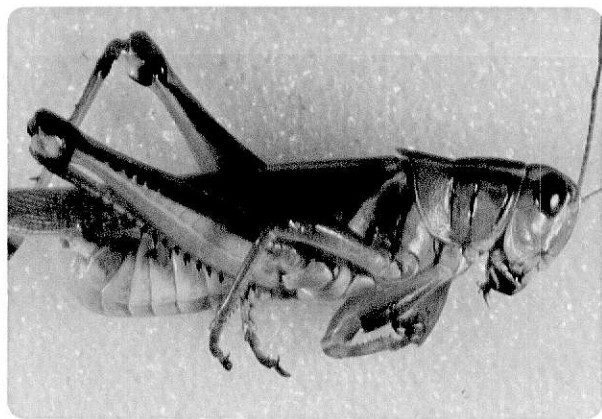
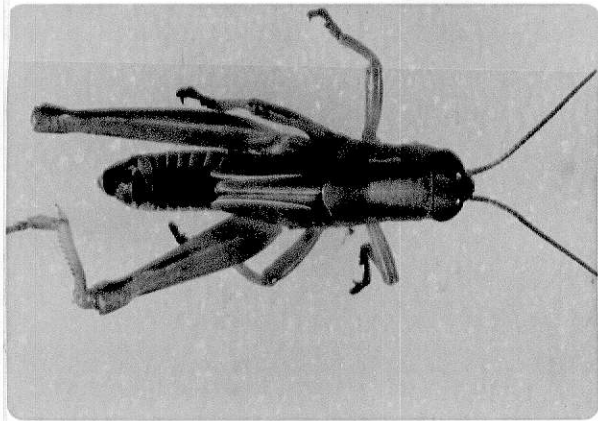
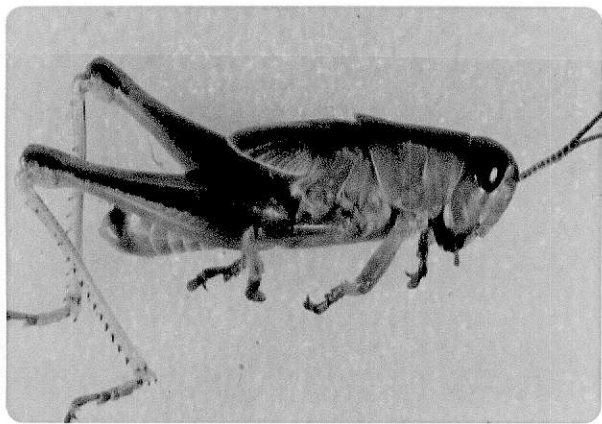
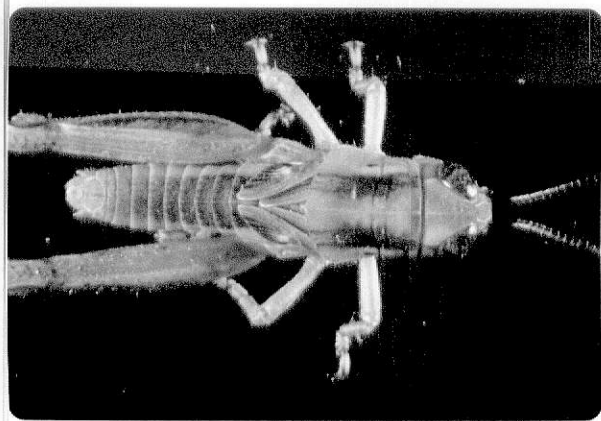
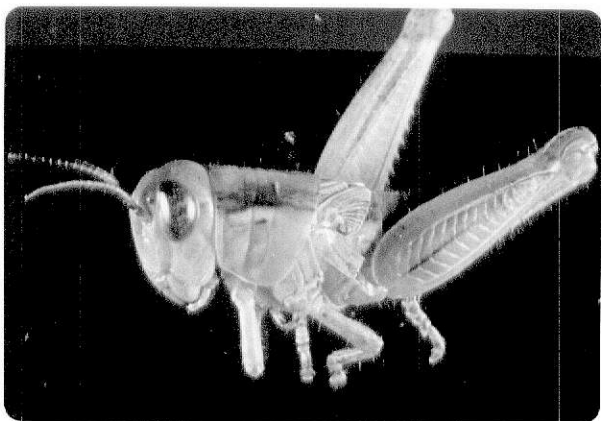
Fifth Instar
p. 185, 186

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 193, 194

Lower Right
dorsal view



Explanation of Plate XVIII

Melanoplus confusus Scudder

Upper Left
lateral view

First Instar
p. 163, 164

Upper Right
dorsal view

Middle Left
lateral view

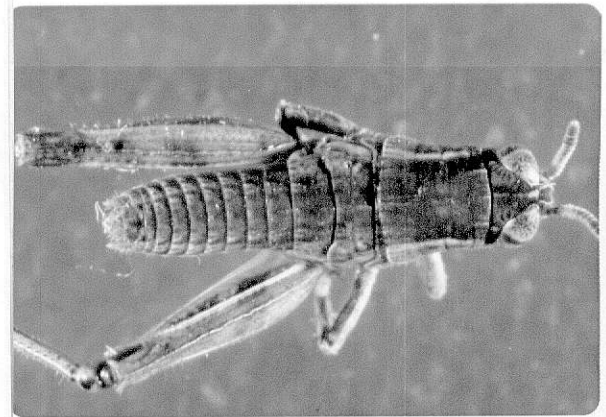
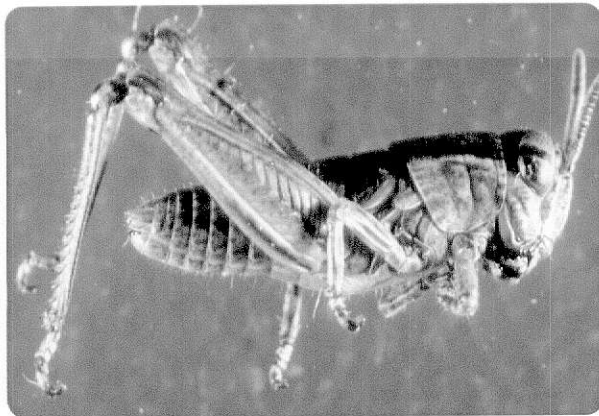
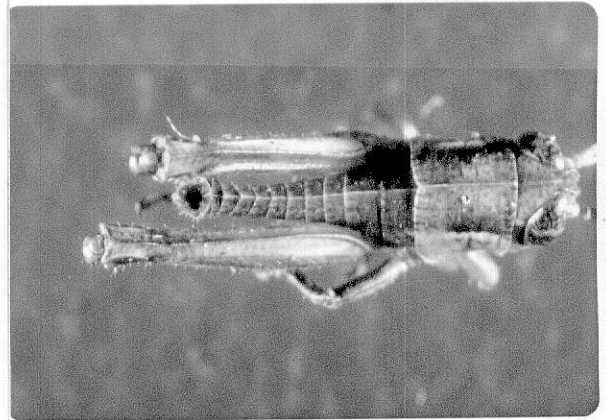
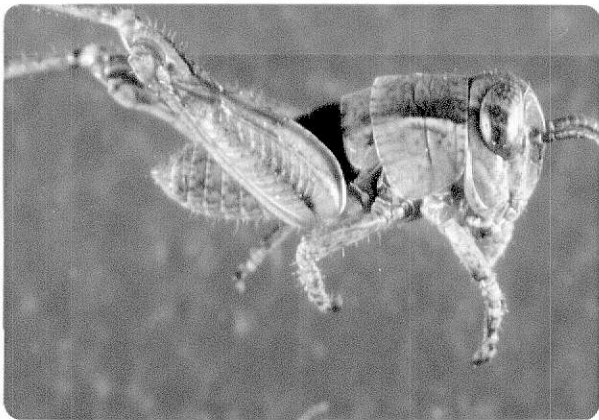
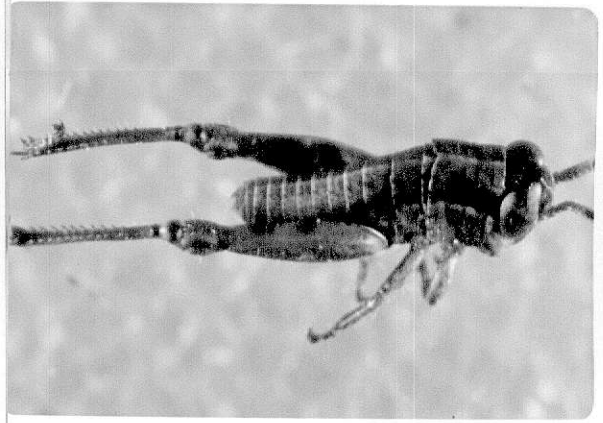
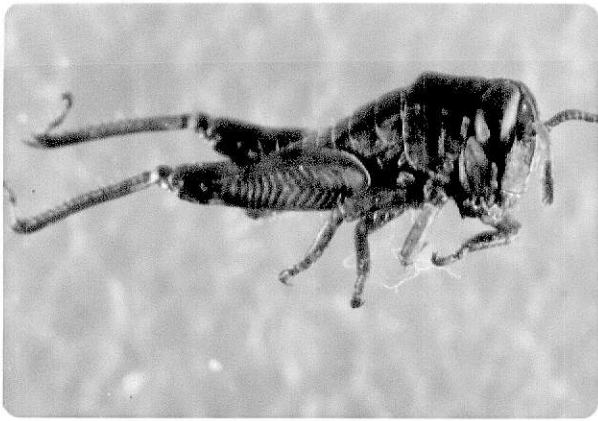
Second Instar
p. 169, 170

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 175, 176

Lower Right
dorsal view



Explanation of Plate XVIIIA

Melanoplus confusus Scudder

Upper Left
lateral view

Fourth Instar
p. 181, 182

Upper Right
dorsal view

Middle Left
lateral view

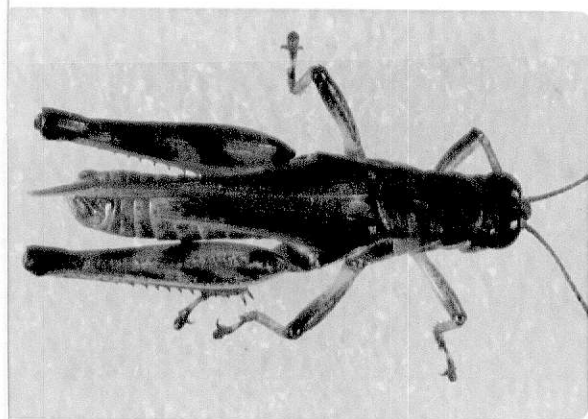
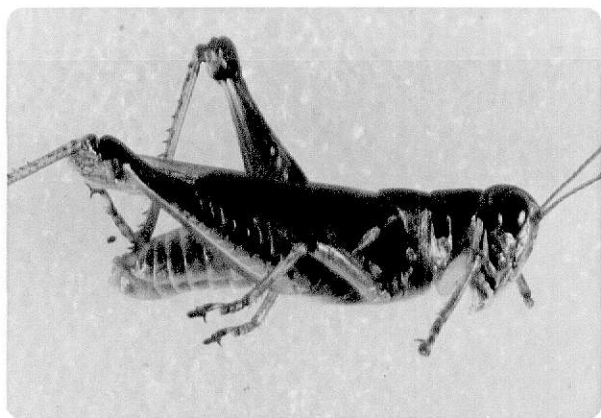
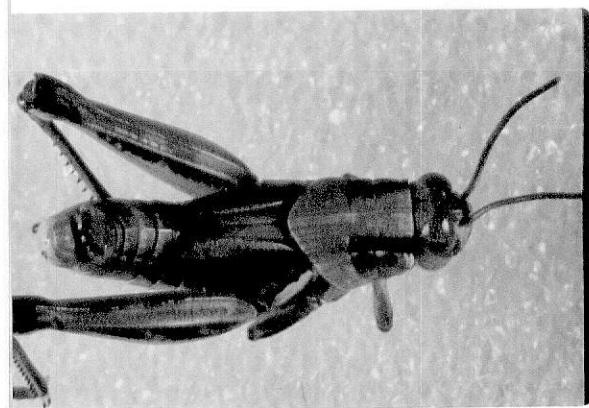
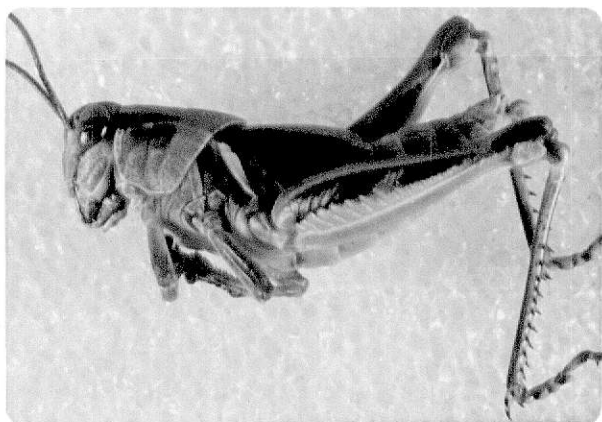
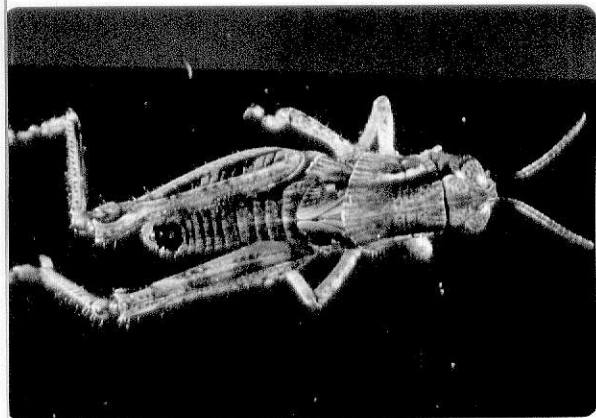
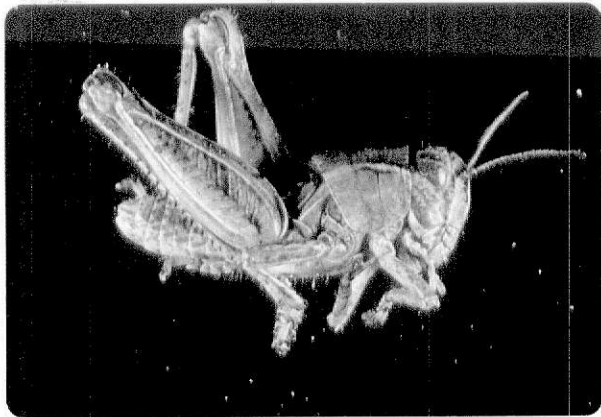
Fifth Instar
p. 187, 188

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 193, 194

Lower Right
dorsal view



Explanation of Plate XIX

Melanoplus femurrubrumfemurrubrum (DeGeer)

Upper Left
lateral view

First Instar
p. 163, 164

Upper Right
dorsal view

Middle Left
lateral view

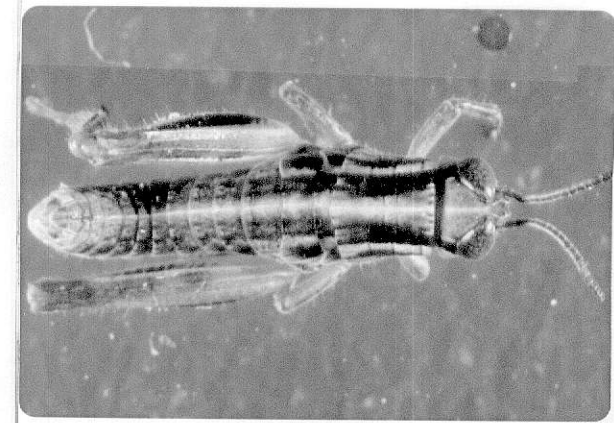
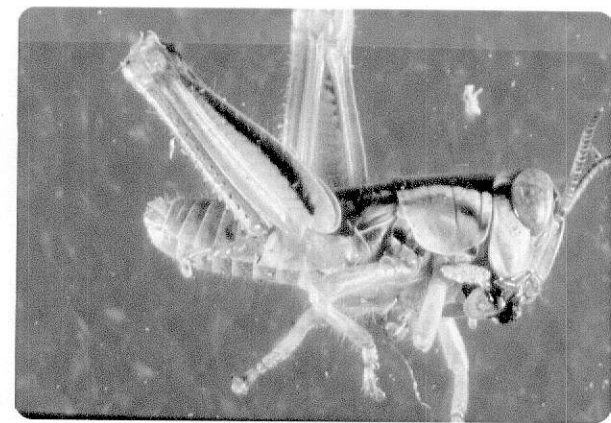
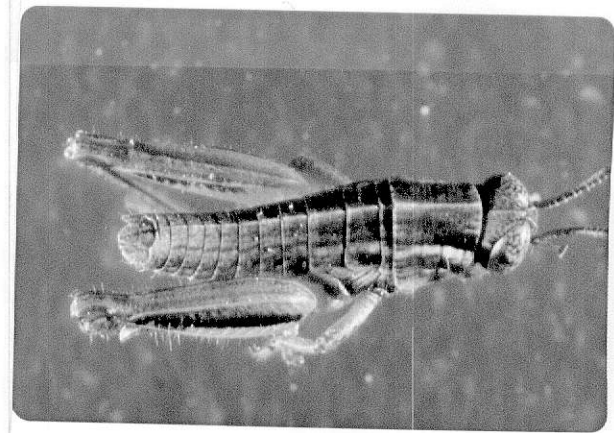
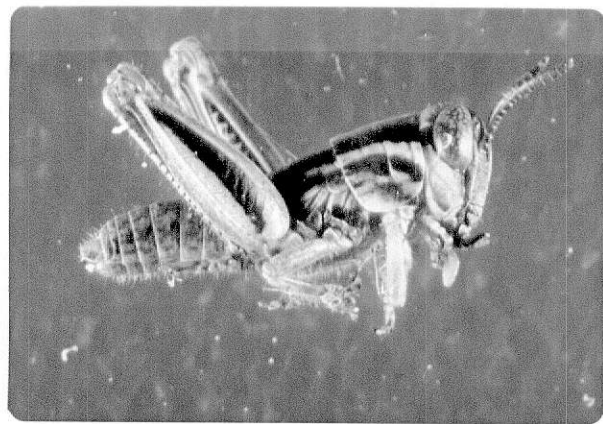
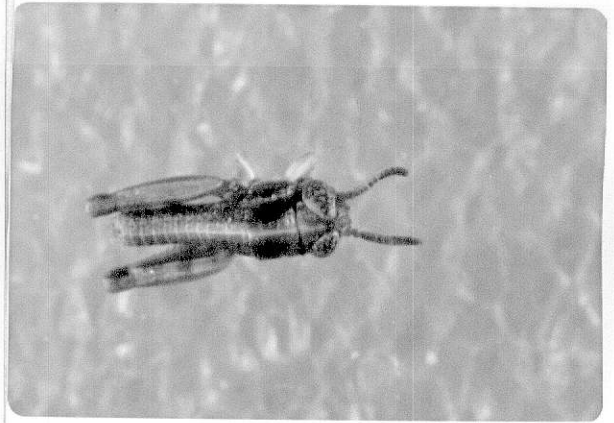
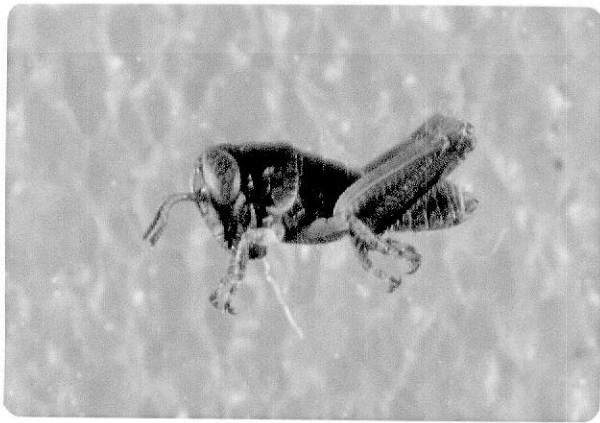
Second Instar
p. 169, 170

Middle Right
dorsal view

Lower Left
lateral view

Third Instar
p. 175, 176

Lower Right
dorsal view



Explanation of Plate XIXA

Melanoplus femurrubrumfemurrubrum (DeGeer)

Upper Left
lateral view

Fourth Instar
p. 181, 182

Upper Right
dorsal view

Middle Left
lateral view

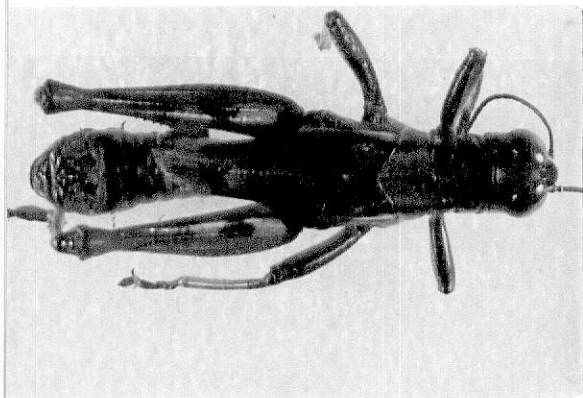
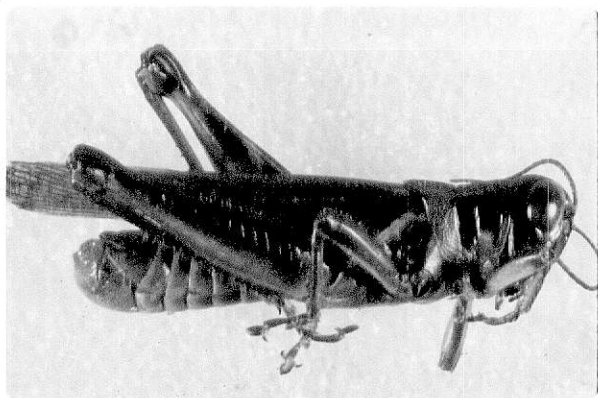
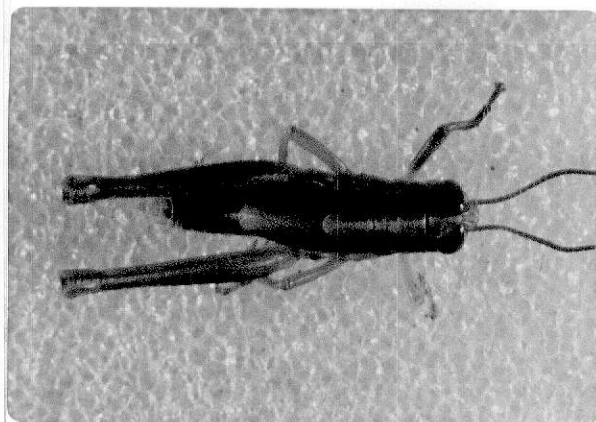
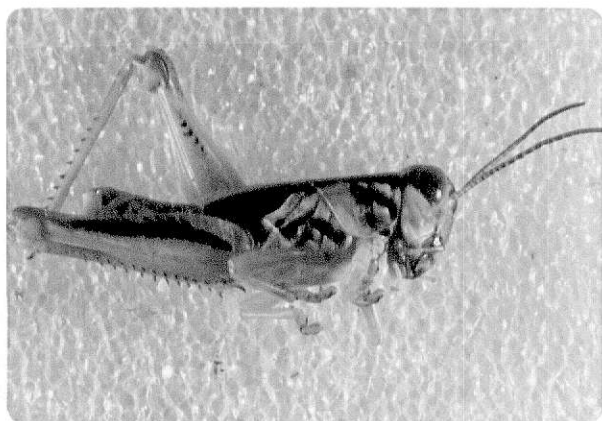
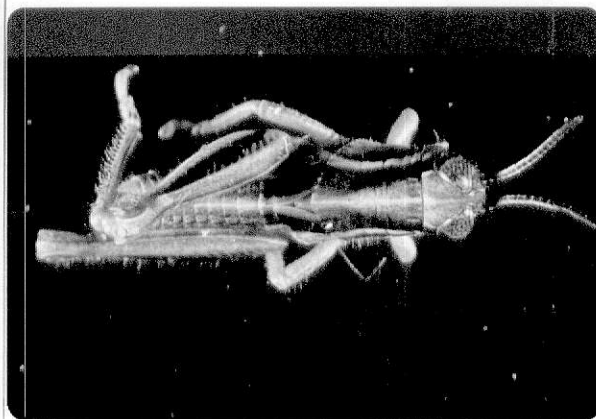
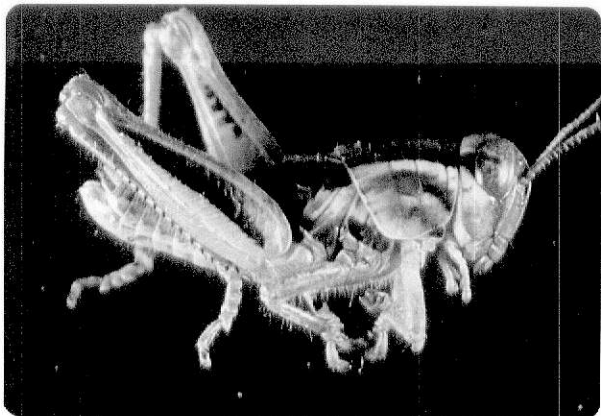
Fifth Instar
p. 187, 188

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 193, 194

Lower Right
dorsal view

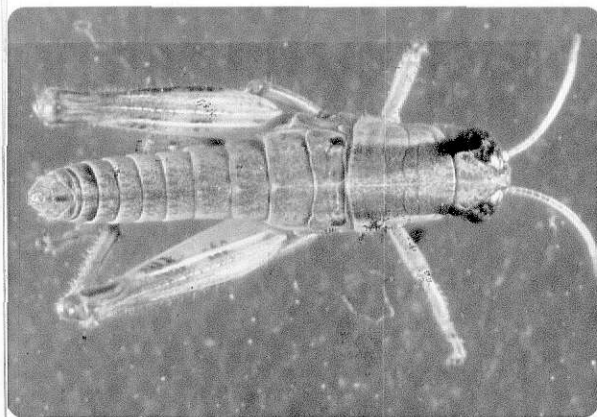
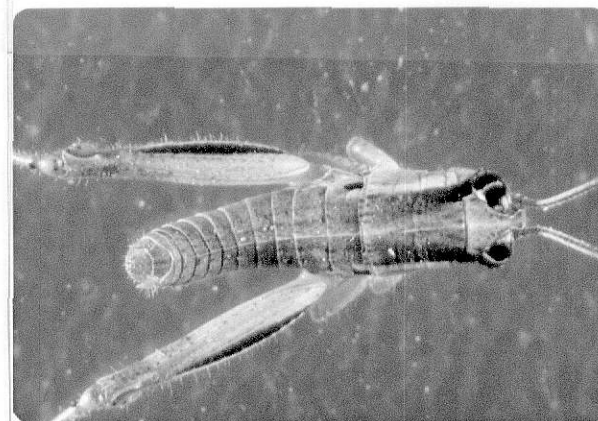
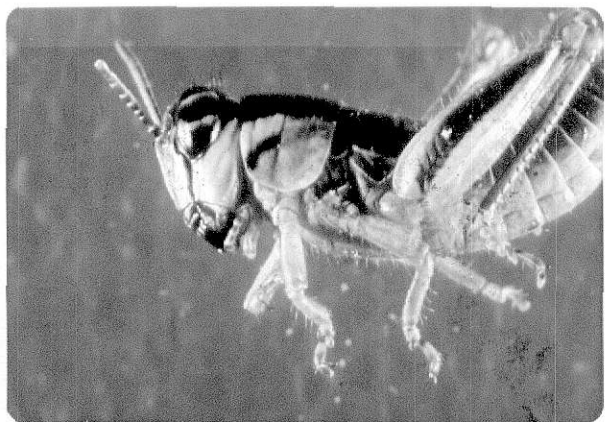
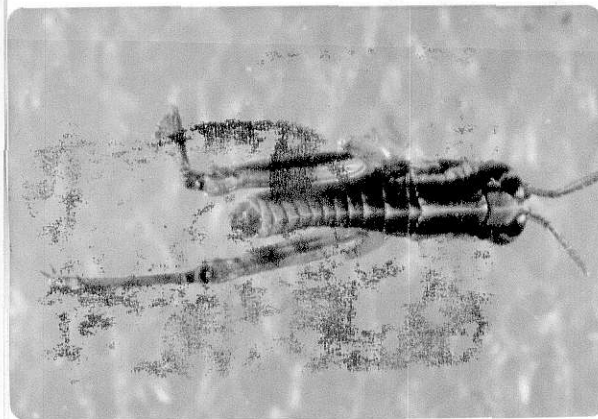
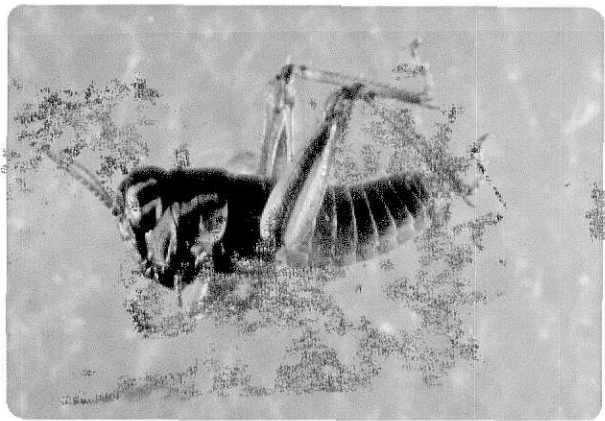


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Explanation of Plate XX

Melanoplus keeleri luridus (Dodge)

Upper Left lateral view	First Instar p. 163, 164	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 169, 170	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 175, 176	Lower Right dorsal view



Explanation of Plate XXA

Melanoplus keeleri luridus (Dodge)

Upper Left
lateral view

Fourth Instar
p. 181, 182

Upper Right
dorsal view

Middle Left
lateral view

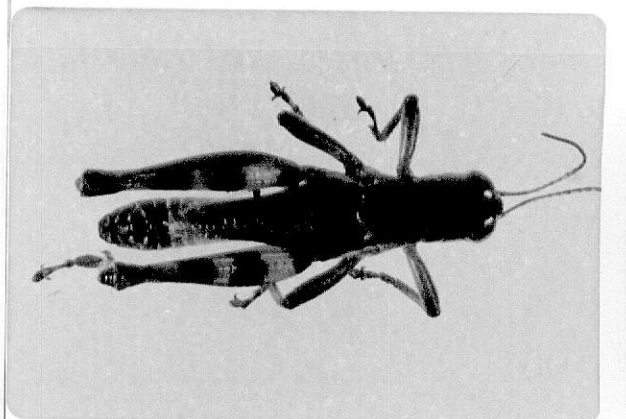
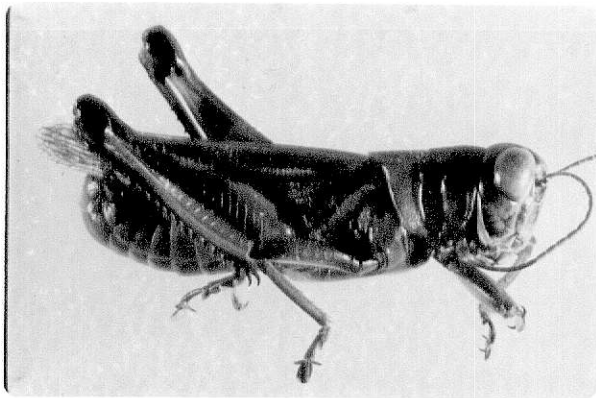
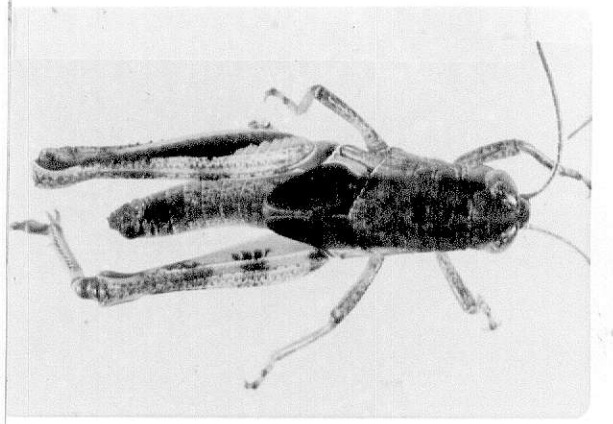
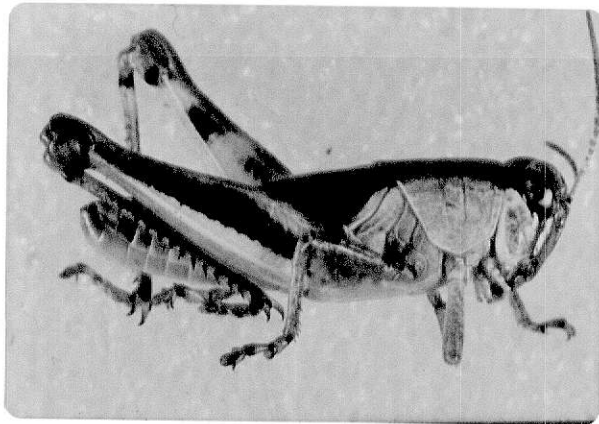
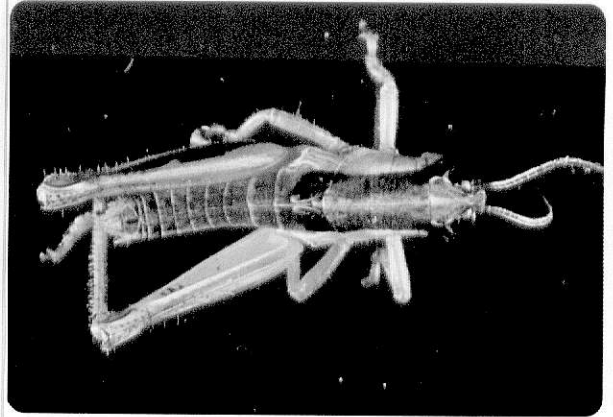
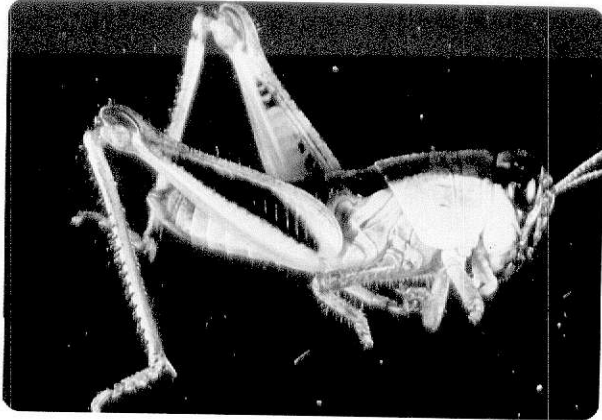
Fifth Instar
p. 187, 188

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 195, 196

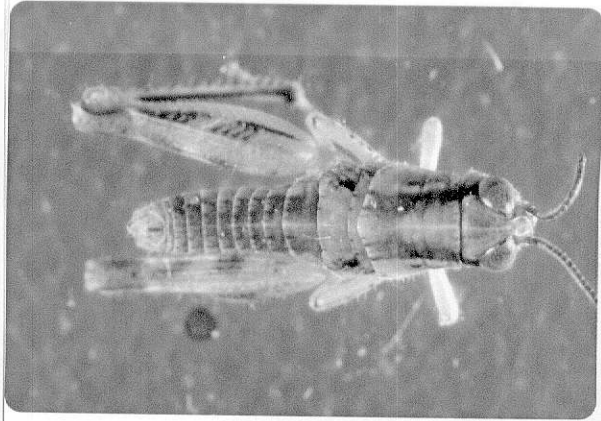
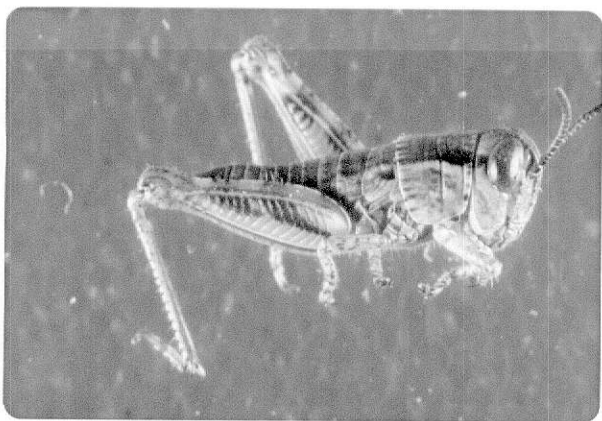
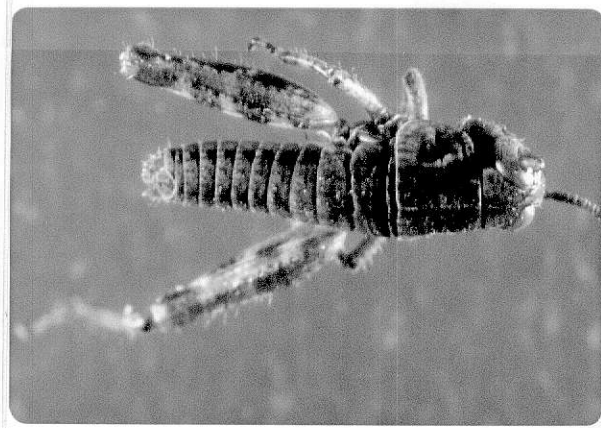
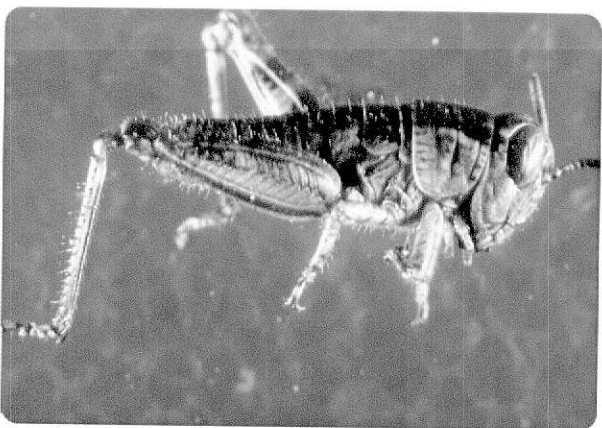
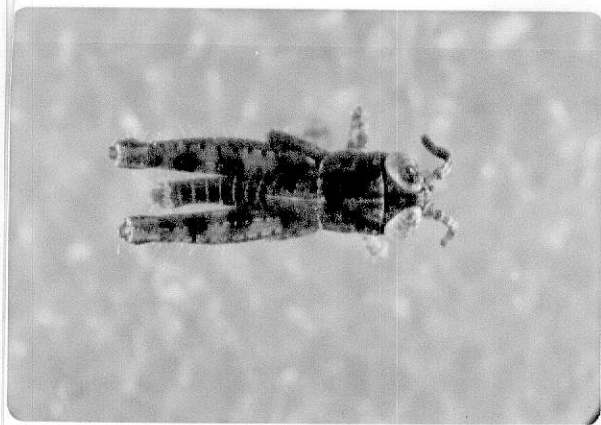
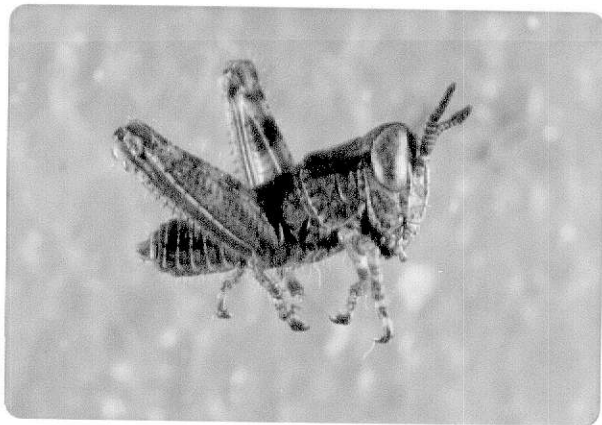
Lower Right
dorsal view



Explanation of Plate XXI

Melanoplus sanguinipes (Fabricius)

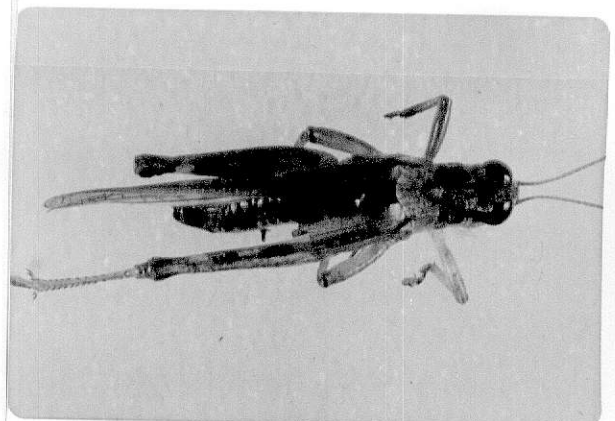
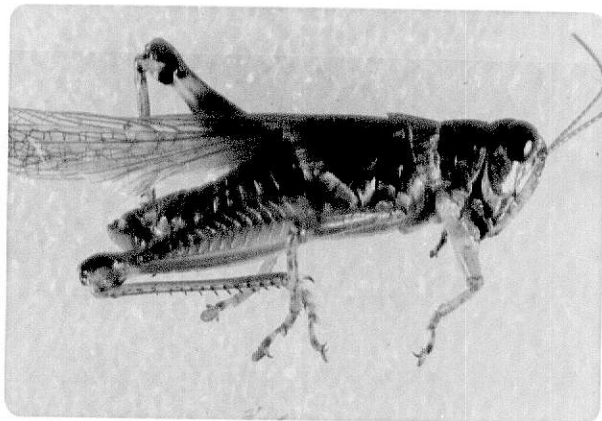
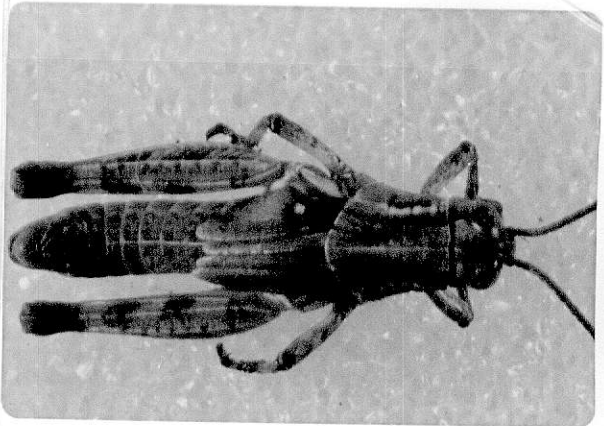
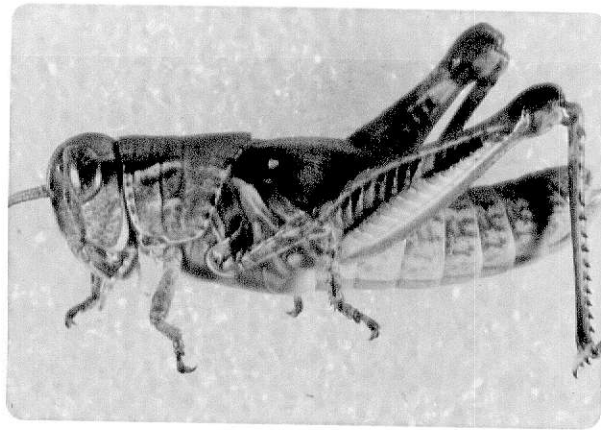
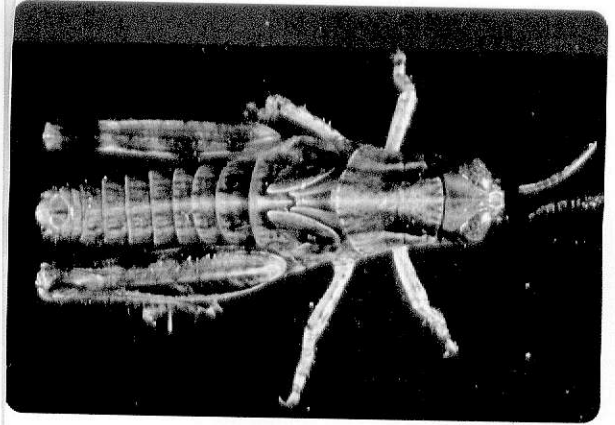
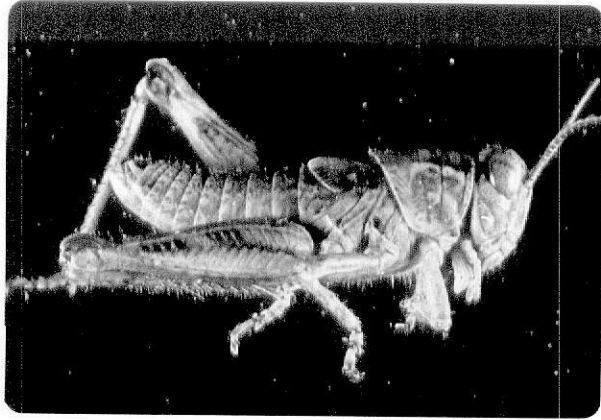
Upper Left lateral view	First Instar p. 165, 166	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 171, 172	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 177, 178	Lower Right dorsal view



Explanation of Plate XXIA

Melanoplus sanguinipes (Fabricius)

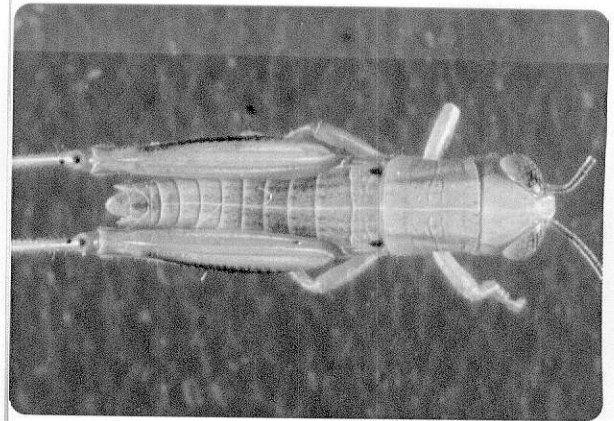
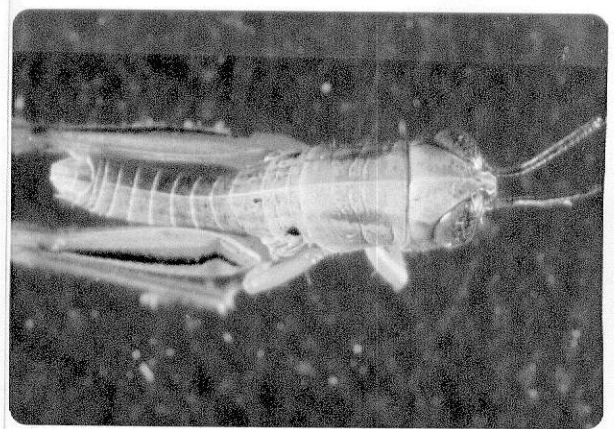
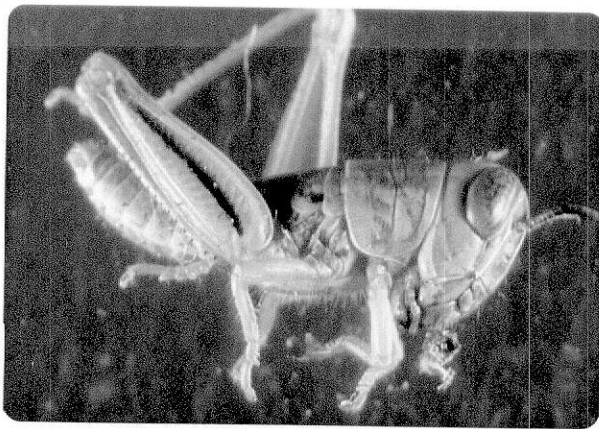
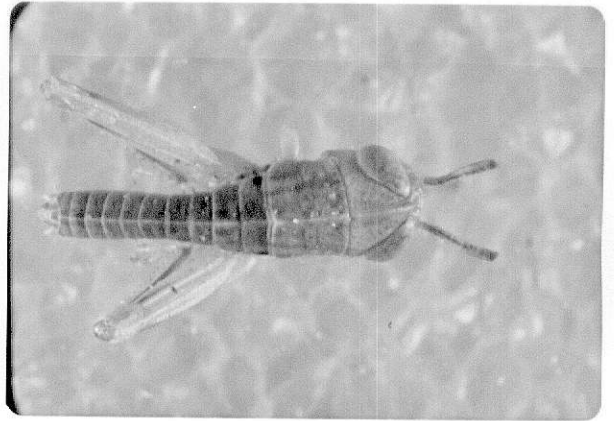
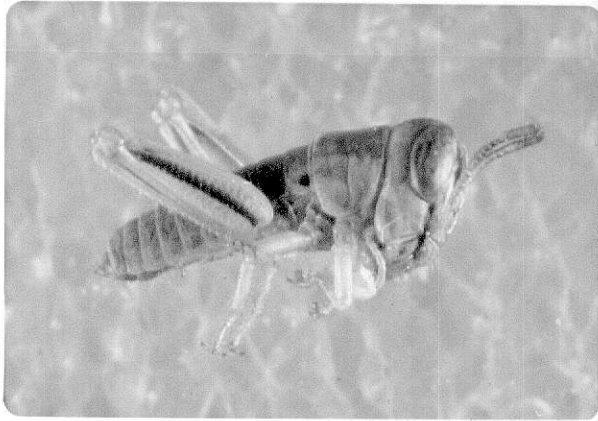
Upper Left lateral view	Fourth Instar p. 183, 184	Upper Right dorsal view
Middle Left lateral view	Fifth Instar p. 189, 190	Middle Right dorsal view
Lower Left lateral view	Adult p. 195, 196	Lower Right dorsal view



Explanation of Plate XXII

Phoetaliotes nebrascensis (Thomas)

Upper Left lateral view	First Instar p. 165, 166	Upper Right dorsal view
Middle Left lateral view	Second Instar p. 171, 172	Middle Right dorsal view
Lower Left lateral view	Third Instar p. 177, 178	Lower Right dorsal view



Explanation of Plate XXIIA

Phoetaliotes nebrascensis (Thomas)

Upper Left
lateral view

Fourth Instar
p. 183, 184

Upper Right
dorsal view

Middle Left
lateral view

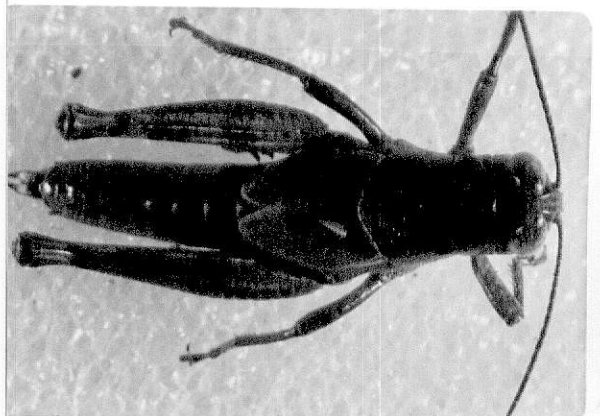
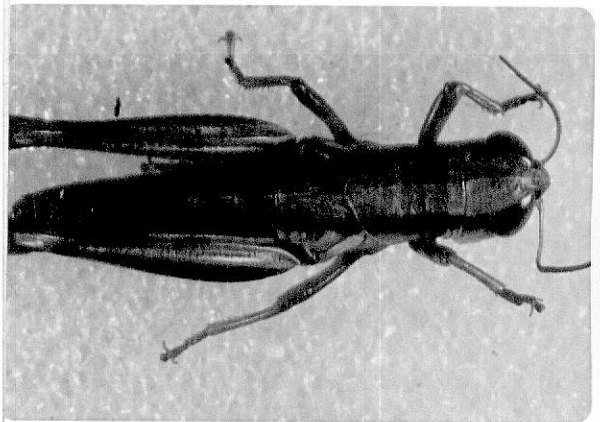
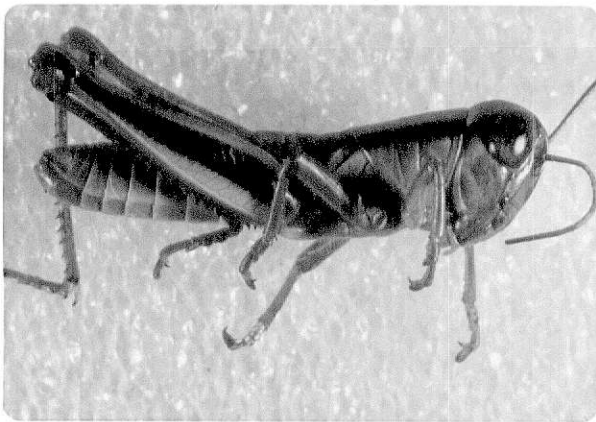
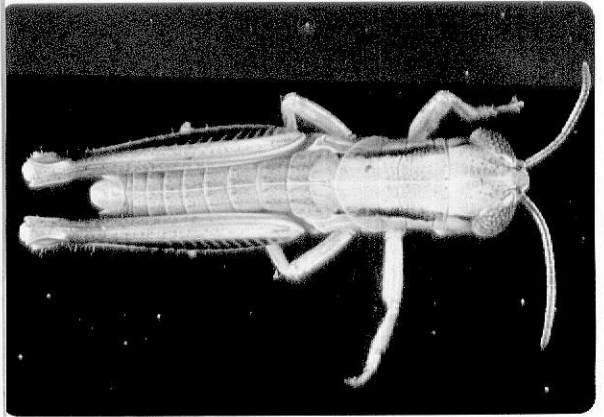
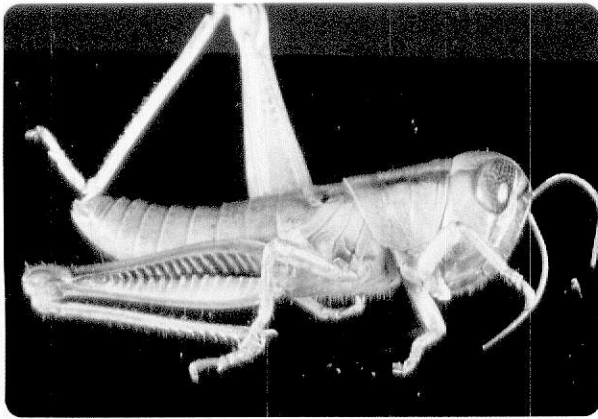
Fifth Instar
p. 189, 190

Middle Right
dorsal view

Lower Left
lateral view

Adult
p. 195, 196

Lower Right
dorsal view



Ageneotettix deorum (Scudder). Plates II, IIA; Table 1. Primary characters: general body color dark to light brown, dorsal area lighter, pale ventrally, adult long winged. "Dirty face", fuscous speckled gena, ashen white antenna, silhouette of head moderately angulate; pronotum with median carina cut by 2 sulci, lateral carina area defined by constriction of anterior third, wider at posterior metanotum than at anterior end of pronotum (in all stages); hind femur with some splotching. Adult with black knee, bright coral hind tibia with basal black band, followed by subbasal white band.

Boopedon auriventris McNeill . Plates III, IIIA; Table 1. Primary characters: general body color grayish brown to black with pale area beneath; adult males black, females brown; mostly short winged. Silhouette of head slightly angulate; lateral lobe with dark triangle bordered by narrow white area anteriorly, broader white area posteriorly, band increases in width, posterior to ventrally in later instars; hind femur, inner and outer face with 3 fuscous splotches in nymphs and adult, in earlier instars splotches on upper flange, lower flange mostly clear. Adult with black knee, hind tibia reddish with broad pale subbasal ring bordered on each side by black.

Eritettix simplex (Scudder). Plates IV, IVA; Table 1. Primary characters: general body color generally yellowish brown to brown sometimes almost velvet; adults

long winged. Flattened, tapered apical antenna that are club shaped in adult; silhouette of head strongly angulate; pronotum, lateral carina distinct and sub-parallel minutely constricted near middle, with supplementary set of lateral carina between lateral and median carina, the black stripe in this location, median carina distinct, cut by sulcus; hind femur, inner and outer face unbanded.

Mermeria bivittatus maculipennis (Bruner). Plates V, VA; Table 1. Jago (1969) separated the Mermeria to species and subspecies; up to this time the Mermeria species have been difficult to separate. I separated the two Mermeria from the 1st instar through adult. Primary characters: general body color green to light brown, marked with speckles; female much larger than male, both nymph and adult with long slender legs. Silhouette of head strongly angulate, ensiform antenna; prozona broader than long, lateral carina absent, median carina cut by sulcus; hind femur and tibia unbanded.

Mermeria picta neomexicana (Thomas). Plates VI, VIA; Table 1. Primary characters: general body color green to light brown marked with speckles; female larger than male; adult and nymph have long slender legs. Silhouette of head strongly angulate, ensiform antenna; prozona longer than broad, lateral carina present, median carina cut by sulcus; hind femur and tibia unbanded.

Orphulella speciosa (Scudder). Plates VII, VIIA;

Table 1. Primary characters: general body color yellowish brown to green, 2 color phases; female larger than male. Silhouette of head strongly angulate, antenna flattened and narrowed apically in early instars; lateral carina distinct and nearly parallel, pronotum shorter and thicker than long.

Syrbula admirabilis (Uhler). Plates VIII, VIIIA;

Table 1. Primary characters: general body color brown to green with pale marking, legs slender; adult tegmen extending to tip of abdomen; male with 3 dark spots basally and lateral pale streak below; female with festuned blotches, first 4 or 5 becoming less dark and larger, 1st 2 or 3 fading into large black veined area; female much larger than male. Flattened, tapered antenna with anterior edge of each segment light colored; silhouette of head strongly angulate; front and middle legs dark colored with a pale longitudinal stripe; lateral carina present, median carina cut by sulcus; hind tibia pale with basal white band.

Arphia spp. Plates IX, IXA; Table 2. Primary characters: general body color generally dark with irregular white areas and dark splotches; adult hind wing light yellow or pale pink. Antenna somewhat flattened and narrowed apically, with diagonal dark stripe through maculated eye, disk of vertex depressed and rugose on head; prozona shorter than metazona,

median carina faintly notched (not as much as Dissosteira carolina); hind femur and tibia usually with dark splotches.

Chortophaga viridifasciata (DeGeer). Plates X, XA; Table 2. Primary characters: general body color wholly green to wholly brown or a mixture of both; adult hind wing is clear to a slight yellow, apically fuscous to pale. Eye light brown with maculated light spots, in earlier instars, later instars have diagonal dark streak with lower half being darker than upper half; antenna somewhat flattened and tapered apically in nymphal stage; median carina raised and arched, cut by sulcus behind middle; hind femur unbanded, except in adult, inner face of hind femur with 3 black splotches.

Dissosteira carolina (Linnaeus). Plates XI, XIA; Table 2. Primary characters: general body color generally light to dark dusty brown to reddish brown in nymph and adult; adult hind wing is black basally and apically white or yellow. Both nymph and adult have a highly arched median carina deeply cut by one sulcus, the arched and raised median carina being more prominent in the later instars and adult.

Hadrotettix trifasciatus (Say). Plates XII, XIIA; Table 2. Primary characters: general body color gray through reddish brown to dark brown in nymph and adult; adult tegmen with 3 broad solid transverse bands with hind wing basally light yellow with apical area clear.

Dark blue splotches on the inner face of hind femur of the later instars through adult; coral orange to red hind tibia with subbasal white band; 1st and 2nd instars have black hind femur and tibia.

Pardalophora haldemanii (Scudder). Plates XIII, XIII A; Table 2. Primary characters: general body color grayish brown; adult tegmen blotched, hind wings disk yellow through pink to light red with broken black band. Pronotum rugose, tuberculate particularly on prozona, a black shining spot on lateral lobe; outer face of hind femur with very little splotching, inner face with 3 dark splotches; hind tibia orange to yellowish red in nymph and adult; nymphal stage, eye of nymph has a dark diagonal streak, upper half lighter than lower half.

Campylacantha olivacea olivacea (Scudder). Plates XIV, XIV A; Table 3. Primary characteristics: olive green varies from yellow to brown; adult usually short winged. Antenna with one prominent dark ring per segment; hind femur unbanded with some splotching and speckling on outer and inner face; splotches and small spots on pronotum and abdomen; head and thorax relatively robust; adult surface of pronotum pilose.

Hesperotettix speciosus (Scudder). Plates XV, XV A; Table 3. Primary characters: generally body light green to green with white maculation; adult wings reaching two-thirds length of abdomen, sometimes to the tip. Antenna alternately white and dark ring; eye

light brown with light maculations from the 1st instar through adult; adult with light pink antenna; pink stripe on median carina; and apical pink band on the hind femur.

Hypochlora alba (Dodge). Plates XVI, XVIIA; Table 3. Primary characters: light bluish green to yellowish green body; adult wings short and more acutely angled at the apex compared to other short-winged species. Very light appearance of antenna as alternating cream and yellowish green rings found in nymph and adult; no other outstanding markings.

Melanoplus bivittatus (Say). Plates XVII, XVIIIA; Table 3. Primary characters: general body color dull light brown, purplish to dark brown in adult, yellow underneath, in many early stages the color may vary from tan to dark green; adult hind wing extends over tip of abdomen. Unbanded eye, light brown with uniform maculation; hind femur with upper half of the chevrons dark sometimes overlapping lower part, times very indistinct, knee dark in adult and 5th instar. Adult with 2 light colored parallel stripes, anterior dorsum of head extending through the tegmen; males separated by shapes of cercus and furcula (Table 3, Adult p.194).

Melanoplus confusus Scudder . Plates XVIII, XVIIIIA; Table 3. Primary characters: general body color dark or reddish brown, dull yellow underneath; adult long winged. Marking of side of head and lateral lobe

similar to M. sanguinipes; eye with dark median diagonal stripe, upper half lighter than lower half; outer face of hind femur with 2 oblique bars on upper half of chervons and upper flange; dark knee (these characters being found in all instars); eye not as distinctly marked in first and adult stage; adult male separated by the shape of cercus and furcula (Table 3, Adult p. 194).

Melanoplus femurrubrumfemurrubrum (DeGeer). Plates XIX, XIXA; Table 3. Primary characters: general body color greenish, grayish to yellowish brown, yellow underneath; adult long winged. White streak extending from area of lateral carina forward, expanding below eye to mandibles, sometimes very indistinct, generally more prominent than with M. sanguinipes; eye marked with numerous irregular white maculations with a weakly indicated transverse dark stripe; outer face of hind femur with upper half of chervons dark, sometimes extending downward beyond upper half (all 5 instars) in adult, shape of sub-gential plate, cercus, and furcula in males separate it from the various Melanoplus (Table 3, Adult p. 194); hind tibia faded red, even pale red.

Melanoplus keeleri luridus (Dodge). Plates XX, XXA; Table 3. Primary characters: general body color usually contrastingly black and gray, yellowish underneath, earlier instars generally a lighter color, even a light green; adult long winged. Dark eye with 2

distinct transverse light stripes; hind femur, upper half of chevrons dark with some overlapping to the lower half, inner face usually splotched; sharp contrast of yellow, green, or white and fuscous to black bordering from the mouthparts to the eye and extending to posterior region of the lateral carina and generally with fading out in the abdominal segments (these characters extend from first instar through adult, being progressively less evident); adult, male mainly separated by the forked cercus (Table 3, Adult p. 196).

Melanoplus sanguinipes (Fabricius). Plates XXI, XXIA; Table 3. Primary characters: general body color grayish brown to reddish brown, nymphal stages color can vary from gray to green; yellowish beneath; adult with wings usually one-third longer than the abdomen, but some short winged forms. Light colored eye with numerous irregularly scattered light maculations with median dark transverse stripe, lower half not darker than upper half; area below lateral carina location generally light, sometimes suggesting stripe extending on forward and below the eye to the mandibles, generally not as prominent as in M. femurrubrumfemurrubrum; hind femur having 2 oblique dark bars on upper half of the chevrons and upper flange (characters carry through from the first instar through adult); adult protuberance on the sternum between the first and second pair of legs (also on fourth and fifth instars); supra-anal plate of

adult male broadly triangular with apex moderately pointed and notched with characteristic shape of cercus and furcula (Table 3, Adult p. 196). Similar to M. confusus but has different habitat and seasonal occurrence (see appendix).

Phoetaliotes nebrascensis (Thomas). Plates XXII, XXIIA; Table 3. Primary characters: general body color grayish brown to reddish brown above, greenish yellow beneath in older specimen; approaching grayish white in smaller nymphs; adult hind wings normally short and overlapping with apical points rounded, often the hind wing extend to tip of abdomen. Disproportionately large head; front margin of pronotum weakly flared to receive the head; hind femur with longitudinal medial fuscous line on outer face; dark spot on hind wing pad in the nymphal stages (characters occur from first instar through adult).

TABLE 1. BLOCK KEY TO INSTARS AND ADULT GOMPHOCERINAE (SLANT-FACED) GRASSHOPPERS
COMMONLY IN NATIVE TALL GRASS PRAIRIE NEAR MANHATTAN, KANSAS

FIRST INSTAR

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	flattened, filiform, light		silhouette moderately angulate side of head darker than top lateral foveolae dis- tinct from above	*area defined by constric- tion at anterior third, wider at posterior metanotum than at anterior end of pronotum	present, uncut by sulci
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	filiform	light brown with light maculation black spot in bottom corner of eye	silhouette slightly angulate	*lateral lobe dark triangle, bordered by narrow white area anterior- ly, broader white area posteriorly	slightly evident, faint sulci
<u>Eritettix</u> <u>simplex</u> Plates IV, IVA	flattened, tapered, apically		silhouette strongly angulate	*median carina slightly raised, lateral carina pre- sent with a set of supple- mentary lateral carina between the lateral & median carina, the dark stripe in this location, this stripe extending forward to vertex of head and posterior through out most of abdomen	

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>A. deorum</u>	apical area pale, predominately spotched	apical area pale some spotching	solid pale, spine black tipped	* generally dark to light brown, dorsal area lighter than side, pale ven- trally
<u>B. auriventris</u>	knee dark, chervon dark, dorsum with three dark bands	three dark bands	tan with two dark bands than match up with the dark spotches on the inner face of femur, spine black tipped	generally dark brown to black with light areas
<u>E. simplex</u>			spine black tipped	generally yellow- ish brown

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Mermeria</u> <u>bivittatus</u> <u>maculipennis</u> Plates V, VA	ensiform		silhouette strongly angulate dorsum length to width of fastigium .66	*absent prozona broader than long	cut by sulcus
<u>Mermeria</u> <u>picta</u> <u>neomexicana</u> Plates VI, VIA	ensiform	diagonal stripping	silhouette strongly angulate dorsum length to width of fastigium .9	*present prozona longer than broad	cut by sulcus
<u>Orphulella</u> <u>speciosa</u> Plates VII, VIIA	flattened and narrow apically	brown with lighter spots	silhouette strongly angulate	*present nearly parallel, strip on the lateral carina extending & continues posteriorly as a white strip throughout the length of abdomen	usually complete
<u>Syrbula</u> <u>admirabilis</u> Plates VIII, VIIIA	flattened, expanded apically	light brown	silhouette strongly angulate dorsum with median carina	present nearly parallel	present

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. bivittatus</u> <u>maculipennis</u>	speckled	speckled		generally light green to light brown, speckled
<u>M. picta</u> <u>neomexicana</u>	speckled	speckled		generally light green to light brown, speckled
<u>O. speciosa</u>	solid tan color light green at base of femur	solid tan color	solid tan color	generally green to dark green with lighter area
<u>S. admirabilis</u>	*front & middle legs dark colored, with pale longitudinal strips		spine black tipped	generally green to tan generally unmarked except as noted

TABLE 1. (Continued)

SECOND INSTAR					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	flattened, filiform light cream color	mottled, upper third lighter color dorsum of head, lower two-third darker like gena	silhouette moderately angulate side of head dark- er than top lateral foveolae dis- tinct from above	*absent area defined by constriction at anterior third, slightly broader, wider at posterior metanotum than at anterior end of prono- tum	slightly raised, sometimes no pos- terior metanotum, uncut by any of sulci
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	flattened toward apex	light brown & light mottling black spot in bottom corner of eye	silhouette slightly angulate	*absent lateral lobe dark triangle bordered by narrow white area anteriorly broader white area posterior- ly, posterior band increases in width, pos- terior to ven- trally	slightly evident, faint sulci

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>A. deorum</u>	apical area pale, pre- dominately spotched	apical are pale, spotching	solid pale, spine black tipped	generally dark to light brown, dorsal area lighter than side, pale ven- trally
<u>B. auriventris</u>	chervons mostly fuscous less so toward apex, upper flange spotched and speckled, lower flange with one or two faint spotches	three dark spotches	two fuscous bands, one subbasally & subapically, spine black tipped	generally dark brown to black with pale yellow areas

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Eritettix simplex</u> <u>Plates IV, IVA</u>	flattened & narrowed apically	light color mottled	silhouette strongly angulate	*median carina slightly raised, lateral carina present with a set of supplementary lateral carina between the lateral & median carina, the dark stripe is in this location, this stripe extending forward to vertex of head & posterior throughout most of the abdomen	
<u>Mermeria bivittatus</u> <u>maculipennis</u> <u>Plates V, VA</u>	ensiform		silhouette strongly angulate dorsum length to width of fastigium .66	*absent prozona broader than long	cut by sulcus
<u>Mermeria picta</u> <u>neomexicana</u> <u>Plates VI, VIA</u>	ensiform	diagonal striping	silhouette strongly angulate dorsum length to width of fastigium .9	*present prozona longer than broad	cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>E. simplex</u>	some dark speckles	some dark speckles	spine black tipped	generally light brown to buff color
<u>M. bivittatus</u> <u>maculipennis</u>	some speckling	some speckling		generally green to brown with some speckling
<u>M. picta</u> <u>neomexicana</u>	some light speckling	some light speckling		generally green to brown some some light brown speckling

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Orphullela</u> <u>speciosa</u> Plates VII, VIA	flattened, narrowed apically	light color mottled	silhouette strongly angulate	*present nearly parallel stripe on the lateral carina exten- ding & continues posteriorly as a white stripe throughout the length of abdomen	cut by sulcus
<u>Syrbula</u> <u>admirabilis</u> Plates VII, VIA	ensiformed, slightly mottled	light color	silhouette strongly angulate	present sub- parallel	weakly cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>O. speciosa</u>	solid light tan	solid light tan	spine black tipped	generally light green
<u>S. admirabilis</u>	*legs dark colored with pale longitudinal stripes			generally light green to tan, usually unmarked with speckles or splotches

TABLE 1. (Continued)

THIRD INSTAR

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	flattened, filiform light cream color	mottled, upper half lighter color than lower half	silhouette moderately angulate, side of head darker than top lateral foveolae dis- tinct from above	*absent area defined by constriction at anterior third, wider at posterior metanotum than at anterior end of pronotum	slightly raised, one of sulci cut through
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	filiform	dark brown, mottled with black spot in bottom corner of the eye	silhouette slightly angulate	*absent lateral lobe dark tri- angle bordered by narrow white area anteriorly, broader white area posteriorly, posterior band increases in width, posterior to ventrally	slightly evident, faint sulci

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>A. deorum</u>	spotched and spotted, area below chervons pale	irregular spotches	spine black	generally dark to light brown, dorsal area lighter than side, pale ven- trally
<u>B. auriventris</u>	chervons mostly fuscous less so toward apex, upper flange spotched and speckled, lower flange with one or two faint spotches	spotches pre- sent	two fuscous bands, one subbasally & subapically, spine black	generally dark brown to black with whitish areas

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Eritettix simplex</u> Plates IV, IVA	flattened & narrowed apically	light tan & mottled	silhouette strongly angulate	*median carina slightly raised, lateral carina present with a set of supplementary lateral carina between the lateral and median carina, the dark stripe is in this location, this stripe extending forward to vertex of head and posterior throughout most of the abdomen	
<u>Mermeria bivittatus maculipennis</u> Plates V, VA	ensiform		silhouette strongly angulate dorsum length to width of fastigium .66	*absent prozona broader than long	cut by sulcus
<u>Mermeria picta neomexicana</u> Plates VI, VIA	ensiform	diagonal striping	silhouette strongly angulate dorsum length to width of fastigium .9	*present prozona longer than broad	cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>E. simplex</u>	upper & lower flange with some splotching	some dark gray speckling	spine black tipped	generally tan to gray some speckling, sometimes almost velvety in appearance
<u>M. bivittatus</u> <u>maculipennis</u>	speckled with light spots	speckled with some light spots		generally green to brown
<u>M. picta</u> <u>neomexicana</u>	green to brown solid some speckling	green to brown solid some speckling		generally green to brown some speckling

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Orphulella speciosa</u> Plates VII, VIIA	flattened, tapered apically	light brown, mottled	silhouette strongly angulate	*present, nearly parallel	cut by sulcus
<u>Syrbula admirabilis</u> Plates VIII, VIIIA	ensiformed, slightly mottled		silhouette strongly angulate	present, sub-parallel	weakly cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>O. speciosa</u>	solid light brown speckled upper & lower of chervon darker	solid light brown speckled	black spine tipped	generally green to brown, speckled
<u>S. admirabilis</u>	*front and middle legs dark colored with buff longitudinal stripes, subapical light area fading rapidly to absent on both femur & tibia, spine black tipped			generally brown or green or both, tan on top

TABLE 1. (Continued)

FOURTH INSTAR					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	filiform, ashen white darker than adults	upper half lighter than lower half	silhouette moderately angulate side of head gen- erally darker than top lateral foveolae dis- tinct from above	* absent area defined by constriction at anterior third, wider at posterior metanotum than at anterior end of pronotum	one of the sulci cut through median carina, behind middle, slightly raised sometimes not reach- ing pos- terior metanotum
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	apically area dark colored, filiform	light mottled	silhouette slightly angulate	* irregular and fades as in adult lateral lobe dark tri- angle bordered by narrow white area anteriorly, broader white area posteriorly, posterior band increases in width, posterior to ventrally	very faint sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia	General Body
	Outer	Inner	Spine	Color
<u>A. deorum</u>	spotted and spotted, area below chervons pale	irregular splotches	same as 5th stage not as fuscous	generally dor- sal area some- what lighter than sides, dark to light brown, pale ventrally
<u>B. auriventris</u>	upper part of chervons mostly dark going over lower part of chervons, lower flange mostly clear	knee dark, 2 distinct black splotches	2 fuscous bands, one subbasally & subapically, spine black	generally black to brown with whitish under- neath

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Eritettix simplex</u> Plates IV, IVA	flattened & narrowed apically	mottled, several diagonal parallel stripes	silhouette strongly angulate	*median carina slightly raised, lateral carina and supplementary set of lateral carina, between the lateral & median carina, is a dark stripe & minutely constricted near middle, this stripe extending forward to vertex of head & posterior through out most of abdomen	
<u>Mermeria bivittatus maculipennis</u> Plates V, VA	ensiform		silhouette strongly angulate dorsum length to width of fastigium .66	*absent, prozona cut by broad as long sulcus	
<u>Mermeria picta neomexicana</u> Plates VI, VIA	ensiform	appears to have diagonal striping	silhouette strongly angulate dorsum length to width of fastigium .9	*present prozona longer than broad	cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>E. simplex</u>	some speckling & splotching on upper part of chervons	some speckling & splotching	gray color with some speckling, spine black tipped	generally tan to gray color
<u>M. bivittatus</u> <u>maculipennis</u>	solid color, buff speckled	solid some buff speckling	tan to buff, spine black tipped	generally green to brown
<u>M. picta</u> <u>neomexicana</u>	solid color some buff specklin	solid color some buff speckling	tan to buff, spine black tipped	generally green to brown

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Orphulella speciosa</u> Plates VII, VIIA	flattened		silhouette strongly angulate	*present nearly parallel, slightly diverges through metazona	cut by sulcus
<u>Syrbula admirabilis</u> Plates VIII, VIIIA	ensiformed, slightly mottled		silhouette strongly angulate	present, sub-parallel	weakly cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>O. speciosa</u>	knee green, light buff to tan color speckled	knee green, light buff color with a line of speckles	buff color, spine black tipped	generally green to brown
<u>S. admirabilis</u>	*front & middle legs dark colored, with pale longitudinal stripes, subapical light area fading, present on both inner & outer face of hind femur & tibia, spine black tipped			generally green to brown on side, tan on top

TABLE 1. (Continued)

FIFTH INSTAR				
	Antenna	Eye	Head	Pronotum Lateral Carina Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	filiform, ashen white, darker than the adult	upper half cream color, lower half darker	silhouette moderately angulate generally light brown & speckled lateral foveolae dis- tinct from above	*almost absent area defined by strong con- striction slightly anterior to middle distinct, cut by one trans- verse sulcus behind the middle
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	filiform	dark mottled	silhouette slightly angulate	*irregular & fades as in adult lateral lobe dark triangle bor- dered by narrow white area anterior- ly, broader white area posteriorly, posterior band increases in width, posterior to ventrally present weakly cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>A. deorum</u>	knee black, chervon area a little spotted, dorsum generally with a few dark spotches, ven- ter unmarked	knee black, spotted	subbasal white band, spine black	generally dark brown to a light brown, light colored underneath
<u>B. auriventris</u>	3 faint dark bands on upper half of cher- vons	3 dark bands	light brown to reddish orange, a faint band in the middle, spine black tipped	generally black to brown with whitish under- neath

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Eritettix simplex</u> Plates IV, IVA	flattened to side, narrowed in middle, expanded on apical third		silhouette strongly angulate		*median carina slightly raised, lateral carina & supplementary set of lateral carina, between the lateral & median carina, is a dark stripe & minutely constricted near middle, this stripe extending forward to vertex of head and posterior throughout most of abdomen faintly cut by posterior sulcus
<u>Mermeria bivittatus</u> <u>maculipennis</u> Plates V, VA	ensiform		silhouette strongly angulate dorsum length to width of fastigium .66	*absent prozona broad as long	cut by sulcus
<u>Mermeria picta</u> <u>neomexicana</u> Plates VI, VIA	ensiform	appears to have diagonal striping	silhouette strongly angulate dorsum length to width of fastigium .9	*present prozona longer than broad	cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>E. simplex</u>	speckled and spotted	speckled and spotted	buff, strongly speckled with brown, spine black tipped	generally light brown to light green
<u>M. bivittatus</u> <u>maculipennis</u>	speckled with brown	speckled with brown		generally green to brown
<u>M. picta</u> <u>neomexicana</u>	speckled with brown	speckled with brown		generally green to brown

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Orphulella speciosa</u> Plates VII, VIIA	filiform		silhouette strongly angulate	*weak nearly parallel to moderately incurved	weak, cut by one posterior sulcus
<u>Syrbula admirabilis</u> Plates VIII, VIIIA	ensiformed, slightly mottled		silhouette strongly angulate	present, sub-parallel, slightly diverges through meta-zona	cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>O. speciosa</u>	generally light with some spots and spots	generally light some splotches and spots	spine black tipped	generally green to dark brown, yellowish brown, heavily speckled
<u>S. admirabilis</u>	*front & middle legs dark colored, with pale longitudinal stripes, subapical pale area on both femur & tibia with some splotching present, spine black tipped			generally green to brown with tan on top

TABLE 1. (Continued)

ADULT				
	Antenna	Eye	Head	Pronotum Lateral Carina Median Carina
<u>Ageneotettix</u> <u>deorum</u> Plates II, IIA	filiform, ashen white to pale yellowish		silhouette moderately angulate lateral foveolae dis- tinct from above	* almost absent area defined by strong con- striction slightly anter- ior to middle distinct, cut by one trans- verse sulcus behind the middle
<u>Boopedon</u> <u>auriventris</u> Plates III, IIIA	filiform, light colored basically, fades rapidly		silhouette slightly angulate	* visible, slight ridge fading toward pos- terior portion on metanotum lateral lobe dark triangle bordered by narrow white area anteriorly, broader white area posteriorly, posterior band increases in width, posterior to ventrally entire, distinct only one transverse sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
(A. <u>deorum</u>) grayish brown or brown, marked with dark spots, long winged	knee black with irregular dark splotches and spots	knee black with irregular dark splotches and spots	broad black band, followed by (apical) light band, remaining coral with black spine	generally dull brown to black, pale beneath, medial stripe to no stripe down dorsum
(B. <u>auriventris</u>) wings short to medium length, usually short winged	knee black, 2 faint splotches present on chervons, upper flange with 2 spots lower flange clear	2 distinct dark dark splotches	reddish color with broad pale subbasal ring border on each side by black, spine black tipped	generally gray brown to black, pale under- neath

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Eritettix simplex</u> Plates IV, IVA	flattened, expanded apically		silhouette strongly angulate, lateral foveolae present, not seen from above	*distinct prozona about twice the length of metazona, slightly in-curved	distinct
<u>Mermeria bivittatus maculipennis</u> Plates V, VA	ensiform		silhouette strongly angulate, dorsum length to width of fastigium .66	*absent, prozona broad as long	distinct
<u>Mermeria picta neomexicana</u> Plates VI, VIA	ensiform	appears to have diagonal striping	silhouette strongly angulate, dorsum length to width of fastigium .9	*present, prozona longer than broad	distinct

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
(<u>E. simplex</u>) hind wings clear, tegmen appears streaked, long winged	knee dark brown to buff, upper half of chevrons dark	knee dark brown to buff, rest darker	buff color, spine black tipped	generally yellowish brown to brown
(<u>M. bivittatus</u> <u>maculipennis</u>) light brown, dark apically with a narrow pale sub- costal stripe in basal third, long winged	knee black	knee black	red to reddish spine black tipped	generally green to light brown, speckled
(<u>M. picta</u> <u>neomexicana</u>) long winged			buff to orange, spine black tipped	generally green to light brown, speckled

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Orphulella speciosa</u> Plates VII, VIIA	filiform, longer than head and pronotum		silhouette strongly angulate, lateral foveolae present, not seen from above	weak, definitely incurved on the pronotum	weak, cut by one posterior sulcus
<u>Syrbula admirabilis</u> Plates VIII, VIIIA male	filiform, slightly expanded at apex and darker		silhouette strongly angulate, side of head with dark and white alternating bands	present, slightly incurved medially nearly parallel anteriorly, ventral border of pronotum white fading out dorsally along anterior margin, meta-notum wrinkled	present, cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
(<u>O. speciosa</u>) tegmen tan to green, upper portion gener- ally with some splotches, lower half of tegmen more often green than upper half, border between upper & lower half of tegmen with strong vein(s) black	generally with some splotches and spots	generally with some splotches and spots	spine black tipped	generally yellowish brown to light green
(<u>S. admirabilis</u>) (male) tegmen 3 dark spots basally and lateral pale streak below	*front & middle legs dark colored, with pale longitudinal stripes, subapical area pale on both femur & tibia with some splotching pre- sent, spine black tipped			generally male dark brown and white marked

TABLE 1. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
female	filiform slightly expanded at apex and darker		silhouette strongly angulate, side of head with dark & white alternating bands	present, more incurved than in male, metanotum wrinkled, a similar white border but remainder of pronotum body ground color, black parallel band medial to lateral carina, narrowing anteriorly to vertex of head	present, cut by sulcus

TABLE 1. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
(female) tegmen with festuned blotches first 4 or 5 becoming less dark & larger, last 2 or 3 fading into large black veined areas	same except, upper portion of outer face splotched, inner face scattered black spots		pale except venter with black splotches, marking spine black tipped	generally green with white marking

TABLE 2. BLOCK KEY TO INSTARS AND ADULT OEDIPIDINAE (BAND WINGS) GRASSHOPPERS
COMMONLY IN NATIVE TALL GRASS PRAIRIE NEAR MANHATTAN, KANSAS

FIRST INSTAR

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Arphia</u> spp. Plates IX, IXA	somewhat flattened and narrowed apically	diagonal stripe through maculated	disk of vertex depressed and rugose	prozona short- er than meta- zona, absent	faintly notched, not as notched as D. <u>carolina</u>
<u>Chortophaga</u> <u>viridifasciata</u> Plates X, XA	slightly flattened	light brown with matu- lated light spots	*disk of vertex with depression, head blunt and rounded		sulcus absent, but location still seen
<u>Dissosteira</u> <u>carolina</u> Plates XI, XIA	filiform	light brown	vertex shallow not bounded by ridge on top or bottom	prozona 40-60 as long as metazona, absent	*high median carina, meta- zona cut behind center
<u>Hadrotettix</u> <u>trifasciatus</u> Plates XII, XIIA	filiform but clubed	light brown	no depressed vertex	absent	developed very little, cut by sulcus
<u>Pardalophora</u> <u>haldemani</u> Plates XIII, XIIIA	slightly flattened	*dark dia- gonal streak upper half light mottled brown, lower half darker brown	head bluntly rounded and smooth		

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>Arphia spp.</u>				*generally dark with irregular white areas and dark splotches
<u>C. viridifasciata</u>			pale to light green, spine black tipped	light brown with light green legs
<u>D. carolina</u>		knee black with 2 dark splotches	black with basal pale band, spine black tipped	dusty brown, reddish brown to mottled
<u>H. trifasciatus</u>	*black, basal third light brown	black, basal third light brown	solid black, spine black	light brown with black
<u>P. haldemani</u>		3 black splotches of variable width	dark color with basal pale band, spine black tipped	grayish brown to buff

TABLE 2. (Continued)

SECOND INSTAR

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Arphia</u> spp. <u>Plates IX, IXA</u>	somewhat flattened and narrowed apically	diagonal stripe through maculated eye	disk of vertex strongly depressed and rugose, median carina broken in center between the top of vertex and fastigium	absent, prozona shorter than metazona	faintly notched, not as notched as D. <u>carolina</u>
<u>Chortophaga viridifasciata</u> <u>Plates X, XA</u>	slightly flattened less toward apex	dark brown with maculated light spots	disk of vertex with a deep depression	prozona longer than metazona	*sulcus absent, but location still seen, lateral view, median carina somewhat arched
<u>Dissosteira carolina</u> <u>Plates XI, XIA</u>	filiform body color	light color	vertex shallow not bounded by ridge on top or bottom	absent, prozona 40-60 as long as metazona	*high, acutely arched on metazona, cut deeply and distinctly ahead of center

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>Arphia</u> spp.				*generally dark with irregular white areas and dark splotches
<u>C. viridifasciata</u>			dark splotched with subbasal light band, spine black tipped	generally green to brown or a mixture of both
<u>D. carolina</u>	some speckling	knee black with two distinct black splotches	black with basal light band, spine black	generally dusty brown reddish brown to mottled

TABLE 2. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Hadrotettix</u> <u>trifasciatus</u> Plates XII, XIIA	filiform	solid color	no depressed vertex	absent, dorsum smooth or very fine rugose, meta-zona appearing reticulose	developed very little cut by sulci
<u>Pardalophora</u> <u>haldemani</u> Plates XIII, XIIIA	slightly flattened yellowish	*upper half maculated brown, lower half darker brown	vertex with sinus on both sides of median carina evident, not extending to fastigium, head bluntly rounded and smooth		sulcus cut one third of distance from anterior margin

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>H. trifasciatus</u>	*black with sub- apical light ring & part of a light ring in the middle	black with subapical ring	black subbasally narrow pale band, spine black	generally gray- ish to light brown
<u>P. haldemanii</u>		3 black splotches of variable width	orange to yellow- ish red, spine black tipped	generally grayish brown to buff

TABLE 2. (Continued)

THIRD INSTAR				
	Antenna	Eye	Head	Pronotum
				Lateral Carina Median Carina
Arphia spp. Plates IX, IXA	flattened & narrowed apically	diagonal stripe through maculated eye	disk of vertex strongly depressed and rugose	absent, prozona shorter than metazona *faintly notched, not as notched as <u>D. carolina</u>
Chortophaga viridifasciata Plates X, XA	slightly flattened narrowed less apically	upper half maculated lighter, lower half darker	disk of vertex with a deep depression	prozona longer than metazona *faintly notched behind middle, lateral view median carina highly arched
Dissosteira carolina Plates XI, XIA	filiform	light color & mottled	vertex shallow not bounded by ridge on top or bottom	absent, prozona 40-60 as long as metazona *high, acutely arched on metazona, cut deeply ahead of center
Hadrotettix trifasciatus Plates XII, XIIA	filiform long and heavy, dark	solid color	no depressed vertex	absent, dorsum smooth or very faintly rugose, hind margin of pronotum a little acute, metazona appearing reticulate

TABLE 2. (Continued)

	Hind Femur		Hind Tibia	General Body
	Outer	Inner	Spine	Color
<u>Arphia</u> spp.			spine black tipped	generally dark with irregular white areas & dark splotches
<u>C. viridifasciata</u>			spine black tipped	generally green to brown or a mixture of both
<u>D. carolina</u>	brownish with black speckles, more speckles posterior	knee dark, speckled with with 2 dis- tinct black splotches	black with sub- basal narrow black band & subapical broad black band, spine hardly tipped black, terminal seg. of tarus dark	generally light to dark dusty brown, reddish brown, uniform brown in color
<u>H. trifasciatus</u>	knee dark, sub- apical pale band, middle diagonal dark band, rest light brown	*knee dark, subapical pale to white band, rest deep blue	coral orange to red, spine uni- formly dark tipped, termi- nal tarus dark	generally grayish to light brown, with black splotches

TABLE 2. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
Pardalophora haldemani Plates XIII, XIIIA	slightly flattened yellowish color	upper half light macu- lated brown, lower half darker brown	vertex with sinus on both sides of median carina, being evident not extending to fastigium, head bluntly rounded and smooth	*forming irregular ridge often not meeting at junction of pro- & metazona, pro- notum rugose & tuberculate on prozona, not on meta- zona, black shining spot on lateral lobe	sulcus cut one third of distance from anterior mar- gin, ridge of median carina not blade like but slightly grooved

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>P. haldemaniai</u>	buff color often 3 black with a faint to splotches of heavy black spot variable on the anterior width lower third of the chervons		orange to yellow- ish red, spine black tipped	generally gray- ish brown to buff

TABLE 2. (Continued)

FOURTH INSTAR					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Arphia</u> spp. <u>Plates IX,</u> <u>IXA</u>	somewhat flattened & narrowed apically	diagonal stripe through maculated eye	disk of vertex strongly depressed, median carina broken in center between the top of vertex & fastigium	absent, prozona shorter than metazona	*low, faintly notched, not as notched as D. <u>carolina</u>
<u>Chortophaga</u> <u>viridifasciata</u> <u>Plates X, XA</u>	slightly flattened & less narrowed apically	maculated, upper half lighter than the lower half	disk of vertex with a deep depression	slightly evident on anterior half of prozona, prozona longer than metazona	*faintly notched behind middle, median carina moderately raised, lateral view shows highly arched
<u>Dissosteira</u> <u>carolina</u> <u>Plates XI,</u> <u>XIA</u>	filiform	light color	vertex sloping downward anterior, median carina low almost not present	absent, prozona 40-60 as long as metazona	*high, acutely arched on metazona cut deeply and distinctly ahead of center

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>Arphia spp.</u>			spine black tipped	generally dark with irregular white areas and dark splotches
<u>C. viridifasciata</u>			spine black tipped	generally green, brown or a mixture of both
<u>D. carolina</u>		2 indistinct dark splotches	spine black tipped	generally light to dark dusty brown to reddish brown, uniform in color

TABLE 2. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
Hadrotettix trifasciatus Plates XII, XIIA	filiform long and black in color	solid color	no depressed vertex	absent, dor- sum smooth or very finely rugose, hind margin of pronotum a little acute metazona appearing reticulate	developed very little, cut by sulci
Pardalophora haldemani Plates XIII, XIIIA	slightly flattened yellowish color	upper half light macu- lated brown, lower half darker brown	vertex with small sinus on both sides, of median carina, evi- dent not extending to fastigium, head bluntly rounded and smooth	*forming irre- gular ridge often not meeting at junction of pro- & meta- zona, pronotum rugose tuber- culate, parti- cularly on prozona but present on metazona, black shining spot on lateral lobe	sulcus cut one third of distance from ant- erior margin, ridge of median carina not blade like, but slightly grooved

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>H. trifasciatus</u>	knee dark, sub- apical pale band, middle diagonal dark band, rest pale color	*knee dark blue, sub- apical pale band, rest deep blue	coral orange to red, spine black tipped	generally gray- ish to cream color
<u>P. haldemanii</u>	buff color often with a faint to heavy black spot on the anterior lower third of the cher- vons	three black splotches of variable width	orange to yellowish red, spine black tipped	generally gray- ish brown to buff

TABLE 2. (Continued)

FIFTH INSTAR				
	Antenna	Eye	Head	Pronotum
				Lateral Carina
				Median Carina
<u>Arphia</u> spp. <u>Plates IX, IXA</u>	somewhat flattened and narrowed apically	upper half somewhat lighter than lower half darker	disk of vertex strongly depressed and rugose, median broken in center between the top of vertex & fastigium	absent, prozona shorter than metazona
				*low, faintly notched, not as notched as D. <u>carolina</u>
<u>Chortophaga</u> <u>viridifasciata</u> <u>Plates X, XA</u>	somewhat flattened narrowed apically	upper half maculated brown lower half darker maculated brown	disk of vertex with a deep depression	prozona longer than metazona
				*faintly notched behind middle, median carina moderately raised, lateral view, highly arched
<u>Dissosteira</u> <u>carolina</u> <u>Plates XI, XIA</u>	filiform	light color	vertex sloping downward anteriorly, median carina low almost not	absent, prozona 40-60 as long as metazona
				*high, acutely arched on metazona, cut deeply and distinctly ahead of center

TABLE 2. (Continued)

	Hind Femur		Hind Tibia	General Body
	Outer	Inner	Spine	Color
<u>Arphia</u> spp.			spine black tipped	generally dark with irregular white areas and dark splotches
<u>C. viridifasciata</u>			spine black tipped	generally wholly green, wholly brown or a mix- ture of both
<u>D. carolina</u>	two narrow black splotches on upper flange speckled	knee black, light brown with two black splotches	subbasal black band, basal pale color, spine black tipped	generally light to dark dusty brown to reddish brown, uniform in color

TABLE 2. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Hadrotettix trifasciatus</u> Plates XII, XIIA	filiform long and heavy black in color	solid color	no depressed vertex	absent, dorsum smooth or very finely rugose, hind margin at pronotum somewhat acute, metazona appearing reticulate	very little developed cut by sulci
<u>Pardalophora haldemani</u> Plates XIII, XIIIA	slightly flattened, basal third light orange, rest dark color	upper half lighter, lower half darker color	vertex with small sinus on both sides of median carina, evident, not extending to fastigium, head bluntly rounded and smooth	*forming irregular ridge often not meeting at junction of pro- & metazona, pronotum rugose tuberculate, particularly on prozona but present on metazona, black shining spot on lateral lobe	sulcus cut one third of distance from anterior margin, ridge of median carina not blade like, but slightly grooved

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>H. trifasciatus</u>	knee dark, light apical band, middle diagonal black band fades basally, rest spotted	*knee deep blue, light apical band, rest deep blue	coral orange to red, spine black tipped	generally gray through reddish brown to dark brown
<u>P. haldemani</u>		three black spotches of variable width	yellowish, spine black tipped	generally grayish brown

TABLE 2. (Continued)

ADULT					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
Arphia spp. Plates IX, IXA	somewhat flattened	maculated	disk of vertex not strongly depressed and rugose, median carina broken in center between the top of vertex and fastigium	absent, prozona shorter than metazona	*low, faintly notched, not as notched as D. <u>carolina</u>
Chortophaga viridifasciata Plates X, XA	almost filiform	upper half light colored, lower half darker	disk of vertex with a deep depression, median carina present broken in center	faint or absent, prozona longer than metazona	*one sulcus faintly notched ahead of center
Dissosteira carolina Plates XI, XIA	filiform	light maculation	vertex sloping downward anteriorly, median carina low almost not noticeable	absent, prozona 40-60 as long as metazona	*high, acutely arched on metazona, cut deeply and distinctly ahead of center

TABLE 2. (Continued)

	Hind Femur	Hind Tibia	General Body Color
	Outer	Spine	
(<u>Arphia</u> spp.) hind wing light yellow or pink		spine black tipped	generally dark with irregular white areas & dark splotched
(<u>C. viridifasciata</u>) tegmina not banded, hind wing, basal part clear to slight yellow apically fuscous to pale		brown to pale, whitish subbasal band, spine tipped	generally green, brown or a mix- ture of both
(<u>D. carolina</u>) tegmina pale not banded hind wing, basal black, apically clear	speckled and some small splotching	basal black band, subbasal pale band, spine black tipped	generally light to dark dusty brown to reddish brown, uniform in color

TABLE 2. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Hadrotettix trifasciatus</u> Plates XII, XIIA	filiform long and heavy black in color	solid color	no depressed vertex	absent, dorsum smooth or finely rugose, hind margin of pronotum somewhat acute, metazona appearing reticulose	very little developed, cut by sulci
<u>Pardalophora haldemani</u> Plates XIII,	filiform slender	upper half light color, lower half darker	vertex with small sinus on both sides of median carina, evident, not extending to fastigium	*present on metazona, still rugose on prozona, very tuberculate along anterior margin, lateral lobe, large dark shining spot, distinctly more rugose on prozona than metazona	sulcus cut one third of distance from anterior margin; median carina grooved ridge disappeared except extreme anterior portion of metazona

TABLE 2. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
(<u>H. trifasciatus</u>) <u>tegmina</u> 3 broad solid transverse bands, hind wing basal light yellow apical clear	knee dark, light subapical band, middle diagonal black band fades basally, basal two-thirds buff	*knee dark blue with light colored apical band	coral orange to subbasal white band, spine black tipped	generally gray through reddish brown to dark brown
(<u>P. haldemanii</u>) <u>tegmina</u> blotched hind wing disk yellow through red has broken black band	3 indistinct dark splotches on chevrons	3 black splotches of variable width	buff, sometimes pale to red, spine black	generally gray- ish brown

TABLE 3. BLOCK KEY TO COMMON INSTARS AND ADULT CATANTOPHINAE (SPINE-BREASTED) GRASSHOPPERS OF NATIVE TALL GRASS PRAIRIE NEAR MANHATTAN, KANSAS

FIRST INSTAR				
	Antenna	Eye	Head	Pronotum Lateral Carina Median Carina
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	prominent dark ring per segment	dark with light maculations		entire and present
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	segments alternating white and dark rings	light brown with light maculations		faint
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	light appearance as alternating cream and yellowish green rings	light brown with sub-uniformly white maculations		entire
<u>Melanoplus</u> <u>bivittatus</u> Plates XVII, XVIIA	segments fuscous	*light brown with uniform maculations	two dark, broad bands in region of lateral carina	entire and raised

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>C. olivacea</u> <u>olivacea</u>			spine black tipped	*generally olive, varies to light brown, pronotum & abdomen with small spots to splotches
<u>H. speciosus</u>				*green with white spots on posterior edge of each seg- ment
<u>H. alba</u>	flected with light brown splotches	flecked with a few light brown splotches	pale-bluish green	*light bluish green to yellowish-green
<u>M. bivittatus</u>	upper half of chervons dark	upper third dark splotch- ed, some- times indis- tinct	spine black	green, tan, to light brown

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus confusus</u> Plates XVIII, XVIIIA		*dark stripe through eye with numerous irregularly scattered white maculations, darker color below stripe than above	side of head and lateral lobe very similar to <u>M. sanguinipes</u>		entire, distinct
<u>Melanoplus femurrubrum</u> <u>femurrubrum</u> Plates IX, IXA		numerous irregular white maculations, transverse dark stripe weakly indicated	*white streak extending from area of lateral carina forward, expanding below eye to mandibles, sometimes very indistinct; generally more prominent than in <u>M. sanguinipes</u>		entire, faint
<u>Melanoplus keeleri</u> <u>luridus</u> Plates XX, XXA	fuscous, apical segments flattened	*dark with 2 distinct transverse, light stripes	light stripe extending posterior from portion of area of lateral carina curving down & upon contact with eye, fading out near mouthpart region, also some stripe extending downward entire length of metanotum		distinctly raised

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. confusus</u>	knee black, 2 dark oblique bars on upper half of chervons; upper flange with 3 dark spotches	knee black, 2 dark spotches	spine black tipped	buff to light brown
<u>M. femurrubrum</u> <u>femurrubrum</u>	upper half of chervons dark sometimes ex- tending over half	upper third dark spotched	spine black tipped	light yellow to pale cream
<u>M. keeleri</u> <u>luridus</u>	prominent dark longitudinal band on upper half of chervons with less on basal portion of chervons	some spotching	pale with sub-basal dark ring, spine dark tipped	contrastingly black and gray

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus sanguinipes</u> <u>Plates XXI, XXIA</u>	appearing as alternating broad fuscous and thin white rings	*numerous irregular scattered light maculations, median dark stripe usually present, lower half not darker than upper half	area below lateral carina generally light, sometimes suggesting a stripe extending forward below eye to mandibles; generally not as prominent as <u>M. femurrubrum-femurrubrum</u>		
<u>Phoetaliotes nebrascensis</u> <u>Plates XXII, XXIIA</u>	light colored	speckled with numerous irregularly scattered white maculations	*disproportionately large in relation to body	front margin weakly flared to receive head	entire

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. sanguinipes</u>	three fuscous oblique bars, sometimes in- distinct, on upper half of chervons & upper flange with 3 splotches more distinct than M. femur- rubrum	three splotches	pale color, spine dark tipped	cream, light to green, with brown speckling
<u>P. nebrascensis</u>	upper third of chervons dark			creamish, yellow- ish pale, some- times speckled

TABLE 3. (Continued)

SECOND INSTAR					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	prominent dark ring per segment	dark with light maculations		all absent or indistinct	no transverse sulcus present
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	appearing as alternating white & dark rings	light brown with light maculations		rugose	faint, does sulci, does not break median carina
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	light appearance as alternating cream and yellowish rings	light brown with subuniformly white maculations			entire, does sulcus, does not break median carina
<u>Melanoplus</u> <u>bivittatus</u> Plates XVII, XVIIIA	slight banding	*brown with uniform maculations		two dark broad bands sometimes indistinct on lateral carina	slightly arched, transverse sulci very indistinct

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>C. olivacea</u> <u>olivacea</u>	small splotches	small splotches	spine black tipped	*generally olive, varies to light yellow, pronotum & abdomen with small spots to splotches
<u>H. speciosus</u>				*green, super- imposed with white fine maculations
<u>H. alba</u>	chervons flecked with light brown splotches	flecked with a few light brown splotches	light bluish green, spine with black on very tip	*light bluish-green to yellowish-green
<u>M. bivittatus</u>	upper half of chervons dark, sometimes in- distinct	upper third dark splot- ched, some- times absent	spine black tipped	green, tan, to light brown

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus confusus</u> Plates XVIII, XVIIIA		*dark stripe through eye with numerous irregularly scattered white maculations, darker below stripe in eye than above	side of head and lateral lobe very similar to <u>M. sanguinipes</u>		entire, distinct
<u>Melanoplus femurrubrum</u> <u>Melanoplus femurrubrum</u> Plates XIX, XIXA		marked with numerous irregular white maculations, transverse dark stripe weakly indicated	*white streak extending from area of lateral carina forward, expanding below eye to mandibles; generally more prominent than in <u>M. sanguinipes</u>		entire, faint
<u>Melanoplus keeleri</u> <u>Turidus</u> Plates XX, XXA	segments almost entirely light at base gradually becoming more fuscous toward apex	*dark, two distinct transverse light stripes	characteristics between that of first & third instars; front left center black, appears white in photo due to reflection		entire, raised

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. confusus</u>	two indistinct to distinct oblique dark bars on upper half of chevrons with 2 dark splotches on upper flange	indistinct dark splotches sometimes present	spine black tipped	buff to light brown
<u>M. femurrubrum</u> <u>femurrubrum</u>	upper half of chevrons dark	upper third dark splotched	spine black tipped	light yellow to pale cream
<u>M. keeleri</u> <u>luridus</u>	prominent dark longitudinal band on upper half of chevrons, less on basal portion of chevrons	starts to show	spine black tipped	contrastingly black and gray

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus</u> <u>sanguinipes</u> Plates XXI, XXIA		*marked with irregular scattered light macu- lations, median dark stripe usual- ly present, lower half not darker than upper half	area extending forward from entire below lateral carina gen- erally light, sometimes suggesting stripe, extending forward & below to mandibles; generally not as prominent as <u>M. femurrubrum-femurrubrum</u>		
<u>Phoetaliotes</u> <u>nebrascensis</u> Plates XXII, XXIIA		speckled with light scattered maculations	*dispropor- tionately large head in relation to body	front margin weakly flared to receive head	entire

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. sanguinipes</u>	two dark oblique bars on upper half of chervons, upper flange with 3 dark splotches	three dark splotches	spine black tipped	cream or light brown to green, brown speckling
(<u>P. nebrascensis</u>) <u>tegmen black</u> spot on outer wing pad	black irregular longitudinal stripe generally on upper half of chervons with less on basal portion		spine black tipped	creamish yellowish pale, sometimes speckled

TABLE 3. (Continued)

THIRD INSTAR				
	Antenna	Eye	Head	Pronotum Lateral Carina Median Carina
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	all fili- form ex- cept C. <u>olivacea</u> <u>olivacea</u> each seg- ment has a dark ring	brown with maculations		all absent or indis- tinct entire
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	alternating white and dark rings	brown with white macu- lations		rugose on surface entire, transverse sulci indis- tinct
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	light appearance as alter- nating cream & yellowish green rings	light brown with sub- uniformly white macu- lations		entire, one transverse sulcus
<u>Melanoplus</u> <u>bivittatus</u> Plates XVII, XVIIA	slightly banded	*brown with uniform macu- lations	two dark broad bands, sometimes indistinct	entire, slightly arched, trans- verse sulci indistinct

TABLE 3. (Continued)

	Hind Femur		Hind Tibia	General Body
	Outer	Inner	Spine	Color
<u>C. olivacea</u> <u>olivacea</u>	small spot- ches and speckles	small spot- ches and speckles	spine black	*generally olive, varies to light yellow or brown
<u>H. speciosus</u>	chervons sparsely flecked with brown		spine black	*green with fine white maculation
<u>H. alba</u>	chervons flecked with light brown spotches	flecked with a few light brown spot- ches	light bluish- green, spine black tipped	*light bluish- green to yellow- ish green
(<u>M. bivittatus</u>) outer wing pad with black spot, sometimes indistinct	upper half of chervons dark sometimes indistinct	upper portion dark spotted sometimes indistinct	spine black tipped	green, tan, to light brown

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus confusus</u> Plates XVIII, XVIIIA		*dark stripe through eye with numerous light maculations, darker below stripe in eye than above	side of head and pronotum very similar to <u>M. sanguinipes</u>		entire, distinct
<u>Melanoplus femurrubrum</u> Plates IX IXA		marked with numerous irregular white maculations, transverse dark stripe weakly indicated	*white streak extending from area of lateral carina forward, expanding below eye to mandibles; generally more prominent than in <u>M. sanguinipes</u>		transverse sulci present
<u>Melanoplus keeleri</u> <u>viridis</u> Plates XX, XXA	segments almost entirely light at base, gradually more fuscous toward apex	*dark with 2 distinct transverse light stripes	sharp contrast of yellow, green, or white, fuscous to black, bordering from mouthparts to eye (and to posterior region of lateral carina fading out into the abdominal segments)		entire, but obscure on prozona

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. confusus</u>	three indistinct oblique dark bars on upper half of chervons with 3 splotches on upper flange	indistinct dark splot-	spine black tipped	buff to light brown
<u>M. femurrubrum-femurrubrum</u>	upper half of chervons dark	upper third dark splotched	spine black tipped	light yellow to pale cream
<u>M. keeleri turidus</u>	black irregular longitudinal stripe generally on upper half of chervons with less on basal portion	with at most a few dark splotches	spine black tipped	contrastingly black and gray

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus sanguinipes</u> Plates XXI, XXIA		*marked with irregular scattered light maculations, median dark stripe usually present, lower half of eye not darker than upper half	area below lateral carina generally light, sometimes suggesting a stripe extending forward and below eye to mandibles; generally not less prominent than <u>M. femurrubrum-femurrubrum</u>		entire
<u>Phoetaliotes nebrascensis</u> Plates XXII, XXIIA	yellowish	light brown with scattered light maculations	*disproportionately large in relation to body	front margin weakly flared to receive head	entire

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. sanguinipes</u>	two dark oblique bars on upper half of chervons with 2 dark spots on upper flange	three dark splotches	spine black tipped	cream, light brown to green with brown speckling
(<u>P. nebrascensis</u>) black spot on outer wing pad	black irregular longitudinal stripe generally on upper half of chervons with less on basal portion		spine black tipped	creamish yellowish pale color sometimes speckled

TABLE 3. (Continued)

FOURTH INSTAR				
	Antenna (all species filiform)	Eye	Head	Pronotum Lateral Median Carina (all species are lacking)
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	each seg- ment has dark ring	light brown with light maculations		entire, transverse sulcus
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	alternating thin white & dark rings per segment	light brown to brown with light macula- lations	rugose sur- face	entire, one trans- verse sulcus
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	light appearance as alter- nating cream & yellowish green rings	light brown with sub- uniformly white macu- lations		entire, one transverse sulcus
<u>Melanoplus</u> <u>bivittatus</u> Plates XVII, XVIIA	irregular dark banded per segment	*brown with uniform macu- lations	two dark broad bands, sometimes in region of lateral carina	entire, fine slightly arched, two transverse sulci

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>C. olivacea</u> <u>olivecea</u>	small speckles & splotches	some small speckles & splotches	spine black	*generally olive, varies to light yellow to brown
<u>H. speciosus</u>	chervons sparsely flec- ked with brown			*green with fine white maculations
<u>H. alba</u>	a few scat- tered brown- ish speckles	sometimes a few brownish speckles	light bluish- green, spine black tipped	*light bluish green to yellowish green
<u>M. bivittatus</u>	upper half of chervons dark, sometimes indistinct	upper third dark splotched sometimes indistinct	spine black	green, tan to light brown

TABLE 3. (Continued)

	Antenna (all species filiform)	Eye	Head	Pronotum	
				Lateral Carina (all species are lacking)	Median Carina
<u>Melanoplus confusus</u> Plates XVIII, XVIIIA	light brown basally, apical darker	*dark stripe through eye with numer- ous macula- tions scatt- ered through eye, darker below stripe than above	side of head and pronotum very similar to <u>M. sanguinipes</u>		entire and distinct
<u>Melanoplus femurrubrum</u> <u>femurrubrum</u> Plates XIX, XIXA		marked with numerous irregular white macu- lations, transverse dark stripe weakly indi- cated	*white streak extending from entire, faint area of lateral carina for- ward, expanding below eye to mandibles; generally more prominent than <u>M. sanguinipes</u>		
<u>Melanoplus keeleri</u> <u>viridis</u> Plates XX, XXA	segments light at base become fuscous to- ward apex	*dark eye with two distinct transverse light stripes	sharp contrast of yellow, green, or white, fuscous to black, bordering from mouthparts to eye to pos- terior region of lateral carina, fading out into the abdominal segments		entire and raised

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. confusus</u>	3 indistinct oblique dark bars on upper half of chevrons with 2 dark splotches on upper flange	indistinct dark spine black splotches	black	buff to light brown
<u>M. femurrubrum-femurrubrum</u>	upper half of chevrons dark	showing some dark splotches	spine black tipped	light yellow to pale cream
<u>M. keeleri</u> <u>luridus</u>	black irregular longitudinal stripe generally on upper half of chevrons with less on basal portion	starts to show 3 dark splotches	spine black	contrastingly black and gray

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus sanguinipes</u> Plates XXI, XXIA		marked with irregular scattered light maculations, median dark stripe usually present, lower half eye not darker than upper half	area below lateral carina generally light, sometimes suggesting stripe extending forward and below eye to mandibles; generally not as prominent as <u>M. femurrubrum-femurrubrum</u>	Lateral Carina	obscure on prozona, distinct on meta-zona
<u>Phoetaliotes nebrascensis</u> Plates XXII, XXIIA	yellowish fuscous longitudinal line on dorsal side	light brown with scattered light maculations	*disproportionately large in relation to body	front margin weakly flared to receive head	entire, two faint transverse sulci

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. sanguinipes</u>	*two dark oblique bars on upper half of chervons with 2 dark splotches on upper flange	three dark splotches	spine black	cream, light brown to green, with brown speckling
(<u>P. nebrascensis</u>) outer hind wing with black spot	black irre- gular longi- tudinal stripe generally on upper half of chervons with less on basal portion	slight splot- ching	spine black tipped	creamish yellow, pale color, some- times speckled

TABLE 3. (Continued)

FIFTH INSTAR				
	Antenna (all filiform)	Eye	Head	Pronotum Lateral Carina Median Carina (all absent)
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	prominent dark ring per segment	light brown to brown with light macu- lations		entire, transverse sulcus
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	basal third light green, apical darker brown	brown to light brown with light maculations	rugose on surface	entire, faint transverse sulcus
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	light appearance as alter- nating cream & yellowish green rings	light with a few brown maculations		entire, one trans- verse sulcus
<u>Melanoplus</u> <u>bivittatus</u> Plates XVII, XVIIA	irregular dark bands	*brown with uniform macu- lations dis- tinct or indistinct	two dark broad bands in region of lateral carina	entire, faint two transverse sulci

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>C. olivacea</u> <u>olivacea</u>	small spot- ches	some small spotches	spine black	*generally olive, varies to light yellow to brown
<u>H. speciosus</u>	generally green apical faint pink band		bluish-green, spine black tipped	*green
<u>H. alba</u>	a few scatt- ered brown- ish spotches		light bluish- green, spine black tipped	*light bluish- green to yellow- ish-green
<u>M. bivittatus</u>	dorsal por- tion of knee dark, exten- ding forward upon upper half of cher- vons or to slightly below apex with inter- mediate lighter stripes between	knee dark with dark spotches on upper third	generally light green, or yellow, spine black tipped	usually green, tan or light yellow

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus confusus</u> Plates XVIII, XVIII A	light brown, apical darker	*dark stripe through median of eye with numerous maculations below dark stripe, darker than above	side of head and very similar to <u>M. sanguinipes</u>		entire, distinct two transverse sulci
<u>Melanoplus femurrubrum</u> <u>femurrubrum</u> Plates XIX, XIX A		brown to light brown with irregular white maculations, transverse dark stripe weakly indicated in medial area	*white streak extending from area of lateral carina forward, expanding below eye to mandibles; generally more prominent than in <u>M. sanguinipes</u>		entire, faint
<u>Melanoplus keeleri</u> <u>luridus</u> Plates XX, XX A	segments lighter basally becoming more fuscous toward apex	*dark with 2 distinct transverse light stripes	modification of fifth instar similar to fourth except the yellow, green, or white portion of the head & thorax undergo transition to fuscous in adult		entire

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. confusus</u>	knee black, 3 dark oblique bars on upper half of chevrons	knee black with dark spotches	dorsal side of tibia much darker, spine black tipped	buff to light brown
<u>M. femurrubrum-</u> <u>femurrubrum</u>	upper half of chevrons dark	slight splotch- ing	spine black tipped	generally light yellow to pale cream
<u>M. keeleri</u> <u>luridus</u>	knee dark, upper flange with 3 dark spotches, chevrons dark except lower third being lighter	three dark spotches	subbasal black, narrow band, spine black	usually contras- tingly black and gray

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus sanguinipes</u> Plates XXI, XXIA	segments fuscous	median dark transverse stripe with scattered light maculations, the area below stripe not darker than upper half of eye	*area below lateral carina generally light, sometimes suggesting stripe, extending forward & below eye to mandibles; generally not as prominent as in <u>M. femurrubrumfemurrubrum</u> ; protuberence swelling on sternum between first & second pair of legs	obscure on prozona, distinct on metazona	
<u>Phoetaliotes nebrascensis</u> Plates XXII, XXIIA	yellowish	speckled	*disproportionately large in relation to size of body	front margin weakly flared to receive head	entire, pre-sent two transverse sulci

TABLE 3. (Continued)

	Hind Femur		Hind Tibia Spine	General Body Color
	Outer	Inner		
<u>M. sanguinipes</u>	2 dark oblique bars on upper half of chervons with 2 spotches on upper flange	3 dark spotches more prominent than in the 4th instar	spine black	usually cream, light brown to green, brown speckling
(<u>P. nebrascensis</u>) tegmen black spot on hind wing	black irregular longitudinal stripe on upper half of chervons with less on basal portion	dark spotted	spine black	creamish yellow to pale brown

TABLE 3. (Continued)

ADULT					
	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Campylacantha</u> <u>olivacea</u> <u>olivacea</u> Plates XIV, XIVA	prominent dark ring per segment	brown to dark brown		surface pilose, absent or very indis- tinct on pronotum & mesonotum	entire, dis- tinct cut one trans- verse sulcus
<u>Hesperotettix</u> <u>speciosus</u> Plates XV, XVA	pinkish with fus- cous base	brown with light macu- lations, pos- terior border of eye a light color		rugose on surface	entire, faint pink stripe defines median carina one trans- verse sulcus
<u>Hypochlora</u> <u>alba</u> Plates XVI, XVIA	pale yellowish, mottled brown	light with a few light brown macu- lations		area slightly raised	entire, one transverse sulcus

TABLE 3. (Continued)

	Hind Femur		Hind Tibia	General Body Color	Male Cercus, furcula, & subgenital plate
	Outer	Inner	Spine		
(<u>C. olivacea</u>) tegmen short, acutely angled			usually coral color, spine black tipped	*usually olive varies light yellow to brown	
(<u>H. speciosus</u>) tegmen generally two-thirds length of abdomen, sometimes reaching tip	*generally green, apical pink	generally green with apical pink	spine black tipped	generally green flushed with pink	
(<u>H. alba</u>) tegmen short, generally acutely angled at apex	a few scattered brownish spots	a few brownish spots sometimes	light bluish-green, spine black tipped	*light bluish-green to yellow green	

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus bivittatus</u> Plates XVII, XVIII	reddish brown, darker apex	dark brown			entire, fine slightly raised, cut by 2 sulci
<u>Melanoplus confusus</u> Plates XVIII, XVIIIA	pale yellow, darker toward apex	dark transverse stripe through median of eye with area below dark stripe, darker than above			entire, distinct, cut by 2 sulci
<u>Melanoplus femurrubrum</u> Plates XIX, XIXA	filiform yellowish to yellowish brown with fuscous apex				raised posteriorly, cut by one principal sulcus

TABLE 3. (Continued)

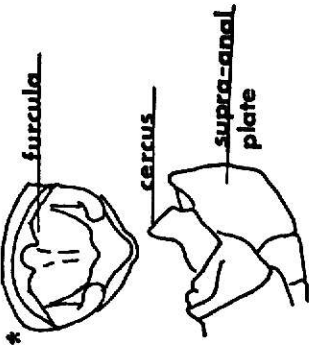
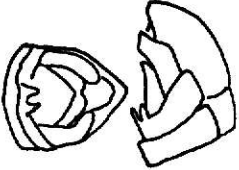
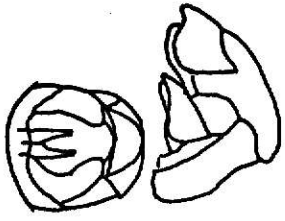
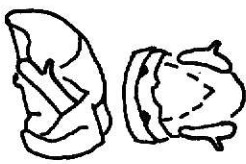
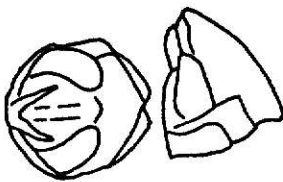
	Hind Femur	Hind Tibia	General Body Color	Male Cercus, furcula & subgenital plate
	Outer	Inner		
(<u>M. bivittatus</u>) tegmen long, 2 light colored stripes extend- ing from near eyes almost to apex of tegmen	dorsal por- tion of knee dark & irr- dark exten- ding forward upon upper half of cher- vons, with intermediate lighter stripe between cher- vons	knee mostly dark & irr- egular dark band on upper half	dull light brown to dark brown above pale yellow beneath	
(<u>M. confusus</u>)	knee black, with 3 obli- que bars on dorsal and outer sur- face to mid- line of cher- vons with intermittent, lighter stripes be- tween chervons	knee black, 3 dark splotches	usually dark or reddish brown above, dull yellow beneath	
(<u>M. femurrubrum</u> - <u>femurrubrum</u>)	dorsal flange and chervons darker than lower flange	3 dark splotches present	usually gray- ish to yellow- ish brown	

TABLE 3. (Continued)

	Antenna	Eye	Head	Pronotum	
				Lateral Carina	Median Carina
<u>Melanoplus keeleri</u> <u>Iuridus</u> Plates XX, XXA	light to yellowish to yellowish brown, darker toward apex	dark, two faint transverse light stripes weakly indicated			entire, on obscure on prozona 3 transverse sulci
<u>Melanoplus sanguinipes</u> Plates XXI, XXIA	yellowish darker toward apex			protuberance swelling on sternum between first & second pair of legs	obscure on prozona, distinct metazona, 3 transverse sulci
<u>Phoetaliotes nebrascensis</u> Plates XXII,	reddish or yellowish, dark apically		*disproportionately large	front margin weakly flared to receive head	entire, distinct, 3 transverse sulci

TABLE 3. (Continued)

	Hind Femur		Hind Tibia	General Body Color	Male Cercus, Furcula, Subcentral plate
	Outer	Inner	Spine		
(<u>M. keeleri</u> <u>luridus</u>) tegmen wings never exceed tip of abdomen as other <u>Melanoplus do</u>	knee dark, dorsal flange, 3 dark spot- ches approx- imately lower third of chervons lighter color	knee dark, 3 dark splotches dorsally	dark pink to red, spine black tipped	usually gray- ish brown above, yellow- ish to yellow- ish orange beneath	
(<u>M. sanguinipes</u>) tegmen usually longer than abdomen, one- third longer	knee black, 2 darker oblique bars on upper flange and upper half of chervons	knee black, 3 dark splotches	pink, buff, or salmon colored spine black tipped	usually brown or reddish brown above, yellowish beneath	
(<u>P. nebrascensis</u>) tegmen normally abbreviated over- lapping apical points, rounded with occasional long winged forms	knee dark, with 3 dark splotches	knee dark, 2 splotches	bluish-green to reddish, spine black tipped	usually dark grayish brown, reddish brown, beneath greenish yellow	

SUMMARY

Various nymphs and adults of grasshoppers representing 21 species commonly occurring in the Flint Hills native tallgrass prairie near Manhattan, Kansas are illustrated with color photographs and block keys giving multiple characteristics are presented.

Nymphs were collected in the field, some were reared to the desired stage or to adulthood for positive identification. When necessary, specimens were quick-frozen to keep color and form.

Antenna, eye, head, pronotum including lateral and median carina and sulci, inner and outer face of hind femur, hind tibia, spine of hind tibia are the characters most commonly of value to separate species including both structural characters and color patterns. (Ecological data, seasonal occurrence, and principal host plants are used as secondary aids in confirming identification.)

ACKNOWLEDGMENTS

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APPENDIX

The following information is supplied from Campbell et al. (1974) unless otherwise stated, which will serve to help locate specimens unless habitat changed.

Ageneotettix deorum. "First instars early May, hatched until mid-May; peaked late May and in June. Adults June 30, peaked in late July and early August; collected through mid-October" (p. 15). Blue grama, Bouteloua gracilis ingested Kentucky bluegrass, Poa pratensis hairy grama, Bouteloua hirsuta > little bluestem, Andropogon scoparius.

Boopedon auriventris. Early instars collected by me last of May and first part of June. Adults last part of July through August. Found mainly in limestone breaks; ingested mainly hairy grama, big bluestem, Andropogon gerardi, little bluestem, Kentucky bluegrass, and indian-grass, Sorghastrum nutans found in my study area (Mulkern et al. 1969).

Eritettix simplex. "Nymphs present April 12, 1972. Fifth instar overwintering nymphs May 25. Adults by May 5, peak in May. First instars again by July 20, many 3rd by late August" (p. 19). Blue grama ingested >sideoats grama, Bouteloua curtipendula > hairy grama > tall dropseed, Sporobolus asper > Kentucky bluegrass. Overwintering nymphs fed on early-spring grasses, Kentucky bluegrass then move to gramas.

Mermeria bivittatus maculipennis. First instars collected by me May 25 to first part of June; July 3 fifth instars. Adults found in August. Mermeria is a prominent, typical genus of the tall grass prairie. Hairy grama, sideoats grama, tall dropseed, and indiangrass most commonly ingested.

Mermeria picta neomexicana. First nymphs collected by me June 20 to first part of July, peak in July. Adults late July and August, peaked August and September. Mermeria is a prominent, typical genus of tallgrass prairie. Hairy grama, sideoats grama, tall dropseed, and indiangrass most commonly ingested.

Orphulella speciosa. "First instars by May 16, hatched through June, peaked mid-June through July. Adults by July 2, peaked in August, collected until October 22" (p. 31). Kentucky bluegrass ingested > blue grama > sideoats grama > little bluestem > big bluestem.

Syrbula admirabilis. "First instars June 9, hatched through June; last instars August 27. Adults July 28, peaked last August; last collected October 22" (p. 34). Blue grama ingested > indiangrass > little bluestem > tall dropseed > big bluestem > sideoats grama > buffalograss, Buchloe dactyloides.

Arphia sp. No differentiation was made between Arphia conspersa, Arphia simplex, and Arphia xanthoptera.

Chortophaga viridifasciata. Later instars collected by me March 16 through May; overwinters in late nymphal

stages. Adults appear in May through September. First instars appeared July 20, collected in August.

Dissosteira carolina. First instars appear around June 10 hatch through June. Adults by July 19 through July and August. It was never dissected for food content; however, Mulkern et al (1966) dissected 5 specimens at North Dakota, and 3 had ingested undetermined grass and one each had western ragweed, which is found in my study area.

Hadrotettix trifasciatus. "Nymphs June 25 to August 8. Adults July 22 to October 6." "Seven specimens from Claypan ingested groundplum milkvetch, Astragalus caryocarpus, western ragweed, Kentucky bluegrass, and big bluestem" (p. 19).

Pardalophora haldemanii. First nymphs August; hibernates as 3rd and 4th instars. First adults June 3, peaked in June and July" (p. 31). Kentucky bluegrass ingested >Japanese brome, Bromus japonicus> blue grama.

Campylacantha olivacea olivacea. "First instars June 2, hatching to July 13; nymphs peaked June and July, collections until September 1. Adults July 29 until end of season, peaked during late August and early September" (p. 16). Western ragweed ingested > Louisiana sagewort, Aromesia ludoviciana > Missouri goldenrod, solidago missouriensis.

Hesperotettix speciosus. "Small nymphs April 25; hatching for several weeks; nymphs peaked late May and

early June. First adults June 25, peaked mid-July to August 27" (p. 19). Western ragweed ingested > Missouri goldenrod > Scribner panicum, Panicum scriberianum.

Hypochlora alba. "First nymphs May 15, hatching until mid-June; peaked mid-June and mid-July. First adults July 1, peaked July and August, collected to October 22" (p. 21). Louisiana sagewort ingested 91% and western ragweed the rest.

Melanoplus bivittatus. "First instars early May, nymphs peaked late May into July. Adults June 20, peaked July and August, disappeared mid-October" (p. 22). Kentucky bluegrass ingested > western ragweed > leadplant, Amorpha canescens.

Melanoplus confusus. "First Melanoplus to hatch. Nymphs first collected April 18, peaked May and early June, last July 15. Adults May 16, peaked in June and July, last July 19" (p. 23). Western ragweed ingested > Louisiana sagewort > Kentucky bluegrass > Japanese brome > leadplant.

Melanoplus femurrubrumfemurrubrum. "First nymphs May 23, hatching until July; peaked through June and July. First adults August 11, peaked late August and early September, extending through season" (p. 23). Western ragweed ingested > Kentucky bluegrass > western yarrow, Achillea millefolium > Missouri goldenrod > Louisiana sagewort.

Melanoplus keeleri luridus. "First instars by May 23, hatching extended to mid-June, last instars until August 31, peaked June and July. First adults August 4, as late as October 22, peaked late August, early September" (p. 25). Western ragweed, and Louisiana sagewort ingested > Missouri goldenrod > Kentucky bluegrass > leadplant.

Melanoplus sanguinipes. "First instars of first generation May 5, hatching continued through May, peaked late May and early June; first adults June 25, peaked mid-July, disappeared in mid-August. A few nymphs of the second generation observed all 3 years, first instars in late July; adults early September into October" (p. 26). Kentucky bluegrass ingested > western ragweed > Louisiana sagewort > leadplant. Melanoplus sanguinipes is scareous in the Donldson pasture, feeds on relatively uneconomic plants.

Phoetaliotes nebrascensis. "First instars June 2 to July 1. Nymphs peaked mid-July, collections to September 9. First adults mid-August, peaked in September, into October" (p. 32). The last to appear among those which hatch as eggs in the spring. Little bluestem ingested > big bluestem > Kentucky bluegrass > tall dropseed > Japanese brome > indiagrass.

IDENTIFICATION OF NYMPHS AND ADULTS OF THE COMMON
GRASSHOPPERS (ACRIDIDAE) INHABITING THE FLINT HILLS
NATIVE TALLGRASS PRAIRIE NEAR MANHATTAN, KANSAS

by

KEITH MOREY BLECHA

B.S., Kansas State University, 1971

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Entomology

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1974

ABSTRACT

Adults and nymphs of virtually each instar and adult of 21 species of Acrididae from the Flint Hills native tallgrass prairie near Manhattan, Kansas were photographed in color to facilitate identification, as was a block key using important characters which differentiate among species.

Color patterns were often important for species differentiation, particularly within a locality. In a few species a single character was sufficient for identification, but a combination of characters was generally needed.

Structure and color markings of eye, head, pronotum, outer and inner face of hind femur, hind tibia, and spine on hind tibia were of particular value. After each succeeding molt, the nymph as it ages, more closely resembles the adult.