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THE ORTHOPTERA OF NOVA SCOTIA

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I. INTRODUCTION

Several papers have included references to species of Orthoptera from Nova Scotia. Four of these were devoted entirely to Nova Scotian species. This report is an attempt to bring the knowledge of the Orthoptera of Nova Scotia up to date. Seven names are added to the previously confirmed number of twenty-four species.

The first information of significance was provided by F. Walker (1869; 1870; and 1872). Twelve species were listed but unfortunately some of these were mis-identifications and only eight species have been subsequently confirmed. The specimens to which Walker referred were probably collected around Halifax by Lt. R. S. Redman from 1820 to 1822.

Nothing further was published until Scudder (1892) (See Piers, 1918) recorded the occurrence of an additional species from Nova Scotia. This was later said to be a mistake by Piers (1918) and the species, *Pardalophora apiculata* (Harris), has not yet been found in the province.

Piers (1894) published a brief note on some crickets collected at Windsor and later (Piers, 1896) issued an annotated list of 14 orthopteroid species collected near Halifax.

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Scudder (1899) also recorded *Orphulella speciosa* (Scudder) from Halifax, collected by Piers. Piers himself (1918) however, refuted this record also, but the species has since been found in the province (See below).

Further references to Nova Scotian Orthoptera did not appear until Gooderham (1917) published a paper listing 13 species of Acrididae, which he followed the next year with another publication containing information on six species of "Locustidae" (Tettigonoidea). (Gooderham, 1918).

In the same year, Piers (1918) published a monograph of Nova Scotian Orthoptera listing twenty-six species of Orthoptera (*sens. strict.*), two of which were hypothetical (thought likely to occur, but not collected) and two doubtful (the records from Scudder, (*11. cc.*)). Piers thus listed twenty-two species as being known from Nova Scotia but he also included notes on fifteen others which he thought might eventually be found. He predicted that the list of Orthoptera of Nova Scotia would not be expanded beyond thirty-five species.

Very little further appeared in print until J. W. H. Rehn (1939; 1939a) published notes on Orthoptera from Nova Scotia and Newfoundland. His first paper, based upon B. Long's collections of about 1920, added one species, *Melanoplus fasciatus* (Wlk.) to the list. This record was based on a single female. It confirmed the presence of a species which Piers (1918) has included as hypothetical.

In 1949, F. A. Urquhart collected in Nova Scotia. *Orphulella speciosa* (Scud.) was confirmed and a small cricket, *Nemobius palustris* Blatch., was also added to the list. *Zubovskya glacialis* (Scud.) was also confirmed by Urquhart from a collection by C. E. Atwood, but these records have so far remained unpublished.

Rehn and Grant (1958) included Nova Scotia in the range of *Tettigidea lateralis lateralis* (Say) from a single atypical specimen. This reference, from South Milford, Nova Scotia, is the first published record of this species from Nova Scotia. The locality marked on their distribution map is Milford, Colchester County, while South Milford is in Annapolis County.

During the present study, four more species were found. These are *Melanoplus keeleri luridus* (Dodge), *Chorthophaga viridifasciata* (De G.), *Neoconocephalus ensiger* (Harr.), and

Nemobius allardi Alexander and Thomas (1959), which is added since this species is described as distinct from *N. fasciatus* (De Geer). In addition to these, *Melanoplus fasciatus* (Wlk.) has been collected at various locations, confirming the presence of this species and adding to its known distribution. The distribution of many of the previously recorded species has been enlarged.

Thirty-one recorded species, and one of doubtful occurrence, in twenty genera are included in this paper as occurring in Nova Scotia, less than five per cent of the total number of species recorded from North America.

It is unfortunate that the whole insect collection, collection catalogue, and records at the Nova Scotia Agricultural College were destroyed by fire in 1946, and were not available for study. The only collection of Orthoptera of consequence in Nova Scotia is that which has been built up by the author and staff members at the Agricultural College since 1946 and supplemented by contributions from Dr. F. A. Urquhart, following his collecting trip in Nova Scotia in 1949.

The Canadian National Collection of Insects, Ottawa, has very few specimens of Orthoptera from Nova Scotia. Their records of this group from Nova Scotia, New Brunswick, and Prince Edward Island have been made available and are included in this paper.

II. PHYSICAL BACKGROUND AND ORTHOPTERAN DISTRIBUTION

Nova Scotia lies between 43 degrees and 47 degrees north-latitude and 59 degrees and 67 degrees west-longitude, with the axis running in a northeast-southwest direction. It is about 340 miles long and averages 50 miles in width. It consists of a peninsula, joined to the mainland (New Brunswick) by the swampy isthmus of Chignecto, and Cape Breton Island which is separated from the eastern end of the peninsula by the Strait of Canso. This island and the mainland are joined by a causeway which was completed in 1955. The province is divided into 18 counties, as shown on the map, Plate I.

The southern half of the province is called the Atlantic Upland, and is composed of rocks resistant to weathering, slates, quartzites and granites. (See Plate II —Fig. I). It is

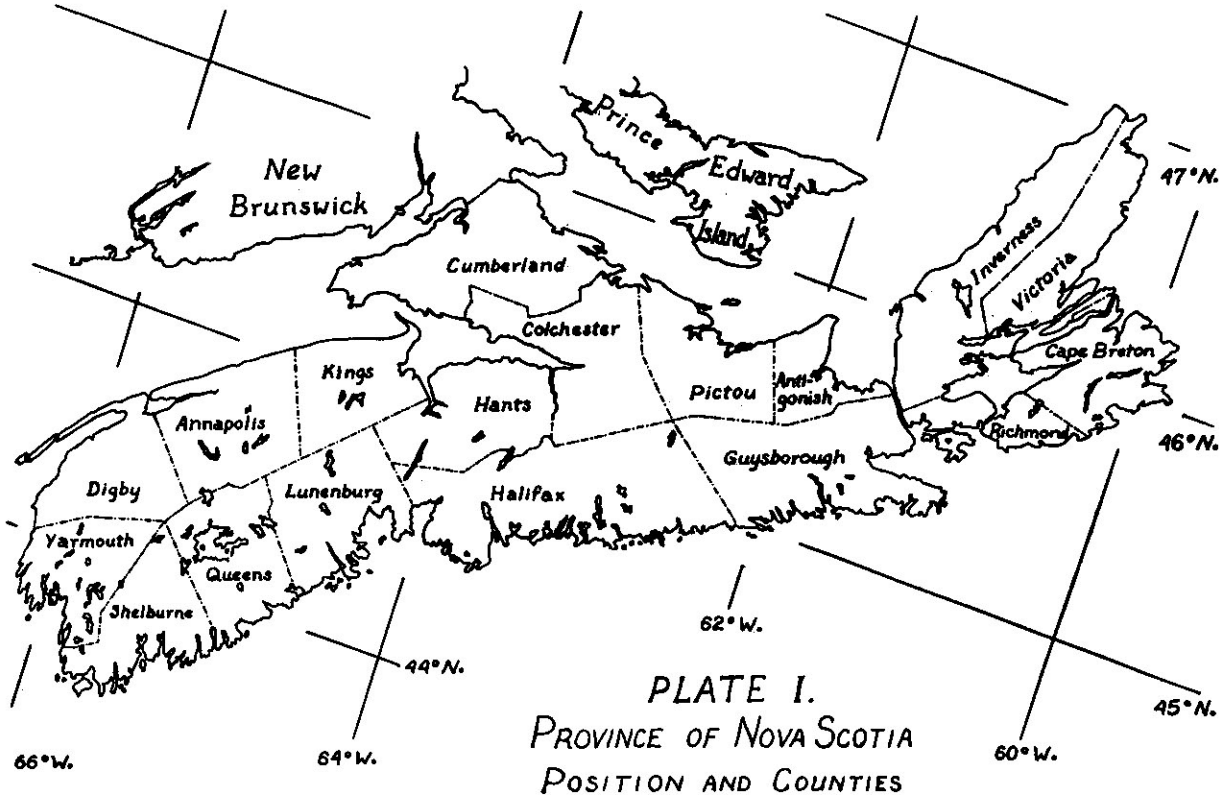


PLATE I.

PROVINCE OF NOVA SCOTIA

POSITION AND COUNTIES

PLATE II.

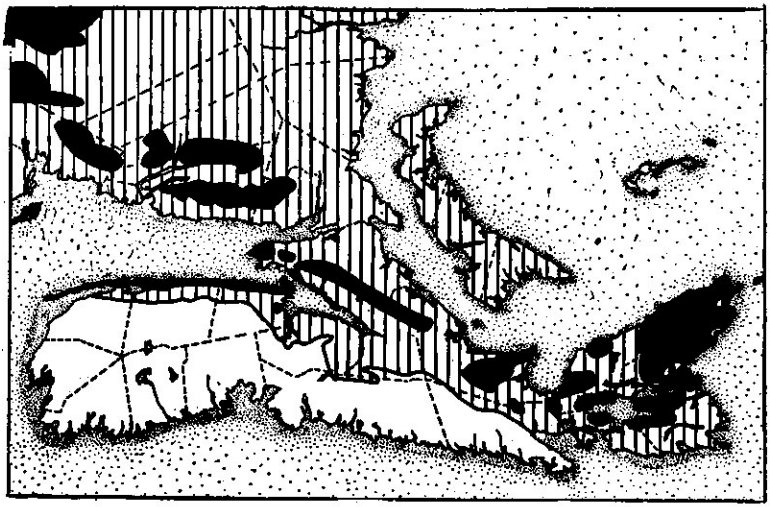


Fig. 1. Physiographic regions of Nova Scotia and adjacent areas: dark areas indicate true uplands; vertically hatched areas represent lowlands which vary considerably in basic structure; and the unshaded area indicates the so-called Atlantic Upland which basically is composed of rocks which are resistant to weathering and is generally poorly drained.

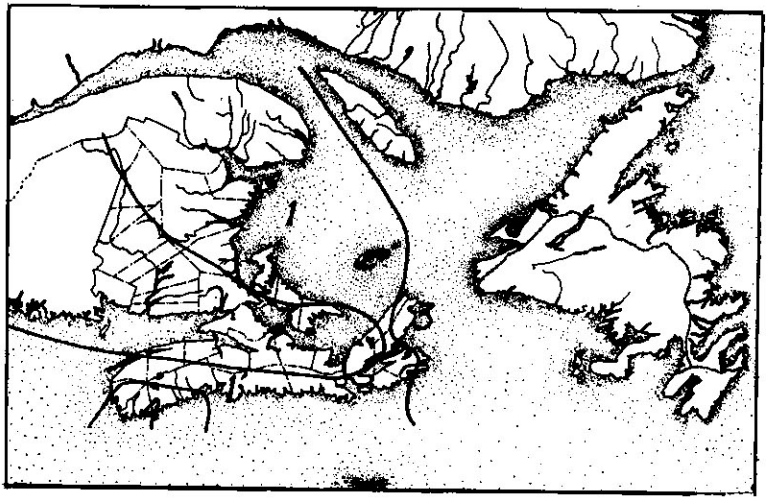


Fig. 2. Floral regions of Nova Scotia and adjacent areas: 1, predominantly Canadian Zone; 2, predominantly Alleghanian Zone; 3, predominantly Hudsonian Zone; and 4, coastal plains region.

not basically an upland but rises gently from sea-level to a height of 100 to 500 feet in the north. In the western half the three rock types appear in about equal proportions; i.e., the area comprising southern Yarmouth, Shelburne, Queens and Lunenburg Counties. In the eastern area granites and quartzites are predominant with slates nearly absent. Lakes, streams, bogs and barrens are very numerous in the Atlantic Upland area.

The true uplands are found in the northern half of Nova Scotia. The North Mountain extends from Kings County, at a height of 600 feet, in a southwest direction to dip beneath the sea at the end of Digby Neck. It is composed largely of basalt or trap rock. The ranges of hills from Cumberland County to Cape Breton are composed of igneous rocks, syonites, diorites and granites. These hills rise to 1000 feet and are covered with forest, mostly deciduous. The broad plateaux of northern Cape Breton are up to 1200 feet high and are very poorly drained. The plateaux are covered with bogs and trees and have a more severe climate than the rest of the province.

The remaining area is lowland which varies considerably. The Annapolis Valley is basically Triassic sandstone, while the northern and eastern lowlands have various mixtures of sandstones, shales, conglomerates, limestones and gypsum. In these areas deep valleys and rugged cliffs are found near the uplands and lakes and ponds are scarce.

The southwestern area has the longest frost-free period and the most foggy days, lower summer temperatures and higher minimum winter temperatures than the other regions. Cape Breton Island presents the other extreme, having a short growing season, very little fog and lower temperatures throughout the year.

Attempts have been made to divide the province into regions of the basis of distribution of insects; e.g., by Piers (1918) and Ferguson (1954). The species of Orthoptera are too few and the area is too small to establish definite regions on such a basis.

However, four general regions are indicated by the distribution of flora (Roland, 1944-45). The peninsula is roughly divided into three areas. The Coastal Plains region is made up of southwestern Yarmouth, Shelburne and Queens Counties and bears flora typical of the coastal plains of more southerly

areas. The remainder of the mainland is divided into two regions by a line drawn between Annapolis and Guysborough. The region to the north of the line is mainly deciduous and representative of the Alleghanian Zone, while the poorly-drained area to the south of the line is representative of the Canadian Zone. Thus, in Nova Scotia, there exists a curious reversal, in that the southern floral elements are found in the north while the northern elements are found in the south.

The island of Cape Breton is considered separately. The Alleghanian Zone extends into the northwestern part and includes the Margaree Valley. The boggy plateaux of northern Inverness and Victoria Counties bear flora such as black spruce, fir, ericaceous plants and sphagnum, typical of a boreal zone. The remainder of the island is similar to the Atlantic Coast of the mainland and is classed as Canadian Zone. (Plate II, Fig. 2)

Piers (1918) listed two zones, Canadian and Alleghanian, into which the province of Nova Scotia was divided longitudinally. The Alleghanian Zone occupied the northern half of the mainland and the Margaree Valley of Cape Breton Island while the Canadian Zone included the remainder of Cape Breton Island and the Atlantic coast of the mainland. He mentioned the possibility of the northern tip of Cape Breton Island containing Hudsonian flora and fauna, so that his classification does not drastically differ from that of Roland (1944-45).

Actually, considerable variation occurs in all of these regions, with small areas in each apparently typical of another region. This is due largely to drainage and elevation of the areas concerned.

No species of Orthoptera is found solely in that part of Nova Scotia which lies within the Canadian Zone. Seven species, namely *Ceuthophilus maculatus*, *Neoconocephalus ensiger*, *Melanoplus keeleri luridus*, *Chorthophaga viridifasciata*, *Orphulella speciosa*, *Tettigidea lateralis*, and *Tetrix arensosa angusta* are found in the region representative of the Alleghanian Division of the Transition Zone. Of these seven species, the presence of three is incidental or accidental. *M. keeleri luridus* and *C. viridifasciata* are found only near the New Brunswick border and have probably moved into Nova Scotia during relatively recent years. *N. ensiger* is found

only near the Greenwood airport and was presumably introduced recently by air.

The small cricket, *Nemobius palustris* has been found only in southwestern Nova Scotia and in the Halifax area.

All other species are either so common or found in such widely separated localities that they must be classed as "general" in distribution.

III. CLASSIFICATION OF NOVA SCOTIA ORTHOPTERA

ORDER ORTHOPTERA

Within the genera commonly grouped together under the name Orthoptera are found some of the most generalized insect types, but a relatively great divergence of form exists among them. Wings are variable, often vestigial or absent; where present, they consist of two pairs, the fore-wings or tegmina being thickened and parchment-like but with distinct venation, and the hind-wings often fan-like and usually folded beneath the tegmina when at rest; where wings are absent, the Orthoptera may be distinguished from other insects by the generalized biting or chewing mouthparts and the cleft labium. Stridulatory mechanisms are commonly found throughout the Orthoptera, reaching their highest development in the winged males of many species of grasshoppers and crickets.

Metamorphosis is gradual; normally, four to six nymphal instars occur. Although many Orthoptera are omnivorous and some are carnivorous, the great majority are phytophagous and some of them are of great economic importance.

Key to the Superfamilies Occurring in Nova Scotia

1. Antennae much shorter than the body; tarsi three-segmented; stridulation, when it occurs, usually by action of the legs or tegmina, or involving the hind wings; external ovipositor consisting of two pairs of short, pointed plates, diverging at tips. (Suborder Caelifera).....2.

Antennae much longer than the body; tarsi three or four-segmented; stridulation, when it occurs, is usually by interaction of the basal areas of tegmina; ovipositor usually

elongated, sword-, sickle-, or needle-like. (Suborder Ensifera) .....3.

2. Length less than 15 mm.; pronotum extending backward, tapering, to or beyond end of abdomen; tegmina represented by small, oval, lateral lobes.
.....Family Tetrigidae, p. 36.

Length of adults 15mm. or more; pronotum not extending backward over abdomen; tegmina usually well developed, but sometimes abbreviated or wanting.
.....Family Acrididae, p. 42.

3. Tarsi four-segmented; tegmina at rest lying roof-like over abdomen; ovipositor flattened, sword- or sickle-shaped; general colour green or brown.....4.

Tarsi three-segmented; tegmina at rest lying flat above the abdomen with the sides bent abruptly downwards; ovipositor nearly straight, or slightly upcurved, needle-like; general colour brown to black.
.....Superfamily Grylloidea, p. 27.

4. Front tibia with slit-like auditory opening near the base.
.....Superfamily Tettigonoidea, p. 19.

Front tibia without auditory opening.
.....Superfamily Gryllacridoidea, p. 9.

Order Orthoptera
Suborder Ensifera
Superfamily Gryllacridoidea[1]
Family Rhaphidophoridae[2]

This family is characterized by the absence of wings; males are not known to stridulate; the pronotum is short, not covering the whole dorsal thoracic area; prosternal spines absent; ovipositor nearly straight; robust with arched back and a large head, which is bent downward between the forelegs. They are nocturnal, living in caves, or hiding under stones or logs in damp woods or along brooks. At least one

1 Some authors include this superfamily in the Tettigonoidea.
2 Formerly regarded as a subfamily of Gryllacrididae.

species is commonly found in damp cellars. Eggs are laid in the soil in the fall and hatch during the spring. Rhaphidophorids (or "camel-crickets") are omnivorous feeders. They do not generally injure cultivated crops. *Tachycines asynamorus* (Adelung) has occasionally caused injury to seedlings in greenhouses on this continent and elsewhere (Hebard, 1934) but has not been reported in Nova Scotia. Only one genus, *Ceuthophilus*, is found in Nova Scotia.

Genus *Ceuthophilus* Scudder

Ceuthophilus Scudder, 1862. Bost. J. Nat. Hist. 7:433.

Key to Nova Scotia species of *Ceuthophilus*.

1. Males.....2.
   Females.....3.

2. Hind margin of terminal dorsal segment of abdomen distinctly obtusely notched; hind tibiae distinctly bowed or curved on basal third. .....*C. maculatus*, p. 10.

   Hind margin of terminal dorsal segment of abdomen entire, rounded; hind tibiae straight.
   .....*C. brevipes*, p. 11.

3. Carina of lower anterior surface of hind femora with many teeth; lower anterior margins of pronotum broadly bordered with brownish, general colour dark; hind tibiae darkened between spur bases; ovipositor 6.5 mm. to 7.5 mm. in length. .....*C. brevipes*, p. 11.

   Carina of lower anterior surface of hind femora with few teeth; lower anterior margins of pronotum pale; hind tibia normally with a single subdistal ventral spur; ovipositor 6.8 to 9.5 mm. in length.
   .....*C. maculatus*, p. 10.

1. *Ceuthophilus maculatus* (Harris). Map 1; Fig. 3.

   Rhaphidophora maculata Harris, 1841. Rpt. Ins. Mass.: 126.
   Ceuthophilus maculatus. F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. 1: 201.
   Onthophilus (*sic.* for *Ceuthophilus*) *maculatus*. F. Walker, 1872. Can. Ent. 4:30.

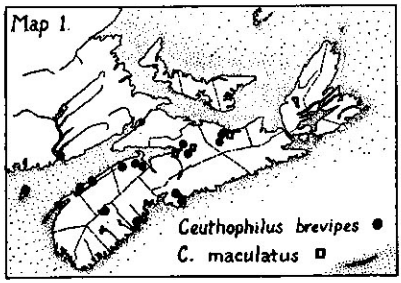
Ceuthophilus maculatus. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**: 31-32.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**: 326-327.
Common name — 'Spotted Camel Cricket'.

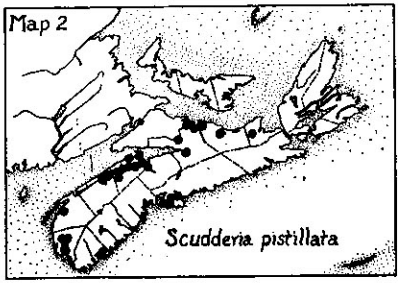
Body stout, back arched; antennae long; hind margin of terminal dorsal abdominal segment notched; fore femora often one-third or more longer than pronotum; hind femora broad; hind tibiae and hind femora of about equal length; lower carina of hind femur with 8 to 15 unequal, rather coarse spines. The colour is blackish-brown above, often with a lighter stripe on the dorsal part of the thorax; yellowish-brown beneath; dorsum of abdomen often bears a number of small, yellow dots; legs pale reddish-brown, the hind femora with brown bars. Body length, male 14 mm., female 16 mm.

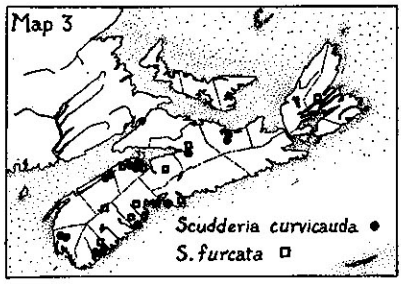
The range of *C. maculatus* extends from the southern Canadian Zone to the northern half of the Upper Austral Zone. It is common in New England, but somewhat rare in Nova Scotia. It is found from mid-July to September under stones, beneath logs, and in hollow trees in dry open woods. It has been found at Truro, and Black Rock, Colchester County; New Glasgow, Pictou County; and at Granville Ferry, Annapolis County.

2. *Ceuthophilus brevipes* Scudder. Map. 1; Fig. 4.
Ceuthophilus brevipes Scudder, 1862. Bost. J. Nat. Hist. **7**:434.
Ceuthophilus terrestris. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:33.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**: 327-328.
Ceuthophilus brevipes. J. W. H. Rehn, 1939a. Fragm. faun. Mus. zool. Polon. **4**:264.
Common name — 'Woodland Stone Cricket'.

Body stout; back arched; antennae long; hind margin of terminal dorsal abdominal segment obtusely rounded; fore femora at least one-third longer than pronotum; hind femora broad and distinctly shorter than hind tibiae; outer lower carina with about 25 crowded, minute teeth; hind tibiae straight in both male and female. Colour reddish-brown; abdomen mottled with pale spots; light stripe on dorsal pronotum bordered by darker blotches often in evidence; legs lighter, hind femora with obscure dark bars. Body length, male 13-14 mm., female 14-15 mm.


Map 1.
Ceuthophilus brevipes ●
C. maculatus □


Map 2
Scudderia pistillata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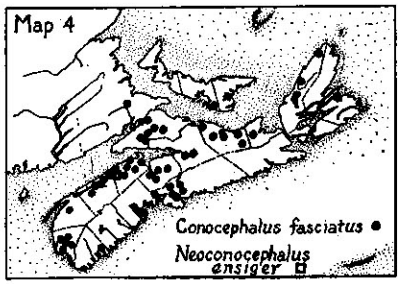
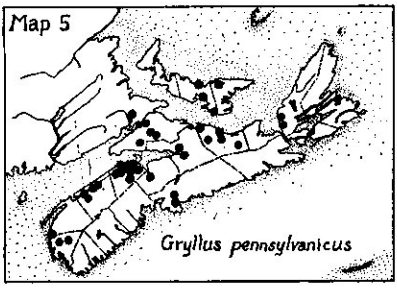
Scudderia curvicauda ●
S. furcata □


Map 4
Conocephalus fasciatus ●
Neoconocephalus ensiger □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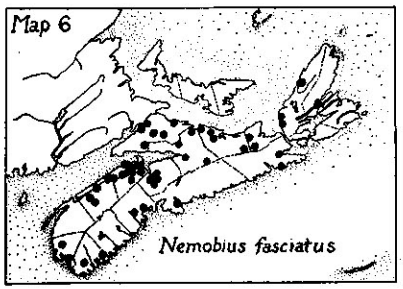
Gryllus pennsylvanicus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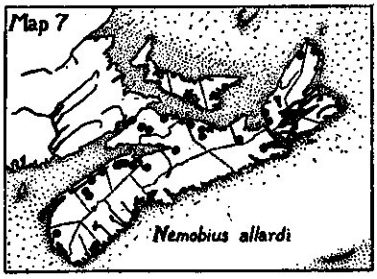
Nemobius fasciatus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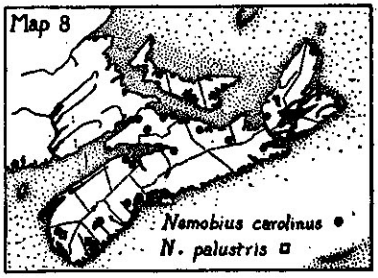
Nemobius allardi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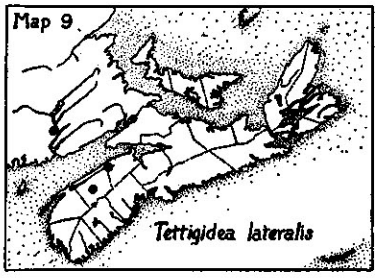
Nemobius carolinus ●
N. palustris □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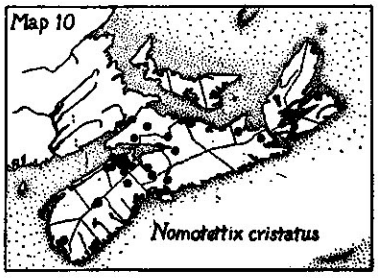
Tettigidea lateralis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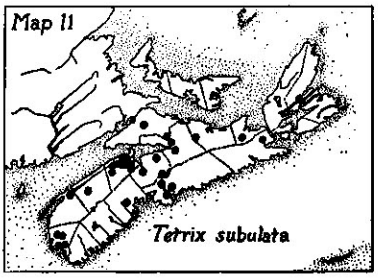
Nomotettix cristatus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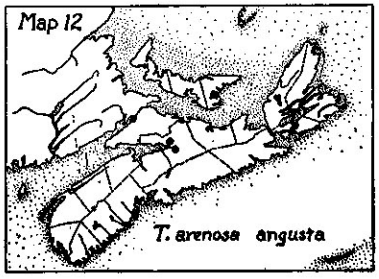
Tetrix subulata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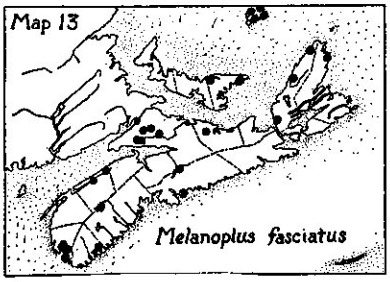
T. arenosa angusta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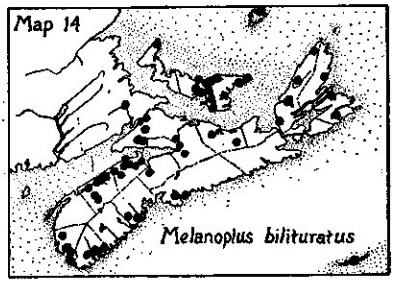
Melanoplus fasciatus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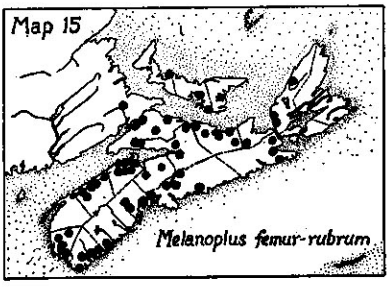
Melanoplus bilituratus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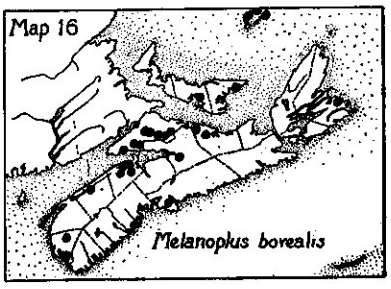
Melanoplus femur-rubrum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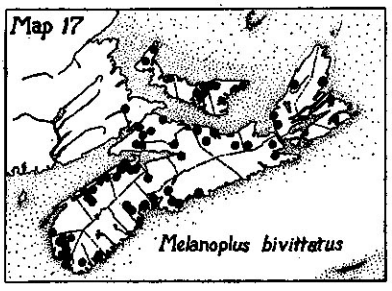
Melanoplus borealis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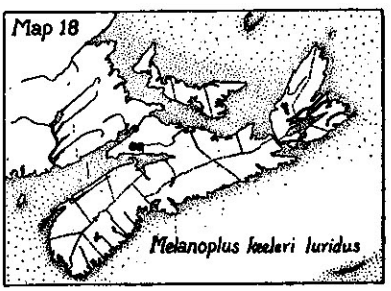
Melanoplus bivittatus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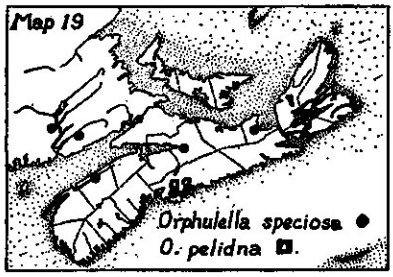
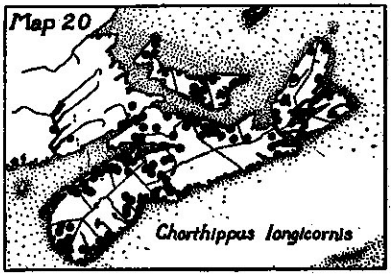
Melanoplus keeleri luridus


Map 19
Orphulella speciosa ●
O. pelidna ■.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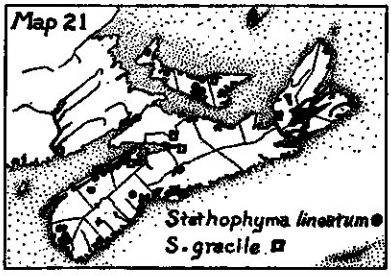
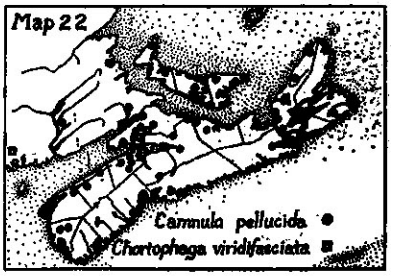
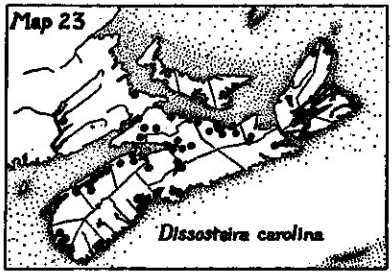
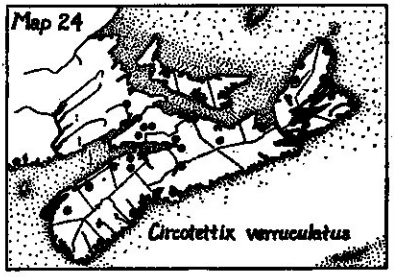
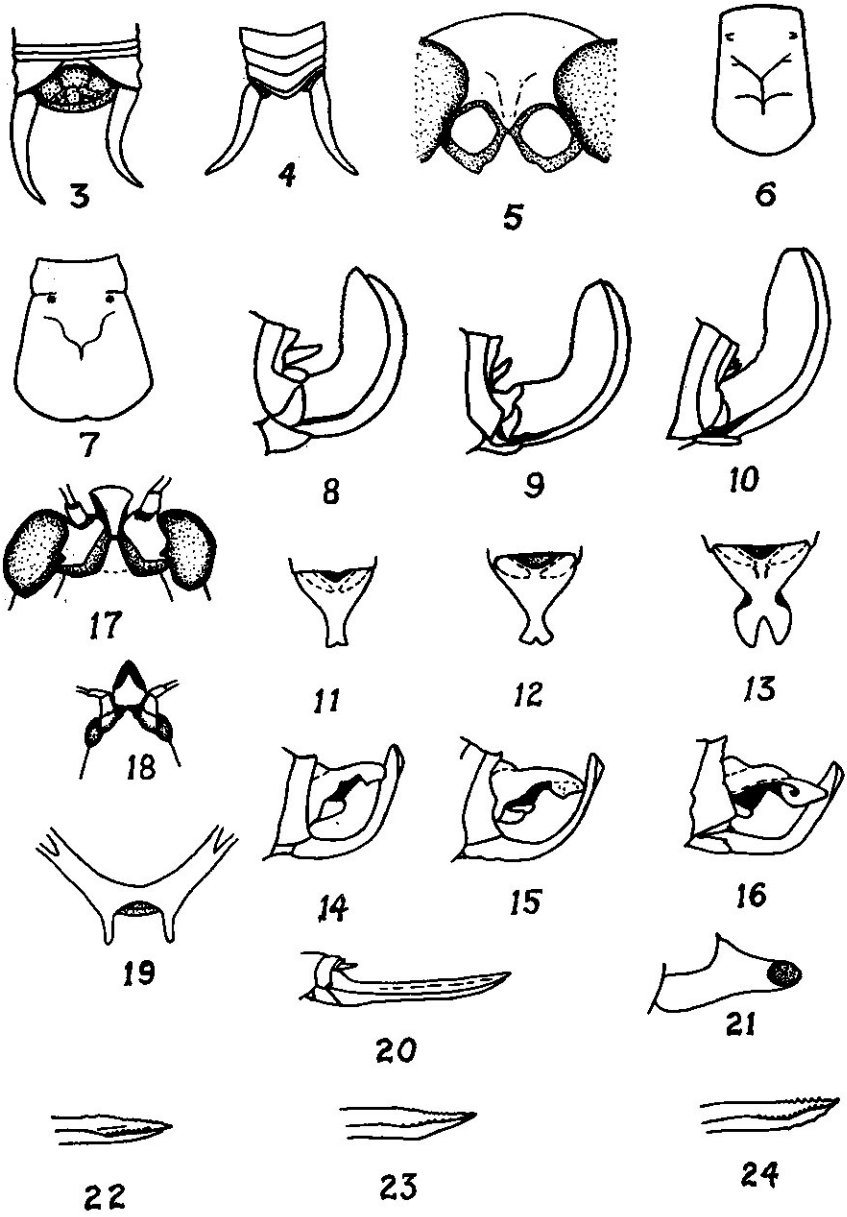
Chorthippus longicornis


Map 21
Stethophyma lineatum ●
S. gracile ■

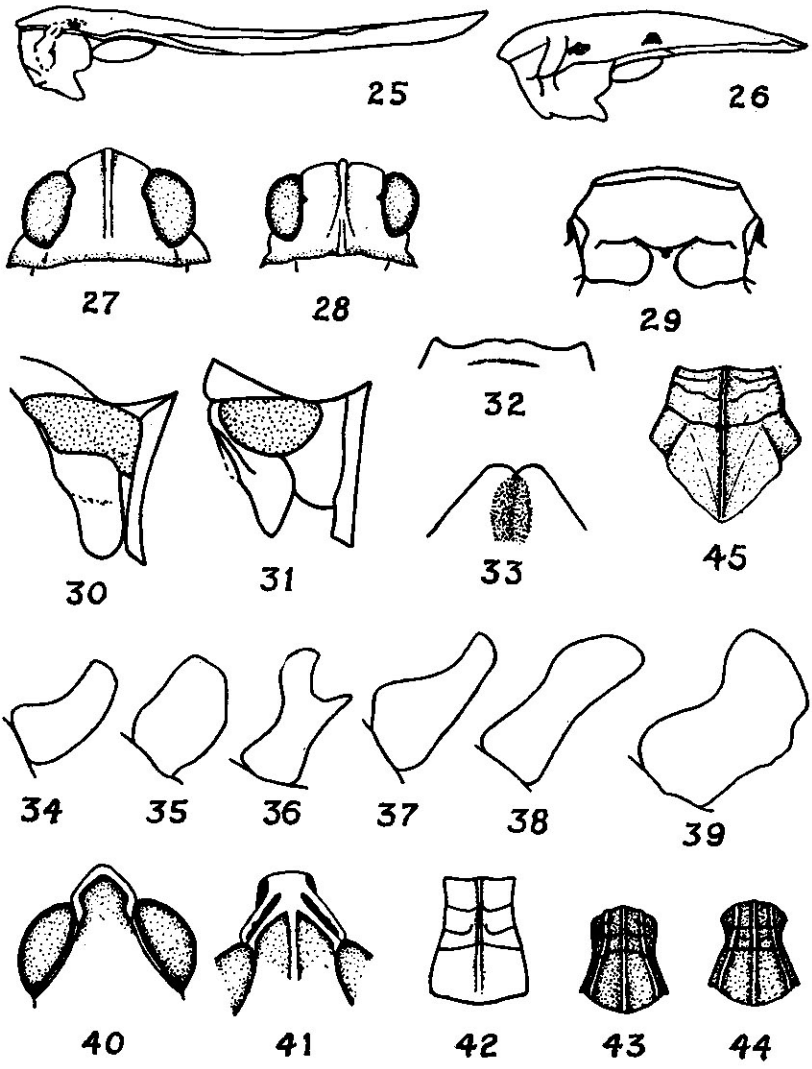

Map 22
Camnula pellucida ●
Chortophaga viridifasciata ■


Map 23
Dissosteira carolina


Map 24
Circotettix verruculatus



Figs. 3-24.



Figs. 25-45

Fig. 3. Posterior part of abdomen of *Ceuthophilus maculatus*, male, dorsal aspect.

Fig. 4. Same, of *C. brevipes*.

Fig. 5. Frontal fastigium of *Scudderia furcata*, anterior aspect.

Fig. 6. Pronotum of *Scudderia furcata*, female, dorsal aspect.

Fig. 7. Same, of *S. pistillata*.

Fig. 8. Ovipositor of *Scudderia pistillata*, female, lateral aspect.

Fig. 9. Same, of *S. curvicauda*.

Fig. 10. Same, of *S. furcata*.

Fig. 11. Supra-anal spine of *Scudderia pistillata*, male, dorsal aspect.

Fig. 12. Same, of *S. curvicauda*.

Fig. 13. Same, of *S. furcata*.

Fig. 14. Extremity of abdomen of *S. pistillata*, male, lateral aspect.

Fig. 15. Same, of *S. curvicauda*.

Fig. 16. Same, of *S. furcata*.

Fig. 17. Frontal fastigium of *Conocephalus fasciatus*, anterior aspect.

Fig. 18. Same, of *Neoconocephalus ensiger*.

Fig. 19. Prosternal spines of *Conocephalus fasciatus*, female, anterior aspect, head removed.

Fig. 20. Ovipositor of *C. fasciatus*, female, lateral aspect.

Fig. 21. Left cercus of *C. fasciatus*, male, dorsal aspect.

Fig. 22. Tip of ovipositor of *Nemobius allardi*, female, lateral aspect.

Fig. 23. Same, of *N. palustris*.

Fig. 24. Same, of *N. carolinus*.

Fig. 25. Pronotum of *Tetrix subulata*, lateral aspect.

Fig. 26. Same, of *Nomotettix cristatus*.

Fig. 27. Head of *T. subulata*, dorsal aspect.

Fig. 28. Same, of *T. arenosa angusta*.

Fig. 29. Mesosternal lobes of *Melanoplus bivittatus*, ventral aspect.

Fig. 30. Prosternal tubercle of *Melanoplus femur-rubrum*, lateral aspect.

Fig. 31. Same, of *M. bilituratus*.

Fig. 32. Subgenital plate of *Melanoplus femur-rubrum*, posterior aspect.

Fig. 33. Same, of *M. bilituratus*.

Fig. 34. Left cercus of *Melanoplus borealis*, male, lateral aspect.

Fig. 35. Same, of *M. bilituratus*.

Fig. 36. Same, of *M. keeleri luridus*.

Fig. 37. Same, of *M. femur-rubrum*.

Fig. 38. Same, of *M. fasciatus*.

Fig. 39. Same, of *M. bivittatus*.

Fig. 40. Head of *Orphulella speciosa*, dorsal aspect.

Fig. 41. Same, of *Chorthippus longicornis*.

Fig. 42. Pronotum of *Orphulella speciosa*, dorsal aspect.

Fig. 43. Same, of *Stethophyma lineatum*.

Fig. 44. Same, of *S. gracile*.

Fig. 45. Same, of *Dissosteira carolina*.

The range includes the eastern part of the Canadian and Transition Zones, in the northern United States and eastern Canada. It is usually found in similar locations to *C. maculatus*, but most of the specimens on hand were taken in damp cellars.

Nova Scotian records are from Truro and Debert, Colchester County; Kentville, Wolfville and Garland, Kings County; Clarence, Annapolis County; Lake Kedgemakoogie, Queens County; Petit Riviere, Lunenburg County; Armdale and Purcell's Cove, Halifax County; and Abercrombie and Hopewell, Pictou County. Piers (1918) also reported it from St. John and Grand Manan Island, New Brunswick. Hebard (1915) has recorded it from Newfoundland. The Zoology Museum, University of Michigan, Ann Arbor, Michigan, has a specimen from Nicholsville, Kings County, Nova Scotia.

Superfamily Tettigonoidea

Family Tettigoniidae (Sens. Lat.)

The group is characterized by the long filiform antennae, much longer than the body; four-segmented tarsi; tegmina, when at rest, held sloping, meeting in an acute ridge over the body; ovipositor sword or sickle-shaped, tip not expanded; stridulating organs, when present, situated just behind the pronotum, at the base of the overlapping dorsal area of the tegmina. Stridulation is brought about by parting the tegmina and bringing them together again, a vein of the upper surface of the right tegmen rasping against teeth of the stridulatory vein on the underside of the left tegmen. Winter is passed in the egg stage. The method of oviposition varies in the different groups.

Key to Nova Scotia Subfamilies of Tettigoniidae

1. Prosternum not spined; vertex rounded; tegmina broad and leaf-shaped; shorter than wings; hind tibiae with apical spurs on both inner and outer sides.
.....Phaneropterinae, p. 20.

Prosternal spines present; vertex projecting as a tubercle or cone; hind tibiae with no apical spines (or spine on outer side only).....2.

2. Vertex ending in a long, usually sharp cone; large (more than 23 mm.), robust; front and middle femora spined beneath.

.....Copiphorinae, p. 24.

Vertex ending in a rounded tubercle with concave sides; smaller (not more than 15 mm.), more slender; front and middle femora without spines beneath.

.....Conocephalinae, p. 26.

Subfamily Phaneropterinae

The members of this group live chiefly in bushes and small trees. They are solitary and slow moving, blending extremely well with their environment. Because of this, some species that are quite numerous are seldom seen. Eggs are glued in double rows to the surface of slender twigs or are inserted in the edges of leaves. The ovipositor is broad, curved, and obtuse at the apex. Stridulation notes are harsh and rasping, and are heard chiefly at night. Three species, all belonging to the genus *Scudderia*, are found in Nova Scotia.

Genus *Scudderia* Stål.

Scudderia Stål, 1873. Ofv. Vet. Akad.Fork. 30 (4); 41.

Key to Nova Scotia Species of *Scudderia*.

1. Males.....2.
   Females.....4.

2. Notch of supra-anal spine rather shallow and V-shaped, the branches of the fork not swollen.....3.

Notch of supra-anal spine very deep, well rounded or U-shaped, each branch of fork much swollen.

.....*S. furcata*, p. 23.

3. Ends of branches of supra-anal spine gently tapering; tegmina broad (over 8 mm.), and short, not more than four times as long as wide.

.....*S. pistillata*, p. 21.

Ends of branches of supra-anal spine subequal in width when viewed from above; tegmina narrower (under 8 mm.), and longer, nearly five times as long as broad.

.....*S. curvicauda*, p. 22.

4. Disc of pronotum with sides nearly parallel.
.....*S. furcata*, p. 23.
Disc of pronotum with sides distinctly widening posteriorly. .....5.

5. Tegmina relatively broad, over 8 mm., proportion — width: length — 1:3; eyes small.
.....*S. pistillata*, p. 21.
Tegmina relatively narrow, under 8 mm., proportion — width: length — 1:4½; eyes large.
.....*S. curvicauda*, p. 22.

3. *Scudderia pistillata* Brunner. Map 2; Fig. 7, 8, 11, 14.
Scudderia pistillata Brunner von Wattenwyl, 1878. Mon. der Phan.: 240.
?*Phaneroptera curvicauda.* F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. 2: 335 (*nec.* De Geer).
?*Phaneroptera curvicauda.* F. Walker, 1872. Can Ent. 4: 30 (*nec* De Geer).
Scudderia pistillata. Piers, 1896. Trans. N. S. Inst. Sci. 9: 211.
.....Gooderham, 1918. Proc. Ent. Soc. N. S. 1917:26-28, 36.
.....Piers, 1918. Trans. N. S. Inst. Sci. 14:312-317.
.....J. W. H. Rehn, 1939. Can. Ent. 71:177.
Common name: "Broad-winged Bush-katydid".

Disc of pronotum distinctly broader posteriorly than anteriorly; tegmina broad and leaf-like, only three times as long as broad; supra-anal spine of male forked, the apical notch acute and shallow without a median tooth, and narrower than the upturned sub-anal spine; lateral flanges of notch subtriangular and distinctly tapering toward their ends, viewed from above; undersides of processes bearing small vertical longitudinal flanges or keels; hind femur of male 21 mm., of female 20 mm. Colour, pale apple-green above, whitish green below; antennae brownish, greenish basally; vertex of head white; dorso-lateral angle of pronotum with cream stripe; abdomen green; annular stripes of brighter on darker green on posterior margins of abdominal segments; two longitudinal raised white lines on ventral abdominal surface. Body length, male 19-23.5 mm., female 19-22 mm.

S. pistillata is common on bushes, mainly alders, in swampy locations. The loud stridulations of the males at dusk and after dark, on August nights, is a familiar sound in Nova Scotia. The call of *pistillata* is described "as a multi-pulse phrase in which the pulses are run together so that the human observer can only detect them clearly at low temperatures." (R. D. Alexander, personal communication, 1959). Irregularly timed, soft 'zik' sounds are heard during afternoons and at night. The significance of these sounds is not understood.

The range of this species includes the area from the southern part of the Canadian Zone to the northern part of the Upper Austral Zone, northern United States and southern Canada, east of the prairie.

The species is very common throughout Nova Scotia, much the most numerous of any species of *Scudderia*. It is recorded from Sutherland's Lake, Bayhead, Tatamagouche and Truro, Colchester County; Brule and Three Brooks, Pictou County; Brierly Brook, Antigonish County; Halifax, Goodwood Peggy's Cove and West Dover, Halifax County; Hantsport, Hants County; Delhaven, Canning, Kentville, Woodville, Waterville, Berwick, Aylesford and Millville, Kings County; Wilmot and Middleton, Annapolis County; Weymouth, Digby County; Yarmouth, Brooklyn, South Ohio and Deerfield, Yarmouth County; and Sable River, Shelburne County, from July 14 to October 21.

4. *Scudderia curvicauda* (De Geer). Map 3; Fig. 9, 12, 15.

   Locusta curvicauda De Geer, 1773. Mem. Hist. Nat. Ins. 3:446.

   Scudderia curvicauda borealis. Gooderham, 1918. Proc. Ent. Soc. N. S. 1917:28-29.

   .....Piers, 1918. Trans. N. S. Inst. Sci. 14:317-320.

   .....J. W. H. Rehn, 1939. Can. Ent. 71:178.

   Common name: 'Curve-tailed Bush-katydid'.

This species resembles *S. pistillata* but is distinguished by features as given in the key to species of *Scudderia*. It has narrower tegmina, larger eyes, and somewhat longer hind femora (20-22.5 mm. as compared with 20-21 mm. in *S. pistillata*); it also has a smaller tympanal area on the male tegmen;

and the branches of the fork of the male supra-anal spines are subequal in width. The colour is generally a uniform green; lateral angles of pronotum weakly outlined in brownish-white. Body length, male 18-22 mm., female, 18-20 mm.

The subspecies *S. c. borealis* Rehn and Hebard (1915), rather than typical *S. c. curvicauda* was generally considered to be represented in Nova Scotia. Blatchley (1920) doubted the justification of recognizing *borealis* solely on the basis of the smaller size and broader and shorter tegmina, but the subspecific name became widely used. It is not now considered to be a valid subspecies.

This species is frequently heard in daylight hours in Nova Scotia. The call is similar to that of *S. pistillata* but is delivered much more slowly. The individual pulses are detectable and can be counted; usually 3 or 4 pulses are given for each phrase. Observations of the call of *S. curvicauda* were not unlike the descriptions given by Piers (1918) as 'bzrwi' by day and a repeated 'tchw' by night.

S. curvicauda is not nearly as common as *S. pistillata* but appears to be generally distributed in Nova Scotia. It has been collected at Stellarton and Three Brooks, Pictou County; Truro, Colchester County; Kentville, Waterville and Canard, Kings County; Melvern Square and Wilmot, Annapolis County; South Ohio and Deerfield, Yarmouth County; Jordan Falls and Sable River, Shelburne County; Green Bay, Lunenburg County; and Peggy's Cove, Halifax County, from August 15 to October 12.

5. *Scudderia furcata furcata* Brunner. Map 3; Fig. 5, 6, 10, 13, 16.
   Scudderia furcata Brunner von Wattenwyl, 1878. Mon. der Phan.:239.
   ?*Phylloptera myrtifolia.* F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. 2:376. (*nec* Serville).
   .....F. Walker, 1872. Can. Ent. 4:30 (*nec* Serville).
   Scudderia furcata. Gooderham, 1918. Proc. Ent. Soc. N. S. 1917:28, 30.
   .....Piers, 1918. Trans. N. S. Inst. Sci. 14:320-323.
   Common name — 'Fork-tailed Bush-katydid'.

Disc of pronotum with sides nearly parallel; tegmina narrow, with proportions width to length, 1:4½ in males; 1:4⅝ in females; supra-anal spine of male deeply forked, apical notch deep and U-shaped, without a median tooth, lateral processes decidedly swollen, broadest at the base; and not much longer than broad; hind femora 17.5 to 22 mm. Colour dark leaf-green, occasionally more or less suffused with brown; head and pronotum paler, lateral outlines of pronotum not outlined with yellowish. Body length, male, 14-18 mm., female 18-22 mm.

S. furcata, according to Allard (1911), calls less often at night than during the afternoons. It calls only at long and irregular intervals, and then produces a single keen 'zeep', or two or three, slowly, in succession, 'zeep, zeep, zeep'. Stridulation of *S. furcata* in Nova Scotia has been observed on several occasions. Each time the call was heard at night and consisted of a single phrase of sound, like 'zeeep'.

This species is of more generally southern distribution than the other species common in Nova Scotia. It is found in southern Canada and in most of the United States, from Nova Scotia to Florida and west to Texas, Nebraska, South Dakota, and Ontario.

S. furcata is rather scarce in Nova Scotia except along the southwestern shore, where it is the dominant species of *Scudderia*. The collection at the Nova Scotia Agricultural College has specimens from Onslow, Colchester County; Rawdon, Hants County; Kentville and Berwick, Kings County; Sable River, Shelburne County; Lake Kedgemakoogee, Queens County; and Middlewood, Lunenburg County. Piers (1918) reported this species from Halifax and the Canadian National Collection has specimens labelled *Scudderia* (prob. *furcata*), from Bridgewater, and White Point Beach, Lunenburg County, and from Baddeck, Victoria County.

Subfamily Copiphorinae

This subfamily contains rather large elongate species with the vertex of the head terminating in a spine, often with a ventral tooth-like projection; antennae long; ovipositor long, straight, slender and sharp-pointed. The males stridulate like the katydids. The eggs are laid in plant material.

Genus *Neoconocephalus* Karny.

Neoconocephalus Karny, 1907. Abr. Zool. Bot. Gesells. Wein. 4(3) :22.

Only one species of this genus, *N. ensiger*, is established in Nova Scotia, although an interesting introduction of another occurred in 1958. A living specimen of *Neoconocephalus*, which had been found in macaroni, packaged in the southern part of the United States, was brought to Mr. D. C. Ferguson of the Nova Scotia Museum of Science, Halifax. It proved to be *N. robustus* (Scudder). It was maintained alive at the Museum for more than a month.

6. *Neoconocephalus ensiger* (Harris). Map 4; Fig. 17.
Conocephalus ensiger Harris, 1841. Rpt. Ins. Mass.: 131.
Common name — 'The Sword Bearer'.

Generally elongated, slender; fastigium slender, slightly constricted in front of the eyes, narrowed from the middle forward, tooth projecting downward from front of base; pronotum with lateral carinae feebly divergent, disc finely punctate; humeral sinus shallow, very broadly rounded; tegmina narrow and much longer than the body; stridulating vein of male long and feebly swollen; female ovipositor long, straight and pointed. Colour grass-green (usually fading to dull yellow on drying); margins and tip of lower face of fastigium black, the tooth green; lateral carinae of pronotum often yellowish; tarsi, hind tibiae and tip of ovipositor somewhat infuscated. Body length, male, 24-26 mm., female, 28-30 mm.

N. ensiger stridulates only at night or during cloudy weather. Allard (1911) reports this call as consisting of an intermittent but brisk 'tsip- tsip-tsip-tsip', which continues indefinitely and lacks the harshness characteristic of *Scudderia* spp. No opportunity to study the stridulation of this species was encountered during the present study.

This species has a very wide distribution, from Nova Scotia, Maine, Southern Ontario, North Dakota and south and south-east to North Carolina, Tennessee, Kansas and New Mexico. It frequents tall grasses along ditches, fields, roadsides, etc. The present record, the first for Nova Scotia, shows *N. ensiger* to be very localized in distribution, having been taken at only one site. This is near the Royal Canadian

Air Force Station, Greenwood, probably introduced by aircraft. Three specimens are to hand, all males taken at Millville, Kings County, one on August 13, 1954 and the other two on August 19, 1954.

Subfamily Conocephalinae

Members of this subfamily are superficially very similar to the Copiphorinae but are considerably smaller; vertex of the head terminating in a tubercle, usually blunt. The males stridulate but the notes are very soft and low and are heard both day and night. The eggs are deposited between the stems and root-leaves of grass or in the pith of twigs, etc.

Genus *Conocephalus* Thunberg.

Conocephalus Thunberg, 1815. Mem. Acad. Impt. Soc. St. Petersburg, **5**:271.

Conocephalus fasciatus (De Geer) is the only species of this genus found in Nova Scotia. It was expected that *C. brevipennis* Scudder might occur but it was not located within the study area.

7. *Conocephalus fasciatus fasciatus* (De Geer). Map 4; Fig. 18, 19, 20, 21.
   Locusta fasciatum De Geer, 1773. Mem. Hist. Nat. Ins. **3**:458.
   Xiphidium fasciatum. F. Walker, 1869. Cat. Derm. Salt. Brit. Mus. **2**:270.
   .....F. Walker, 1872. Can. Ent. **4**:30.
   .....Piers, 1896. Trans. N. S. Inst. Sci. **9**:213.
   Conocephalus fasciatus. Gooderham, 1918. Proc. Ent. Soc. N. S. for **1917**:24-25.
   .....Piers, 1918. Trans. N. S. Inst. Sci. **14**: 324-325.
   Conocephalus fasciatus fasciatus. J. W. H. Rehn, 1939. Can. Ent. **71**:178.
   .....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:204.
   Common name — 'Slender Meadow Grasshopper'.

Very slender, delicate species; vertex of head extends forward and slightly upward as a rounded tubercle with concave sides; antennae long; prosternal spines short and weak; tegmina narrow, straight, and extending well beyond the

abdomen; wings slightly longer than tegmina; ovipositor slender, straight, and about two-thirds as long as the hind femora; hind legs long and slender, femora and tibiae about equal in length. The colour is a translucent light apple-green, finely sprinkled with brown on face, sides of head, pronotum and legs, those on the hind femora arranged in longitudinal lines; a dark brown dorsal stripe extends from vertex to end of abdomen, narrow on head, wider on abdomen; sides of abdomen brown; tegmina greenish white to yellowish, with a brownish-red blotch on the lateral basal part, this colour extending to the veins; hind femora green with apical third fawn; hind tibiae light fawn, spines tipped with black; Body length, male 12-13.5 mm., female 12-14.5 mm.

The stridulation of *C. fasciatus*, according to Allard (1911) consists of faint, staccato lisps preceding a long drawn out note, like 'tip-tip-tip-tseeeeeee'. The preceding lisps usually number from three to six, and are so faint they may easily be missed. The stridulation in Nova Scotia conforms very well to this description.

The range of this subspecies is very wide, all over the United States and southeastern Canada from the Rocky Mountains east to the Atlantic, and southward into Mexico. It is very common all over Nova Scotia. It prefers tangles of weeds and grasses bordering fields and often is found in large numbers. The earliest and latest dates of collection in Nova Scotia are July 18 and September 22. E. M. Walker (1915) reported *C. fasciatus* from Moncton, New Brunswick and Urquhart collected it at Wood's Island, Prince Edward Island, in 1949.

Superfamily Grylloidea

Family Gryllidae

This family includes all the true crickets found in Nova Scotia. The filiform antennae are much longer than the body and the tegmina lie flat above the body, bent abruptly downward at the sides; hind femora stout, tarsi three-segmented; ovipositor straight or up-curved, needle-like, with the tip often enlarged; the stridulating organ, when present, is large, extending across the proximal portion of both anal and median areas of the tegmina; the hind wings are often of little use in flight and may be considerably reduced. Eggs are laid in the

ground and winter is passed in the egg stage in species occurring in Nova Scotia, although hibernation of nymphs is common in other species and in other parts of the world. Many species of Gryllidae are grass feeders and may cause considerable damage to grassland.

Key to Nova Scotia Subfamilies and Genera of Gryllidae

Species small (body length less than 12 mm.); last segment of maxillary palp twice the length of the preceding segment; hind tibiae with long, moveable, pilose spines; first segment of hind tarsus without teeth or with one row of small teeth.

.....Nemobiinae, *Nemobius*, p. 31.

Species large (body length more than 12 mm.); last segment of maxillary palp little if any longer than the preceding segment; hind tibiae with strong, immoveable spines; first segment of hind tarsus grooved above, with two rows of teeth.

Gryllinae, *Gryllus*, p. 28.

Subfamily Gryllinae

This subfamily contains robust crickets of medium to large size; head large, eyes prominent; pronotum broader than long; hind tibiae armed above on each side with five to eight stout spines and three pairs of unequal apical spurs; ovipositor as long or longer than hind femora, apex enlarged but not serrulate.

Genus *Gryllus* Linnaeus.

Gryllus Linnaeus, 1758. Syst. Nat. ed. **X**:425.

Uvarov (1935) erected the genus *Gryllulus*, with the type species *G. domesticus* (L.), to define the limits of a group of species, originally included under *Gryllus* Linnaeus, in its modern sense. Roberts (1941) pointed out that the name *Acheta* Fabricius, 1775, was available and had priority over *Gryllulus*. The use of this name *Acheta* in place of *Gryllulus* was established by Gurney (1950). However, Randell (in manuscript) has shown that common North American species differ markedly from *A. domesticus* (Linn.), type species of *Acheta*, and are properly included under *Gryllus*, as they are

more closely related to *G. campestris* Linn., type species of *Gryllus*.

8. *Gryllus pennsylvanicus* (Burmeister). Map 5.
Gryllus pennsylvanicus Burmeister, 1838. Handb. Ent. 2:734.
Acheta abbreviata. Piers, 1894. Trans. N. S. Inst. Sci. 8:410.
Gryllus pennsylvanicus form *neglectus.* Piers, 1896. Trans. N. S. Inst. Sci. 9:210.
Gryllus assimilis. Rehn and Hebard, 1915. Proc. Acad. Nat. Sci. Philad. 67:293. (partim, *nec* Fabricius).
Gryllus assimilis form *neglectus.* Piers, 1918. Trans. N. S. Inst. Sci. 14:341-354.
Gryllulus assimilis. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. 4:264.
Common name — 'Northern Fall Field Cricket'.

Size small to medium; width of abdomen about one-third body length; head nearly same in width as pronotum; pronotum half again as wide as long, little if any narrower behind, front margin slightly concave, hind margin slightly convex; tegmina of female usually covering three-fifths to four-fifths of the abdomen, never longer than the abdomen; tegmina in male usually nearly covering abdomen, rarely slightly longer; inner edges of tegmina overlap for entire length in male, but may be somewhat separated in female at the ends to form an inverted V-shaped notch. Colour generally black, often with fine grey pubescence on the pronotum, femora and some other parts; head shining black; tegmina shining black with a light coloured line; ovipositor brownish; femora with brownish areas on inner and outer faces. Body length, male 15-21 mm., female 14.7-23.7 mm.

Allard (1911) made the observation that this species stridulates incessantly in sunshine, emitting a brief, intermittent, musical 'chirp, chirp, chirp'. This is certainly true of specimens in Nova Scotia but stridulation is by no means confined to the daylight hours.

Fulton (1952) carried out a comprehensive study of the North Carolina field crickets making up the complex, known since the revision of Rehn and Hebard (1915) as *Gryllus assimilis* (Fabr.). Fulton concluded, on the basis of differences in

ecology, distribution, life history and song, that this complex included four valid North Carolina species.

Alexander (1957) pointed out that *assimilis* (Fabr.), 1775, was described from Jamaica and found that specimens from Jamaica were morphologically different from those of the eastern United States, so that Fabricius' name *assimilis* should not be applied to the northern forms. The next valid name is *pennsylvanicus* Burmeister, 1838.

In the eastern United States, and in Quebec, two distinct seasonal populations exist: one which over-winters in the late nymphal stages, with adults present from May until early August; and another which over-winters in the egg and is present in the adult condition from August to October. This was recognized by Criddle (1925) in Manitoba, when he called the spring cricket *Gryllus assimilis pennsylvanicus* Burm. and the autumn cricket *G. a. luctuosus* Serville.

No spring-maturing crickets have been found in Nova Scotia during the twelve years that the author has been collecting Orthoptera there. No crickets have been heard before early August, except in very sheltered locations. Piers (1918), who collected Orthoptera for twenty-four years before that date, made the following statement, "I have never noted crickets in the spring or early summer, as in Ontario and other places to the south where nymphs hibernate to some extent." (p. 353). No *Gryllus* specimens have been found in the adult condition before July 29 (these were in a sheltered location) during the present study.

The absence of the spring field cricket in Nova Scotia proves the theses of Alexander (1957) and Bigelow (1958) to be correct; the spring and fall field crickets are distinct species. Alexander and Bigelow (1960) have named the spring species *G. veletis*. The fall maturing species, occurring in Nova Scotia, is *G. pennsylvanicus* (Burm.).

This species is common in Nova Scotia from early August to October. It has been collected from August 2 to November 5 from the following points: Amherst, Collingwood, West Brook and Wyndhamhill, Cumberland County; Truro and Debert, Colchester County; Pictou, West River, Westville, Brule and Garden of Eden, Pictou County; Windsor, Hants County; Kentville, Wolfville, Berwick, Black Hole, North

Alton, and Aylesford, Kings County; Bridgetown, Le Quille, and Paradise, Annapolis County; Beaver River, Digby County; South Ohio and Kemptville, Yarmouth County; Bedford and Halifax, Halifax County; Judique and Creignish Mountain, Inverness County; and from Dorchester, New Brunswick.

Rehn (1939a) recorded it from North Sydney and Annapolis Royal, as well as from some of the above mentioned localities.

Urquhart supplied five specimens, three males and two females from Windsor and Pictou, labelled *Gryllulus assimilis luctuosus*, to the Nova Scotia Agricultural College insect collection in 1949. He also collected this species at Wood's Island, Prince Edward Island. E. M. Walker (1915) reported it from Brackley Point, Charlottetown and Dundee, Prince Edward Island.

Subfamily Nemobiinae

Small, compact species; body and legs usually covered with long hairs; ocelli small, round, and arranged in a triangle; eyes oval, prominent; pronotum slightly broader than head; tegmina of males usually shorter than abdomen, tips rounded or subtruncate; tegmina of females with few prominent longitudinal veins and numerous small cross veins; hind wings variable, often absent; hind femora swollen; cerci of both sexes slender, tapering, hairy, and about one-half as long as the femora; ovipositor variable.

These crickets are often gregarious, and unlike the Gryllinae, feed during daylight. They are omnivorous, and according to Blatchley (1920) feed "upon carrion, cow dung, and grasses with equal avidity". As they are usually very numerous they may cause considerable damage to grasses.

Genus *Nemobius* Serville.

Nemobius Serville, 1839. Hist. Nat. Ins. Orth :345.

Key to Nova Scotia Species of *Nemobius*

1. Lower pair of apical spurs of hind tibiae unequal in length, inner one much longer; apex of ovipositor of female with only upper margin more or less finely serrulate. .....2.

Lower pair of apical spurs of hind tibiae equal in length; apex of ovipositor of female with both upper and lower

margins serrulate, teeth of lower margin very fine and widely spaced, teeth of upper margin coarse; general colour pale brown; last two joints of maxillary palpi partially but not wholly white.

..... *N. carolinus*, p. 35.

2. Ovipositor short, about two-thirds as long as hind femora, weakly but evidently curved; wings usually present and usually longer than abdomen; ovipositor armed with fine, close-set teeth; general colour dark brown to uniform piceous, occiput without longitudinal stripes; body length of male rarely over 6 mm.; habitat — sphagnum bogs.

..... *N. palustris*, p. 35.

Ovipositor longer than or nearly as long as hind femora, straight or nearly so; teeth of upper margin of apex fairly coarse; occiput with four dark longitudinal stripes, varying from distinct to nearly obsolete; general colour black to dark brown; males 7.5 mm., females 8-10 mm. in length.

.....3.

3. (Adapted from Alexander and Thomas, 1959, p. 600) Head colouration showing distinct, dorsal, longitudinal dark and lighter stripes; head wide and well rounded, pronotum barrel-shaped so that head and front edge of pronotum are as wide or wider than rear edge of pronotum; ovipositor shorter, 5.9 to 10 mm. (over 7.5 mm. only in specimens with head width behind eyes over 2.6 mm.); stridulatory vein on right tegmen of male with 100 to 150 teeth, portion inside ulnar vein less than 1.0 mm. long and less than one-third as long as width of head behind the eyes; generally found in moist situations; song a steady repetition of short buzzing chirps, like 'bzzzt, bzzzt, bzzzt'.

..... *N. fasciatus*, p. 33.

Dorsal striping of head indistinct; head narrow and retracted, pronotum narrower in front, so that head and front edge of pronotum is narrower than rear edge of pronotum; ovipositor longer, 6.0 — 10.3 mm.; head width behind eyes not over 2.8 mm.; stridulatory vein on right tegmen of male with more than 160 teeth, portion of vein inside ulnar vein usually more than 1.0 mm. and more than two-fifths as long as width of head behind eyes; found in dry or moist areas; song a rapid trill, like 'ti-ti-ti-ti-ti', in which the individual notes are barely perceptible.

..... *N. allardi*, p. 34.

9. *Nemobius fasciatus* (De Geer). Map 6.
Gryllus fasciatus De Geer, 1773. Mem. Ins. 3:522.
Nemobius vittatus. Walker, F., 1869. Cat. Derm. Salt. Brit. Mus. 1:57, 114.
.....Walker, F., 1872. Can. Ent. 4:30.
Acheta vittata. Piers, 1894. Trans. N. S. Inst. Sci. 8:410.
Nemobius fasciatus vittatus. Piers, 1896. Trans. N. S. Inst. Sci. 9:210.
Nemobius fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. 14:330-335.
Nemobius fasciatus fasciatus. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. 4:265.
Common name — 'Striped Ground Cricket'.

Size relatively small, males 7.5 to 10 mm., females 8 to 11 mm. in length; head and pronotum hairy; ovipositor straight; tegmina of females cover about one-half of abdomen in micropterous forms, and about two-thirds of abdomen in males, cross veins prominent; macropterous females with wings and tegmina extending to tip of ovipositor, of males, correspondingly long; colour black to sooty brown, tegmina and legs somewhat paler; occiput with four distinct dark longitudinal stripes, ovipositor blackish.

N. fasciatus has been commonly called *N. f. socius* Scudder in the literature. This situation has been clarified recently by the separation of two good species, this being called *N. fasciatus* (De Geer), and the species formerly called *N. f. fasciatus* (De Geer) being called *N. allardi* Alexander and Thomas (1959).

This species is separable from the related *N. allardi* Alexander and Thomas, rather easily in the case of living specimens in the field and with considerably less ease, in the case of dried, pinned specimens. It has been found easier to determine species in the field by observation of stridulation (see key) than by collecting and basing determination upon morphological characters. Of the nearly 700 specimens of *N. fasciatus* and *N. allardi* presently housed in the collection of the Nova Scotia Agricultural College, eighty-one per cent are *N. fasciatus*, the remaining nineteen per cent are *N. allardi*. *N. fasciatus* is the most common and widespread field cricket in Nova Scotia, having been taken at forty-six localities in fourteen counties during the present study.

It is difficult to determine to which species previous records for Nova Scotia referred. Piers (1918) gives some indication, from his description of colour variation that both species were included. His description of longitudinal head stripes is typical of *N. fasciatus*, but his description of stridulation —"a trilling sound or tremolo-resembling the syllable *ple-e-e-e, ple-e-e-e, ple-e-e-e*" — is more typical of *N. allardi*. Rehn (1939a) mentions "both the intense black and the striking contrasted forms", so it is possible that he also had both species.

10. *Nemobius allardi* Alexander and Thomas. Map 7; Fig. 22.
Nemobius allardi Alexander, R. D. and E. S. Thomas, 1959. Ann. Ent. Soc. Amer. **52**(5):592.
Nemobius fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. **24**:330-335.
Nemobius fasciatus fasciatus. J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:265.
Common name — "Allard's Ground Cricket".

Very similar to *N. fasciatus*; average lighter in colour; longitudinal stripes on occiput obscure to almost absent; distinguishable from *N. fasciatus* by features in key.

Fulton (1931) described the differences in stridulation in *fasciatus* (now *allardi*) and *socius* (now *fasciatus*). In 1933, Fulton reported on failure of the two to hybridize in the laboratory, and Fulton (1937) gave differences in morphology, colour, ecology and life history in North Carolina. He did not however, assign specific rank but considered them subspecies. Alexander and Thomas (1959), after examination of all existing types in the group, determined that *socius* is in fact *fasciatus* (De Geer) and assigned *allardi* as a new name for the species formerly called *fasciatus fasciatus*.

N. allardi, is not nearly as numerous as *N. fasciatus* in Nova Scotia, although it is widespread in distribution. It is recorded from Pugwash, Collingwood and Springhill, Cumberland County; Truro, Colchester County; Brule, Scotsburn and West River, Pictou County; Lochaber, Antigonish County; Creignish Mountain, Judique and Pleasant Bay, Inverness County; Sweet's Corner, Hants County; Kentville, South Berwick and Wolfville, Kings County; Melvern Square, Bridgetown, Le Quille and Graywood, Annapolis County;

South Ohio, Yarmouth County; and Sable River, Shelburne County.

11. *Nemobius carolinus* Scudder. Map 8; Fig. 24.
Nemobius carolinus Scudder, 1877. Proc. Bost. Soc. Nat. Hist. 19:36.
Nemobius carolinus. Piers, 1918. Trans. N. S. Inst. Sci. 14:335-336.
Common name — 'Carolina Ground Cricket'.

Resembles *N. fasciatus*, but is smaller; tegmina of male reach about the tip of the abdomen, of female cover about one-half of abdomen; hind wings wanting; ovipositor distinctly shorter than the hind femora and a little upcurved; teeth of ovipositor, very coarse on upper side, very fine and widely spaced on under side. Colour generally pale brown, head dark brown with yellow markings on vertex; antennae dark brown on three basal joints and on distal third, middle light brown; disc of pronotum mottled with light and dark brown spots, lateral lobes dark brown, sparsely clothed with coarse dark hairs; femora light brown with transverse darker markings on outer face; tibiae light brown and thickly clothed with fine dark hairs, bases of spines dark brown; tegmina yellowish. Body length, male 8.3 mm., female 8.5 mm.

Range is wide over eastern Canada and United States. Nova Scotia probably marks the northern limit. Its distribution extends south to Florida and Texas. It is found on grassy, sunny banks of streams, and about fences. Its trill is weak and continuous, indefinitely prolonged.

N. carolinus occurs rather widely in Nova Scotia, having been collected at Amherst, Collingwood and Pugwash, Cumberland County; Truro, Colchester County; Centreville and Wolfville, Kings County; South Ohio, Yarmouth County; Cookville, Lunenburg County; Dalhousie Mountain, Eden Lake, Pictou County; Cook's Cove, Guysborough County, and Creignish Mountain, Inverness County. Urquhart collected this species at Chester, Lunenburg County and at Sable River, Shelburne County in 1949 and Ferguson has taken it at Halifax and at Lake Rossignol, Queens County (Identified by the author at the Nova Scotia Museum of Science).

12. *Nemobius palustris* Blatchley. Map 8; Fig. 23.
Nemobius palustris Blatchley, 1900. Psyche 9:53.
Common name — 'Marsh Ground Cricket'.

Very small slender species, males shorter and broader than females; pronotal disc one-third broader than long, thickly covered with stiff, black bristles; occiput, and dorsal parts of the fore and middle femora also hairy; tegmina of male forming elongate quadrangle with sides feebly converging from base; tips narrowly rounded; tegmina of female covering slightly over one-half of the abdomen, tips broadly rounded; ovipositor distinctly but feebly upcurved, apex feebly enlarged, teeth of upper edge very fine and closely set. Colour generally uniform dark pisceous; maxillary palpi light except for apical joint. Body length, males 5.2-6.2 mm., females 6-6.8 mm.

This species is found in and around sphagnum mosses, peat bogs, tamarack swamps and cranberry bogs all along the Atlantic coast of the United States and the southwestern coast of Nova Scotia. Its call, according to Allard (1911) is a faint quavering, high-pitched trill. It was collected only at South Ohio, Yarmouth County, during the present study, and stridulation was not observed. Other collections are also from the Atlantic coastal area, two males, in the Nova Scotia Agricultural College collection, taken by Urquhart at Sable River, Shelburne County, August 8, 1949. Ferguson has found it on a bog on Prospect Road, Halifax County (Identified by the author at the Nova Scotia Museum of Science).

Suborder Caelifera
Superfamily Acridoidea
Family Tetrigidae

The Tetrigidae are characterized by the backward extending pronotum and by small size, averaging smaller than most other grasshoppers of Nova Scotia. Long and short-winged variants of the same species are common. Individual adults may be found nearly throughout the season. Adults usually hibernate and lay eggs during May and June. The nymphs usually mature by fall, but some nearly full grown nymphs may hibernate, as nymphs have been found early in April.

Four species, in two subfamilies, have been found in Nova Scotia.

Key to Nova Scotia Subfamilies of Tetrigidae.

1. Antennae with 22 segments; tegmina with subapical pale spot.

.....Batrachideinae, p. 37.

Antennae with 12-14 segments; tegmina without subapical pale spot.

.....Tetriginae, p. 38.

Subfamily Batrachideinae

Genus *Tettigidea* Scudder.

Tettigidea Scudder, 1862. Bost. J. Nat. Hist. 7:476.

13. *Tettigidea lateralis* (Say). Map 9.
Acrydium laterale Say, 1824. Amer. Ent. 1:10.
Tettigidea lateralis subspecies, Rehn and Grant, 1958. Trans. Amer. Ent. Soc. **85**:24-65.

Vertex very slightly produced beyond front margin of eyes; frontal costa rounding broadly into median carina of vertex, absent basally; pronotum convex between and in front of humeri; anterior margin of pronotum obtusely angled, not surpassing middle of eyes; median carina of pronotum distinct but not prominent, somewhat higher anteriorly; tegminal sinus more acute than lower sinus; surface of pronotum with fine raised pustules and distinct longitudinal rugae. Colour dark, variable. Length of body, males, 8.5 to 9.1 mm., females, 10.1 to 10.8 mm.

The first published report of this species from Nova Scotia was that of Rehn and Grant (1958), a single specimen from South Milford, July 10. This is in Annapolis County, although their distribution map indicates Milford, Colchester County.

Rehn and Grant (*loc. cit.*) studied a large series of *T. lateralis* and described a new subspecies, *Tettigidea lateralis cazieri*, with its typical range in the southwestern plains of the United States of America. Many northern specimens of *T. lateralis*, from Manitoba, Ontario, Quebec and Nova Scotia are classed as *T. lateralis lateralis* (Say), but intermediate, tending toward *T. lateralis cazieri*, and not typical of *T. lateralis lateralis*.

This species was found at Kingston, Kings County, during the present survey, in company with *Tetrix subulata*. It was not found elsewhere. These specimens, and a male from Hampstead, New Brunswick, appear to be very similar to a specimen from Hanover, New Hampshire, by comparison with the keys, descriptions and figures of Rehn and Grant (*loc. cit.*). They are thus probably not typical *T. lateralis lateralis*.

Subfamily Tetriginae

Key to Nova Scotia Genera of Tetriginae.

1. Antennae 12- or 13-segmented; median carina of pronotum high and crest-like, arched longitudinally; upper lateral sinus of pronotum about half as deep as lower sinus. ..... *Nomotettix*, p. 38.

Antennae 14-segmented; median carina of pronotum low and rather flat from lateral view; upper lateral sinus of pronotum nearly as deep as lower sinus. ..... *Tetrix*, p. 39.

Genus *Nemotettix* Morse.
Nomotettix Morse, 1894. Psyche **7**:150.

Rehn and Grant (1955) consider that *Nomotettix* is derived from *Tetrix*. North American species can be separated by the cristate pronotum but no single character will separate these two genera on a world-wide basis.

14. *Nomotettix cristatus cristatus* (Scudder). Map 10; Fig. 26.
Batrachidea cristata Scudder, 1862. Bost. J. Nat. Hist. **7**:478.
Nomotettix cristatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:23, 27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:254-257.
Nomotettix cristatus cristatus. J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.....J. W. H. Rehn, 1939a. Frag. faun. Mus. Zool. polon. **4**:260.
Common name — 'Crested Grouse Grasshopper'.

This is one of the smallest of Nova Scotian orthopterans; pronotum is high and arched; body finely granulate, especially on the pronotum; vertex projects beyond the eyes, front margin of pronotum extended over back of head; notches of lateral posterior pronotum as in key; pronotum reaching to apex of hind femora. Greyish-brown in colour, slightly lighter beneath; two blackish spots on the lateral areas of the pronotal disc. Length of body, male 7.5-9 mm., female 8-9.5 mm.

The native range of *N. cristatus* covers the eastern United States and southern Canada. It is rather widely distributed in Nova Scotia where it is common in dry pastures.

It has been collected at the following points: West Brook and Windham, Cumberland County; Truro and Sutherland's Lake, Colchester County; Mount Uniacke and Sweet's Corner, Hants County; Brule, Pictou County; Brierly Brook, Antigonish County; Kentville, North Alton, Centreville, Aylesford, Coldbrook, Gaspereaux and Kingston, Kings County; Pleasant Lake, Yarmouth County; Sable River, Shelburne County; Waverley, Prospect Road and Halifax watershed area, Halifax County; New Ross, Lunenburg County; Lake Kedgemakooge, Queens County; and Lincolnville, Guysborough County; Nova Scotia and from Allardville, New Brunswick. Rehn (1939a) reported two juveniles of this species from North Sydney, Cape Breton County, Nova Scotia. The earliest and latest recorded dates in Nova Scotia are April 15 and August 30. *N. cristatus* was collected at Wood Island, Prince Edward Island, by Urquhart in 1949, and was reported by Rehn and Grant (1955) from Hampton, York County, and Holcomb and McNamees, Northumberland County, New Brunswick.

Genus *Tetrix* Latreille.

Tetrix Latreille, (1802). Hist. Nat. Crust. Ins. 3:284.

Only two species, *T. subulata* (Linn.), and *T. arenosa angusta* (Hanc.) have been found in Nova Scotia although *T. brunneri* (Bolivar) is found in northern and central New Brunswick. Rehn and Grant (1956) reported *T. brunneri* from Tabusintac, Fredericton and Bathurst, New Brunswick while the Canadian National Collection also has a specimen from Bathurst, New Brunswick. *T. ornata* Say was erroneously reported by Gooderham (1917), a misidentification of *T. arenosa angusta.*

Key to Nova Scotia Species of *Tetrix.*

Median carina of pronotum elevated more or less distinctly along entire length; dorsal part of pronotum high in middle, sloping on the sides; body very slender, especially males; front margin of vertex obtusely angulate viewed from above, median carina at most very slightly projecting; hind part of pronotum long, apex narrowly acute, surpassing hind

femora in extended form and reaching the ends in abbreviated form.

.....*T. subulata*, p. 40.

Median carina of pronotum indistinct, slightly elevated on anterior third; dorsal area of pronotum flat or nearly flat; body robust; front margin of vertex very slightly rounded, the median carina projecting; apex of pronotum reaching considerably beyond hind femora in extended form and only slightly beyond in abbreviated form.

.....*T. arenosa angusta*, p. 41.

15. *Tetrix subulata* (Linnaeus). Map 11; Fig. 25, 27.
Gryllus subulatus Linnaeus, 1761. Fauna Suecia, ed. 2:236.
Acrydium granulatum Kirby, 1837. Faun. Bor. Am. Ins. 4:251.
Acrydium granulatum. Gooderham, 1917. Proc. Ent. Soc. N. S. 1916:23, 27.
.....Piers, 1918. Trans. N. S. Inst. Sci. 14:257-259.
Acrydium subulatum. J. W. H. Rehn, 1939. Can. Ent. 71:176.
.....J. W. H. Rehn, 1939a. Frag. faun. Mus. Zool. polon. 4:261.
Tetrix subulata. Rehn and Grant, 1955. Proc. Acad. Nat. Sci. Phila. 107:145-165.
Common name — 'Granulated' or 'Slender Grouse Grasshopper'.

Pronotum and legs finely granulated; easily recognized by the prominent angulate form of front margin of vertex. Colour variable, greyish to reddish-brown, sometimes blackish, often with median white band along full length of pronotum; inner wings often with bluish or bottle-green. Length of body, male 8.5 to 13.5 mm., female 11 to 15.3 mm.

T. subulata prefers sedgy meadow lands and swales on sandy soil which remains moist. The general range is northern North America, northern Europe, and northern Asia, north of 38 degrees Latitude.

T. subulata is a relatively common species in Nova Scotia, by far the most common of the Tetrigidae. It has been found at Springhill, Cumberland County; Truro, Debert and Sutherland's Lake, Colchester County; Millville and Mount Thom,

Pictou County; Kennetcook, East Uniacke and Windsor, Hants County; many points in Kings County; Graywood, Annapolis County; Smith's Cove, Digby County; Yarmouth, Deerfield, Pleasant Lake and South Ohio, Yarmouth County; Cookville, Lunenburg County; Halifax, Port Wallis and Sackville, Halifax County; Glen Alpine, Antigonish County; Lincolnville, Guysborough County; and at Baddeck, Victoria County.

It is also reported from Fredericton, New Brunswick, (Canadian National Collection). Rehn and Grant (1955a) reported this species from Tabusintac, Holcomb, Fredericton, and St. Andrews, New Brunswick, as well as some of the previously mentioned localities in Nova Scotia. The earliest and latest recorded capture dates are April 5 and October 4.

Hebard (1935) concluded that this species, known as *granulatus* (Kirby), was the same as the palaearctic species *subulata* and that the name *subulata* (Linn.) should take precedence over *granulatus*. This opinion was accepted until Rehn (1952) stated that *granulatus* Kirby should stand as "the North American representative of the *subulata* species group" until further work could be done to clarify the situation. Rehn and Grant (1955a), after studying specimens from a wide range of the Holarctic region concluded that Hebard was correct in placing Kirby's *granulatus* in synonymy with *subulata* of Linnaeus.

16. *Tetrix arenosa angusta* (Hancock). Map. 12; Fig. 28.
Tettix angustus Hancock, 1896. Trans. Amer. Ent. Soc. **23**:238.
?*Tettix ornata* Harris. F. Walker, 1871. Cat. Derm. Salt. Brit. Mus. **5**:813.
Acrydium ornatum. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:23, 27. (*nec* Say).
Acrydium arenosum angustum. Gooderham, 1918. Proc. Ent. Soc. N. S. **1917**:35.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:259-263.
Tetrix arenosa angusta. Rehn and Grant, 1956. Trans. Amer. Ent. Soc. **82**:129-139.

Description as in key to species; pronotum narrow in front, nearly twice as broad at shoulders; lateral carinae close together anteriorly, becoming obsolete, reappearing twice as

wide apart, diverging to shoulders, and converging to apex. Generally light brown in colour, somewhat darker on pronotal disc; basal part of hind wings irridescent, veins dusky. Length of body to end of pronotum, male 8.9 mm., female 10 mm.

T. arenosa angusta is found near banks of streams and boggy places. The subspecies *angusta* occurs throughout the Alleghanian Division of the Transition Zone, an Austral type as opposed to the Boreal distribution of other *Tetrix* species. This species has been found over the western part of the province. Specimens to hand were collected at Debert and Truro, Colchester County. Truro marks part of the northern limit of the species, according to Rehn and Grant (1956a). Gooderham (1917) reported it also from Kings, Hants, Annapolis, and Yarmouth Counties but gave no localities. The earliest and latest capture dates are April 23 and August 20.

F. Walker (1871), as reported by Piers (1918), identified "*Tettix ornata* Harris" from the Redman collections of 1821. This single specimen is said to be correctly identified. The species has not been taken since and Piers has somewhat doubtfully referred the record to *T. arenosa angusta.* It is more likely that the identification should stand, but that the locality (stated merely as 'Nova Scotia') is not accurate. Rehn and Grant (1956b) have pointed out that none of the *T. ornata* (Say) subspecies have been found in Eastern Quebec or the Maritime provinces although they occur in wide distribution over the remainder of southern Canada and the United States. The nearest approach to this region is *T. ornata hancocki* (Morse) from Fort Kent, Maine and Lac Ste. Marie, Quebec.

Family Acrididae[3]

The Acrididae are characterized by having long, stout, hind femora; tibiae armed with numerous spines; tarsi three-segmented; head hypognathous, with face often oblique. This family contains the best known and the most destructive species of Orthoptera.

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[3]Sometimes referred to by North American authors as Locustidae, following Comstock, a name which is not internationally recognized and which is in any case confusing because of its former erroneous application to the Tettigoniidae.

Key to Nova Scotia Subfamilies of Acrididae.

1. Prominent conical tubercle borne on the prosternum between the prothoracic legs.
.....Cyrtacanthacridinae[4], p. 43.

No tubercle borne on the prosternum between the prothoracic legs.
.....2.

2. Face usually very oblique; median carina of pronotum never high and crest-like, or cut by more than one sulcus.
.....Acridinae, p. 53.

Face nearly or quite vertical; median carina of pronotum usually cut by more than one sulcus.
.....Oedipodinae, p. 60.

Subfamily Crytacanthacridinae

Included in this subfamily are some of the most injurious species of Orthoptera. Winter is passed in the egg stage in Nova Scotia species; nymphs hatch early in summer, and adults are present from July to the end of October. Stridulation does not occur in this group as represented in Nova Scotia.

Key to Nova Scotia Genera of Cyrtacanthacridinae.

Tegmina absent; space between mesosternal lobes distinctly broader than long, as broad or nearly as broad as the lobes; prosternal spine short and conical.
.....*Zubovskya*, p. 43.

Tegmina present; usually well developed, sometimes short, but never absent; space between mesosternal lobes generally longer than broad.
.....*Melanoplus*, p. 45.

Genus *Zubovskya* Dovnar-Zapolskij.

Zubovskya Dovnar-Zapolskij, 1933. Trav. Inst. Zool. Acad. Sci. U.R.S.S. 1-253-258.

This genus is one of a group into which the old genus *Podisma* of Latreille (1829) has been divided. All Canadian species which were previously known under *Podisma* fall into the genus *Zubovskya*.

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[4]Cantatopinae of European authors.

17. *Zubovskya glacialis glacialis* (Scudder).
Pezotettix glacialis Scudder, 1863. Bost. Jour. Nat. Hist. 7:630.
Podisma glacialis. Piers, 1918. Trans. N. S. Inst. Sci. 14:286-288. [Hypothetical—not reported].
Zubovskya glacialis glacialis. Urquhart (*in litt.*), 1955.
Common name — 'Wingless Mountain Grasshopper'.

Wingless, medium to small species; prozona nearly twice as long as metazona, pronotum smooth, lateral carinae usually wanting, median carina evident, but low, cut by three transverse sulci in male, by hind one only in female; sulci deep on lateral lobes, front one short; prosternal spine short, stout, with bluntly rounded tip; interspace between mesosternal lobes of males as wide as the lobes, of females nearly twice as long; abdomen of female compressed, carinate, of male subcylindrical, upcurved; vertex between the eyes as broad in male, or twice as broad in female as first antennal joint; face distinctly but not strongly oblique; male supra-anal plate long, triangular, acute at tip, sides sinuous, median sulcus deep; furculae of male slender, subparallel; cerci stout, erect, feebly tapering above broad basal third, tips oblique; upper margin of subgenital plate broadly rounded, truncate, but with slight median notch, tubercle below upper margin broad, prominent. Colour dark, greenish above, greenish-yellow beneath, sparsely clothed with erect hairs; head greenish-yellow, often with dark streak on face; mouthparts pale; pronotum dark green, shining black stripe from eye to abdomen, faint on metazona and abdomen; inner and lower faces of hind femora coral red; hind tibiae bluish-green, spines black at tips, cerci black. Body length, male 15-17.5 mm., female 19-28 mm.

Piers (1918) included *Z. glacialis* as probably occurring in Nova Scotia but not reported. It was taken in Nova Scotia, possibly at Sable River, Shelburne County, by Dr. C. E. Atwood (Urquhart, *in litt.*, 1955) but the specimens appear to have been misplaced at the Royal Ontario Museum of Zoology and Palaeontology. The species frequents patches of alders and wire birch in heavily wooded areas. It is mainly subalpine E. M. Walker (1915) reported *Z. glacialis* from Dundee, Prince Edward Island.

In Ontario and Manitoba the race *Z glacialis canadensis* is found, but typical *Z. g. glacialis* is recorded from Quebec, Prince Edward Island, the New England States, New York and Pennsylvania. Presumably specimens from Nova Scotia would also be *Z. g. glacialis*. No specimen was found during the present study, for it was unfortunately not possible to make collections in the localities where the species is most likely to be found. It was not found, after thorough search, in the area surrounding Sable River, Shelburne County.

Genus *Melanoplus* Stål.
Melanoplus Stål, 1873. Recens. Orth. 1:79.

Key to Nova Scotia Species of *Melanoplus*.

1. Males ..... 2.
Females ..... 7.

2. Tegmina fully developed, reaching or surpassing apex of abdomen ..... 3.

Tegmina short, not reaching apex of abdomen. ..... 6.

3. Cerci either equal in breadth or tapering beyond the middle, tip slender or acuminate, never forked. ..... 4.

Cerci with apex expanded, broader beyond the middle, tip spatulate, or forked. ..... 5.

4. Apex of subgenital plate elevated, with small but distinct median notch; cerci short, nearly equally broad throughout, not longer than twice middle breadth. ..... *M. bilituratus*, p. 48.

Apex of subgenital plate not notched; cerci at least three times as long as middle breadth, apical half tapering. ..... *M. femur-rubrum*, p. 49.

5. Size large (more than 25 mm.); cerci with apical half much enlarged, but not forked; pronotum with light-coloured lateral stripes along margin of disc and continued along tegmina. ..... *M. bivittatus*, p. 52.

Size smaller (less than 20 mm.); cerci distinctly forked, forks nearly equidistant. ..... *M. keeleri luridus*, p. 53.

6. Cerci elongate, slightly expanded at base, middle little narrower than base, apex expanded; furculae small, triangular, well separated.
.....*M. fasciatus*, p. 47.

Cerci less elongate, apical half narrower but more than half as broad as extreme base; furculae about half as long as supra-anal plate, fused along inner base.
.....*M. borealis*, p. 50.

7. Size large, robust, hind femora 15 mm. or more long; two distinct lateral yellow stripes on head, pronotum and tegmina.
.....*M. bivittatus*, p. 52.

Size smaller, hind femora not over 15 mm., yellow stripes, as above, lacking.....8.

8. Dovetailing interspace between mesosternal lobes longitudinal or quadrate; tegmina usually passing hind femora, prozona not swollen. .....9.

Dovetailing interspace between mesosternal lobes subquadrate or distinctly transverse; tegmina not longer than hind femora; prozona swollen. .....10.

9. Prosternal tubercle nearly cyclindrical; tip bluntly rounded; cerci one and one-half to twice as long as greatest width, sharply pointed, somewhat acuminate, the converging sides slightly concave.
.....*M. femur-rubrum*, p. 49.

Prosternal tubercle tapering, tip pointed; cerci short, only about one and one-third times as long as greatest width, rather blunt at tips, converging sides straight or convex.
.....*M. bilituratus*, p. 48.

10. Tegmina about reaching ends of hind femora.
.....*M. keeleri luridus*, p. 53.

Tegmina shorter, covering only one-half to two-thirds of the abdomen (some long-winged variants are exceptions).
.....11.

11. Dull greyish brown above, clay yellow below.
.....*M. fasciatus*, p. 47.

Dull greenish yellow, tinged with fuscous.
.....*M. borealis*, p. 50.

Females of *M. fasciatus* and *M. borealis* are difficult to separate with any degree of certainty. It is notable that *M. fasciatus* females found in Nova Scotia are consistently and distinctly darker above than those of *M. borealis*.

18. *Melanoplus fasciatus* (F. Walker). Map 13; Fig. 38.
Caloptenus fasciatus F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. 4:680.
Melanoplus fasciatus. Piers, 1918. Trans. N. S. Inst. Sci. 14:296-297. [Hypothetical—not reported].
Melanoplus fasciatus. J. W. H. Rehn, 1939. Can. Ent. 71: 177.
Common name — 'Huckleberry Grasshopper'.

Size small, sexes nearly equal; robust; occiput elevated about pronotum; interocular space as broad in male, nearly twice as broad in female, as basal joint of antennae; frontal costa as broad as interocular space, feebly sulcate below ocellus in male, and slightly concave around it in female; pronotum expands feebly on metazona, disc rounded on prozona, flat on metazona, hind margin broadly rounded or obtuse-angled; median carina distinct only on metazona, faint on parts of prozona; tegmina usually covering two-thirds of abdomen in female, or three-quarters in male; male cerci straight, four times as long as broad, middle third slightly narrowed, apical third concave with tip rounded and incurved; supra-anal plate broad, triangular, apex subacute, margins elevated, median ridges extending from base three-quarters of distance to apex, uniting with a cross carina at apical third; furcula minute, widely separated, lying outside the median ridges; subgenital plate longer than broad, apical margin rounded, feebly elevated at middle. Colour dull greyish-brown or reddish-brown above, clay yellow below; male darker than female; females much darker above than females of *M. borealis*; black band behind eye extending to metazona, bordered below by greenish-yellow; tegmina dull red-brown; hind femora dull yellowish-brown with two broad blackish bars; hind tibiae red to pale green, lighter ring near base, spines black. Body length, male, 17-19.5 mm., female, 20-23 mm.

This species ranges from northern Labrador to New Jersey and west nearly across the continent. It is primarily boreal, having its southern limit at 40 degrees north latitude. It is found in dry, open woods on sandy or rocky soil.

Piers (1918) did not record this species; it was first reported in Nova Scotia by J. W. H. Rehn (1939) by a single female taken by Bayard Long in Yarmouth County on "bog barrens back of Goose Lake, Lower Argyle, August 11, 1920". Urquhart collected *M. fasciatus* at Bridgetown, Annapolis County, Grand Lake, Halifax County and North East Margaree, Inverness County in 1949. In 1953 a single male was found together with *M. keeleri luridus* and a few *M. femur-rubrum* on October 27, while hunting deer at West Brook, Cumberland County. The character of the environment of the area is very different from the Argyle barrens, as it is on rather high ground, near the edge of a heavily forested area. The presence of blueberry (*Vaccinium* spp.), and other ericaceous plants is the only feature common to both sites.

Subsequent collections revealed that *M. fasciatus* is common in blueberry fields around West Brook, New Canaan, Farmington, Windham and Ward's Brook, Cumberland County, and at Pleasant Lake, Lower Argyle and Lower West Pubnico, Yarmouth County. On Cape Breton Island it was found at Creignish Mountain, North East Margaree and Pleasant Bay, Inverness County, and Black Brook Cove, Victoria County. Specimens from apparently small and scattered colonies have been found at Dalhousie Mountain, Pictou County; Grand Lake and Cow Bay, Halifax County; Melvern Square and Bridgetown, Annapolis County; Lake Kedgemakoogee, Queens County; and Sable River, Shelburne County. E. M. Walker (1915) reported this species from Dundee and Bothwell, Prince Edward Island, as well as from the Magdalen Islands. Hebard (1915) and Rehn (1939; 1939a) both supplied records from Newfoundland. As indicated by capture records, adults may be found between August 9 and October 27.

19 *Melanoplus bilituratus bilituratus* (Walker). Map 14; Fig. 31, 33, 35.

Caloptenus bilituratus F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:679.

Melanoplus mexicanus auctt. (*nec* Saussure).

Melanoplus atlanis. Scudder, 1894. Ann. Rpt. Ent. Soc. Ont. **26**:64.

.....Piers, 1896. Trans. N. S. Inst. Sci. **9**:215.

.....Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:26, 27.

.....Piers, 1918. Trans. N. S. Inst. Sci. 14:290-296.

Melanoplus mexicanus. J. W. H. Rehn, 1939. Can. Ent. 71:177.

Melanoplus mexicanus mexicanus J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. 4:263.

Common name — 'Lesser Migratory Grasshopper'.

Prosternal spine tapering, tip pointed; tegmina much longer than abdomen (one-quarter or more beyond the tip); apex of subgenital plate of male with small distinct median notch; male cerci short and nearly equally broad throughout, rounded at ends, length less than or equal to twice middle breadth. Colour similar to *M. femur-rubrum*, variable, upper parts dark greyish-brown; under surface of abdomen yellowish; face light green; mouthparts light; blackish band from behind eye to lateral part of prozona; tegmina greyish-brown, distinctly sprinkled with fuscous along median area; hind femora dirty yellowish-brown, or slightly reddish-yellow, with two oblique blackish bars across the upper and outer faces; hind tibiae dull burnt red. Body length, male, 17-21 mm., female, 16-27 mm.

The range of this species is very wide, from the Canadian to the upper part of the Lower Austral Zone, approximately the same as for *M. femur-rubrum*. It is one of the commonest species in Nova Scotia where it is the most important agricultural pest of all the Orthoptera. It is widely reported from New Brunswick, Prince Edward Island, and the Magdalen Islands as well as from all parts of Nova Scotia. It has been recorded as adult from June 30 to October 28.

M. bilituratus appeared on Sable Island in 1891 and during the next four years became extremely abundant there. In 1896, it suddenly disappeared and from then until 1918, no grasshoppers were reported from the island (Piers, (1918)). Since that date no records are available and the present status of insect populations there is unknown.

20. *Melanoplus femur-rubrum femur-rubrum* (De Geer). Map 15; Fig. 30, 32, 37.

Acrydium femur-rubrum De Geer, 1773. Mem. Hist. Nat. Ins. 3:498.

Caloptenus femur-rubrum. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. 4:678.

.....F. Walker, 1872. Can. Ent. 4:30.
Melanoplus femur-rubrum. Piers, 1896. Trans. N. S. Inst. Sci. 9:215.
.....Gooderham, 1917. Proc. Ent. Soc. N. S. 1916:24-27.
.....Piers, 1918. Trans. N. S. Inst. Sci. 14:297-301.
.....J. W. H. Rehn, 1939. Can. Ent. 71:177.
Melanoplus femur-rubrum femur-rubrum J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. 4:263.
Common name — 'Red-legged Grasshopper'.

Prosternal spine nearly cyclindrical, tip bluntly rounded; tegmina somewhat longer than abdomen; apex of male subgenital plate not notched; male cerci at least three times as long as middle breadth; apical half less than half as broad as its extreme base (broad and tapering). Colour variable; usually brownish above; greenish grey on front and sides of head and thorax, sides and underparts; dirty white or greyish yellow line on side of thorax from insertion of tegmina to insertion of hind leg; broad black bar from behind eye extends on lateral part of pronotum; tegmina brown, usually spotted with fuscous along basal and median area; hind femora brown with two fuscous bars on upper edge, lower edge yellowish with pale red on outer part, joint black; hind tibiae bright red with black spines. Body length, male 16-23 mm., female 18-28 mm.

The range of the subspecies is very wide, from the Canadian to the upper part of the Lower Austral Zone. It is very common all over Nova Scotia where it is most numerous on dykes and dry meadows.

It was also reported from Moncton, New Brunswick, and Bunbury and Malpeque, Prince Edward Island, by E. M. Walker (1915), and the Nova Scotia Agricultural College insect collection has specimens from Wood Island, Prince Edward Island. In Nova Scotia, adults have been recorded from July 3 to October 28. This species and *M. bilituratus* are found in the adult stage over a longer period than all other Orthoptera in Nova Scotia with the exception of the Tetrigidae.

21. *Melanoplus borealis borealis* (Fieber). Map 16; Fig. 34.
Caloptenus borealis Fieber, 1853. Lotos 3:120.

Melanoplus extremus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:24, 27.
Melanoplus extremus junius. Piers, 1918. Trans. N. S. Inst. Sci. **14**:301-302.
Common name — 'Northern Grasshopper'.

The short-winged form has tegmina not reaching the tips of the hind femora, generally about 11 mm. long and reaching to the tip of the abdomen in males and covering one-half to three-quarters in the female; bluntly subacuminate at apex. In the long-winged form the tegmina surpass the tips of the hind femora, and are generally considerably longer (up to 17 mm. long), rather broadly rounded at apex. In short-winged form, the wings are much shorter than the tegmina; in the long-winged form the wings are very little shorter.

Apex of male subgenital plate without a median notch; male cerci short and broad, apical half distinctly more than half as broad as extreme base, gently curved, well rounded at tip; furculae parallel, cylindrical, tapering, about half as long as supra-anal plate. Colour dark greenish-yellow; black bar behind eye extending on prozona; pronotum olive brown above, greenish yellow on sides; tegmina olive-brown, sometimes with a few dark spots on median area; hind femora yellowish, tinged with red-brown, lower face light orange; hind tibiae reddish or yellowish with black spines. Body length, male, 16-20 mm., female, 20-24 mm.

The range includes much of Canada and the northern part of the United States. It is a boreal species confined to the Hudsonian, Canadian and Transition Zones.

The species is common in certain localities in Nova Scotia; Rodney, West Brook, New Canaan, Windham, Farmington, Westchester Station, Westchester Mountain and Ward's Brook, Cumberland County; Truro, Colchester County; Dalhousie Mountain and Brule, Pictou County; Kentville, Centreville, Aylesford Lake and Woodville, Kings County; Bridgetown, Annapolis County; Goodwood, Halifax County; Crescent Beach, Lunenburg County; Lower Argyle and Kemptville, Yarmouth County; and River Ryan, Cape Breton County. The earliest recorded date is July 3. The latest recorded date is August 11, but there is little doubt that adults persist until somewhat later in the season.

M. b. borealis was reported by E. M. Walker (1915), as *M. b. junius* Dodge, from Hillsboro, New Brunswick, Souris and Southport, Prince Edward Island, and from the Magdalen Islands. J. W. H. Rehn (1939) reports it from Port-aux-Basques, Newfoundland as *M. borealis* (Fisher). The same author (1939a) records it (also as *M. borealis*) from Grande Miquelon and St. Pierre. The Nova Scotia Agricultural College insect collection has specimens from MacDonald's Corner, Queens County, New Brunswick.

22. *Melanoplus bivittatus* (Say). Map 17; Fig. 29, 39.
Gryllus bivittatus Say, 1825. J. Acad. Nat. Sci. Phila. **4**:308.
Caloptenus bivittatus. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:678.
.....F. Walker, 1872. Can. Ent. **4**:30.
Melanoplus femoratus (Burm.). Piers, 1896. Trans. N. S. Inst. Sci. **9**:218.
Melanoplus bivittatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:24, 27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:303-307.
.....J. W. H. Rehn, 1939. Can. Ent. **71**:177.
.....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Two-striped Grasshopper'.

Largest of genus in Nova Scotia; tegmina reaching or slightly passing hind femora, sometimes slightly shorter in female; cerci of male large, wide, with apical half expanded but not forked, somewhat boot-shaped with wide toe and distinct but small heel; furculae short, swollen, triangular. Colour above, bright apple-green, underparts yellowish; distinct yellow line extends from upper part of eye along lateral angle of pronotum, and along anal vein of tegmen to its extremity; bordered below by a wider black band on head and pronotum, widest on prozona; diagonal yellow line extends from insertion of tegmen to insertion of hind leg; hind femora greenish-black on upper half of outer face to darker at tibial segment; outer face margined with yellow; hind tibiae poppy-red, dusky at base, spines black. Body length, male, 26.5-28 mm., female 31-35 mm. (Some up to 40 mm.).

The red-legged form of *M. bivittatus* is common all over Nova Scotia and has been reported from July 2 to October 27.

Occasionally, it causes crop damage, particularly to hay, pasture and grain on dyked lands. E. M. Walker (1915) reported it as common in Prince Edward Island and also from Moncton, New Brunswick. Hebard (1915) recorded it as *M. femoratus* (Burm.) from Newfoundland.

23. *Melanoplus keeleri luridus* (Dodge). Map 18; Fig. 36.
Caloptenus luridus Dodge, 1876. Can. Ent. 8:11.
Melanoplus luridus. Piers, 1918. Trans. N. S. Inst. Sci. 14:307. [Footnote: possibility of occurrence only.]

Rather small in size, head not prominent; tegmina reaching or slightly surpassing tips of hind femora, narrow and gently tapering; prosternal spine short, conical, blunt and erect; male cerci distinctly forked, branches nearly equally distant; furculae minute triangular lobes. Colour generally brownish-fuscous and rusty brown; fuscous post-ocular band narrow and confined to prozona; hind femora with outer face yellowish-brown, dorsal area blackish-fuscous broken by three yellowish spots which suffuse the whole inner face; lower face bright orange; hind tibiae coral red with narrow fuscous basal annulus, tibial spines black on apical half. Body length, male 19 mm., female, 27 mm.

M. keeleri keeleri (Thomas) occurs in the south eastern part of the United States. The range of *M. keeleri luridus* (Dodge) covers the northeastern part of the United States and north into Alberta, Manitoba and Ontario. Since it is present in Nova Scotia it undoubtedly occurs in New Brunswick although it has not been reported thence. The collection of this species during the present study constitutes the first record for Nova Scotia. Piers (1918) indicated the possibility that this species might be found in this province. A series of 18 specimens was collected at West Brook, Cumberland County; 3 males and 3 females, October 27, 1953; 5 males and 7 females, September 7, 1954. The only other capture location is only five miles distant, at New Canaan, where the species is not common.

Subfamily Acridinae

The face in the Acridinae is usually decidedly oblique, meeting the vertex in an acute angle; lateral foveolae are well developed.

In Nova Scotia four species in three genera are known, and a fifth species may occur.

Key to Nova Scotia Genera of Acridinae.

1. Lateral foveolae of vertex small and not visible from above.
.....*Orphulella*, p. 54.

Lateral foveolae of vertex plainly visible from above as linear depressions between the eyes and the apex.
.....2.

2. Median carina of pronotum low, cut somewhat behind the middle by the principal sulcus.
.....*Chorthippus* p. 56.

Median carina of pronotum rather high and sharp, cut somewhat in front of the middle by the principal sulcus.
.....*Stethophyma*, p. 57.

Genus *Orphulella* Giglio-Tos.
Orphylella Giglio-Tos, 1894. Boll. Mus. Zool. Anat. Comp. Torino 9:10.

Key to Nova Scotia Species of *Orphulella*.

Pronotum generally with lateral carinae little incurved, about equally separated in front and behind; vertex blunt, central depression extending close to apex; prozona usually slightly longer than metazona; dorsal valve of aedeagus, in lateral view, more or less constricted at apex, almost pointed.
.....*O. speciosa*, p. 54.

Pronotum generally with lateral carinae strongly incurved, more widely separated behind than in front; vertex rectangular to slightly acute, the central depression removed from apex one-third in male, to one-fourth in female, of width of apex; prozona and metazona nearly equal in length or metazona slightly longer; dorsal valve of aedeagus, in lateral view, more or less enlarged or knobbed at apex.
.....(*O. pelidna*), p. 56.

24. *Orphulella speciosa* (Scudder). Map 19; Fig. 40, 42.
Stenobothrus speciosus Scudder, 1862. Bost. J. Nat. Hist. 7:458.

Orphulella speciosa (Scud.). Scudder, 1899. Can. Ent. 31:184. ["Halifax, N. S., Piers".]
.....Piers, 1918. Trans. N. S. Inst. Sci. 14:264-266. [Refuted record of Scudder, above.]
.....Urquhart, *in litt.*, 1951.
Common name — 'Pasture Grasshopper'.

Face very oblique, vertex bluntly rounded, obtuse in female, right-angled in male; lateral foveolae not visible from above; pronotum as in key; tegmina usually reaching ends of hind femora, but varying from 3 mm. shorter to 3 mm. longer in females, and 1.5 mm. shorter to 2 mm. longer in males. Colour variable, four distinct variations occurring; (a) head, disc of pronotum and tegmina green, (b) head and disc of pronotum green, tegmina rose-red, (c) head and pronotum brown; tegmina rose-red; (d) head, pronotum, and tegmina brown; the green variant is the only one recorded from Nova Scotia; dark line behind eye reaching pronotum along whitish lateral carina; tegmina with a few spots which are sometimes wanting; hind femora greenish or brownish, not banded; hind tibiae dull brown to yellow without a pale ring at the base. Length of body, male 13-14 mm., female 16-21 mm.

O. speciosa ranges over eastern and central North America. It is very numerous in New England, but scarce in Nova Scotia.

It prefers dry, sandy, or loamy soils, and grassy untilled fields, and is most active during hot weather. It is non-migratory and moves chiefly by leaping.

O. speciosa was reported from Nova Scotia by Scudder (1899) from a collection by Piers, but the record was later rejected by Piers (1918) as being in error. Urquhart (1949) holds the belief that the error was made in determination, and that the species in question was actually *O. pelidna*. However, *O. speciosa* has been taken in Nova Scotia by Urquhart, at Bridgetown, Annapolis County, August 14, 1949. the first definite record. A female specimen taken at Norton, New Brunswick, September 9, 1949, another from Welsford, New Brunswick, August 31, 1949, and a damaged specimen from Antigonish, Nova Scotia, August 7, 1949, are located in the Nova Scotia Agricultural College insect collection.

25. *Orphulella pelidna* (Burmeister). Map 19.
Gomphocerus pelidnus. Burmeister, 1838. Handb. Ent. 2:650.
Orphulella pelidna. Urquhart, 1949. (Unpublished).

This species has not been recorded from Nova Scotia, but Urquhart (1949) believes that it almost certainly is present. As noted under *O. speciosa*, he is of the opinion that Scudder's (1899) record refers to *O. pelidna.* There is no previous record of any attempt to search out this species in its normal habitat in localities where it might be found. It was not found during the present study.

Genus *Chorthippus* Fieber.
Chorthippus Fieber in Kelch, 1852. Grundl. Orthop. Obserschles.; 1.

26. *Chorthippus longicornis* (Latreille). Map 20; Fig. 41.
Acrydium longicorne Latreille, 1804. Hist. Nat. Crust. Ins. 12:159.
Stenobothrus curtipennis (Harris). F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. 4:754.
.....F. Walker, 1872. Can. Ent. 4:31.
.....Piers, 1896. Trans. N. S. Inst. Sci. 9:213.
Chorthippus curtipennis. Gooderham, 1917. Proc. Ent. Soc. N. S. 1916:25, 27.
.....Piers, 1918. Trans. N. S. Inst. Sci. 14:266. 269.
Chorthippus longicornis. J. W. H. Rehn, 1939. Can. Ent. 71:176.
.....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. 4:261.
Common name — 'Short-winged Brown Grasshopper'.

The name *Acridium longicorne* of Latreille is a *nomen dubium* and may refer to either of the European species *Chorthippus parallelus* (Zetterstedt, 1821) or to *Ch. montanus* (Charpentier, 1825). It is considered doubtful that any of the European names should apply to North American species (Vickery, unpublished).

Foveolae of vertex plainly visible from above as linear depressions; median carina of pronotum not high or sharp, cut behind the middle, lateral carinae incurved; tegmina of male usually reaching end of abdomen, of female usually

covering two-thirds of abdomen, but longer or shorter in either sex; wings slightly shorter than tegmina; hind femora rather slender. Colour variable, green, olive-grey, brownish to reddish; lateral carinae of pronotum whitish, each with a dark line crossing diagonally from behind the eye and forming a dark margin outside of the anterior three-fifths and inside of the posterior two-fifths. Body length, male 15 mm., female 18.5 mm.

This insect frequents thick grasses in damp places, dry meadows and roadsides. It is not considered to be economically important.

The distribution of this species in Nova Scotia is very general, as it has been found in all but two counties and in these two counties very few collections have been made. It is common all over the northern United States and Canada in the Canadian and Transition Zones. The full distribution of the species, as presently defined, is Holarctic.

Genus *Stethophyma* Fischer.
Stethophyma Fischer, 1853. Eur. :297.

Brooks (1958) has followed Dirsh (1956) in removing this genus from the Acridinae and placing it with the oedipodines. The change was based upon the type of tegminal venation and the stridulatory apparatus found in males. Dr. D. K. McE. Kevan, of the Entomology Department, Macdonald College of McGill University (personal communication, 1959), for the present agrees in principle with Jacobs (1953) and Dirsh (1956) in giving separate tribal status to three groups (Acridini, Oedipodini, and Truxalini) within the subfamily Acridinae, placing *Stethophyma* in the tribe Oedipodini. Rehn and Grant (1960) rejected Dirsh's classification, following a survey of stridulatory apparatus and tegminal venation, as well as genitalia, in over 140 genera. They recognize a single subfamily, Acridinae, to include both the Oedipodinae and Acridinae of former authors, as well as the Truxalinae (sensu Dirsh). Apparently no category between genus and subfamily is recognized.

With this in mind, the genus *Stethophyma* is retained in the subfamily Acridinae.

Key to Nova Scotia Species of *Stethophyma*.

Scapular area of tegmina with a pale yellow streak; intercalary veins of male tegmina with very obscure, low teeth; lateral carinae of pronotum cut by all three sulci before the middle.

.....*S. lineatum*, p. 58.

Scapular area of tegmina without a pale yellow streak; intercalary veins of male tegmina with minute, sharp, elevated teeth; lateral carinae of pronotum cut only by first and third sulci.

.....*S. gracile*, p. 59.

27. *Stethophyma lineatum* (Scudder). Map 21; Fig. 43.
Arcyptera lineata Scudder, 1862. Bost. J. Nat. Hist. 7-462.
Mecostethus lineatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:25-27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:269-271.
Stethophyma lineatum. J. W. H. Rehn, 1939. Can. Ent. **71**:176.
Common name — 'Striped Sedge Grasshopper'.

Foveolae of vertex very shallow but visible from above; pronotum with three distinct carinae; median carina rather high and sharp, plainly cut somewhat in front of the middle by principal sulcus; lateral carinae distinctly divergent behind; wings and tegmina well developed, surpassing ends of femora by about one-third the length of the tibia. Colour generally brownish to purplish-brown with yellow markings; head and pronotum brown, pronotal disc lighter, underparts green; abdomen dark brown on top and sides, light green beneath; pale yellow line from eye across pronotum to join yellow line on tegmina; hind femora olive on outer face, blackish near apex, with three white spots midway, upper edge brownish, lower edge maroon with two black marks separated by yellow near apex; hind tibia buff, darker near base and apex. Body length, male 26 mm., female 36 mm.

The range is wide, Canadian, Transition, and northern part of Upper Austral Zones, in the northern United States and southern Canada, east of the prairie, east of longitude 100 degrees, and north of latitude 40 degrees. It frequents wet meadows from late July to near the end of October.

It is found in western Nova Scotia but it is rather rare in the rest of the province.

It is recorded from Aylesford and Wolfville, Kings County; Bridgetown and Graywood, Annapolis County; Tiddville, Digby County; Deerfield, Gavelton, Quinan and South Ohio, Yarmouth County; Sable River, Shelburne County; Frank Lake, Lunenburg County; and Grand Lake, Goodwood, and Lawrencetown, Halifax County. The earliest and latest recorded capture dates are August 8 and October 26. It is also reported to be widespread in Prince Edward Island and has been recorded from the Magdalen Islands by E. M. Walker (1915). Hebard (1915) and Rehn (1939, 1939a) also reported this species from Newfoundland.

28. *Stethophyma gracile* (Scudder). Map 21; Fig. 44.
Acryptera gracilis Scudder, 1862. Can. Nat. and Geol. **7**:463.
Mecostethus gracilis. Piers, 1896. Trans. N. S. Inst. Sci. **9**:215.
Mecostethus gracilis. Gooderham, 1917. Proc. Ent. Soc. **1916**:25, 27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:271-272.
Common name — 'Graceful Sedge Grasshopper'.

This handsome species resembles *S. lineatum*, but the intercalary vein of the tegmina of male has sharp, elevated minute, closely set teeth. It is more robust and squat than *S. lineatum*. The pale yellow line of the tegmina is absent. The lower edge of the hind femora is a striking bright red. Body length, male 19-23 mm., female 26.5-31 mm.

The range is about the same as for *S. lineatum* but slightly more northern. It is chiefly confined to the Canadian and Transition Zones. *S. gracile* appears to have about the same distribution as *S. lineatum* in Nova Scotia, being quite common in the western counties from early August to late September. It has been collected at Kentville, Black Hole, Grafton and Kingston, Kings County; Bridgetown, Annapolis County; Truro and Sutherland's Lake, Colchester County; Halifax and Cow Bay, Halifax County; and from Creignish Mountain, Inverness County. Gooderham (1917) also reported *S. gracile* from Yarmouth County but gave no locality for the record.

E. M. Walker (1915) reported this species from Dundee, Prince Edward Island, and the Canadian National Collection has two specimens from St. John, New Brunswick.

Subfamily Oedipodinae[5]

The members of this subfamily are characterized by the nearly vertical face; pronotum short with median carina often raised as a crest and cut by one or more transverse sulci; prosternum not bearing a spine or tubercle; wings are frequently brightly coloured. The general colour is usually dull brown, green or grayish. Winter is usually passed in the egg stage. Males often stridulate while in flight.

Key to Nova Scotia Genera of Oedipodinae.

1. Median carina of pronotum notched by only one sulcus.
.....2.

Median carina of pronotum notched by two sulci, the front notch often less distinct than the hind one; hind wings with two or three radial veins greatly enlarged, yellow with a dark median transverse band widening behind.
.....*Circotettix*, p. 64.

2. Disc of hind wing nearly transparent, but not distinctly bordered black. .....3.

Disc of hind wing opaque, black with yellow border lateral carinae of pronotum extending only to principal sulcus; disc with few or no tubercles.
.....*Dissosteira*, p. 63.

3. Disc of pronotum roof-shaped, front margin angulate; hind wings transparent with a dark bar along middle of anterior margin, yellow at base, remaining two-thirds smoky, paler at apex.
.....*Chortophaga*, p. 61.

Disc of pronotum flat, front margin truncate; median carina low, faintly notched by principal sulcus; hind wings

[5]No longer recognized by Rehn and Grant (1960), who include this group in the subfamily Acridinae.

transparent with dusky veins.

.....*Camnula*, p. 62.

Genus *Chorthphaga* Saussure.

Chortophaga Saussure, 1884. Mém. Soc. Phys. Nat. Genève **28** (9):72.

29. *Chortophaga viridifasciata* (De Geer). Map 22.
Acrydium viridifasciata De Geer, 1773. Mem. Hist. Nat. Ins. 3:498.
Common name — 'Northern Green-striped Grasshopper'.

Medium sized species, body slim; vertex horizontal and triangular, apex truncate; foveolae very shallow, elongate triangular; frontal costa prominent; segments of antennae short and slightly flattened; disc of pronotum roof-shaped, anterior margin angulate and projected forward, hind margin acute-angled; median carina not prominent, straight and faintly notched on anterior half; lateral carinae visible only on metazona; tegmina long and narrow, longer than abdomen, with apical half membraneous.

Colour dimorphic, either brown or green; green form with head, pronotum, basal part of tegmina and outer face of hind femora grass-green, with apical part of tegmina and narrow costal stripe pale brown, and abdomen reddish-brown; brown form with apical halves of tegmina darker; hind tibiae brown with white ring near the base. Body length, males 17-24 mm., females 24-30 mm.

This species is here recorded in Nova Scotia for the first time. It frequents sunny slopes in dry, grassy places. It is widely distributed over North America east of the Rocky Mountains, south to Georgia, Oklahama and Texas, and north to Nova Scotia, New England and Ontario. Blatchley (1920) stated that both colour phases occur together in Indiana with green females and brown males predominant. Less than twenty per cent of the females were brown and much less than twenty per cent of the males were green. The series taken during the present study includes four green females, three brown females and four brown males: 2 females, West Brook, Cumberland County, June 23, 1951; same location, 2 males, 2 females, June 20, 1952; 2 males, 1 female, Rodney, Cumberland County, June 21, 1952; and 2 females, West Brook, June

29, 1953. Urquhart collected this species at Southampton, Cumberland County in 1949. The Canadian National Collection has a specimen of *C. viridifasciata* which was taken by T. N. Freeman, June 27, 1938, at Waweig, Charlotte County, New Brunswick. This is the nearest previous record to Nova Scotia.

Genus *Camnula* Stål.
Camnula Stål, 1873. Recens. Orth. 1:114.

30. *Camnula pellucida* (Scudder). Map 22.
Oedipoda pellucida Scudder, 1862. Bost. J. Nat. Hist. **7**:472.
Camnula pellucida. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.
.....Gooderham, 1917. Proc. Ent. Soc. **1916**: 26-27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:274-277.
.....J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Clear-winged Grasshopper' or 'Roadside Grasshopper'.

Small species; head compressed; pronotum with disc flat and smooth, much wider behind, truncate in front, median carina low, of equal height throughout, faintly cut by one sulcus in front of the middle; sides of the pronotum deeper than long; tegmina narrow, reaching beyond abdomen. Colour generally light brown; dark triangular spot behind eye and dark vertical spot on front half of lateral lobe of pronotum; tegmina smoky brown, light and dark patches on the sides, darker on dorsal surface with a yellowish stripe along humeral angle; wings transparent with dark veins; hind femora yellowish brown, darker at apices, and faintly marked with dark bars; tibiae yellowish-brown; abdomen yellowish beneath, sides darker. Body length, males, 17 to 21 mm., females, 19.5 to 28.5 mm.

The range of *C. pellucida* includes the southern part of the Canadian Zone, the Transition, and upper part of the Upper Austral Zones. It is common throughout southern Canada and northern and western United States. It is found

in dry locations, particularly in fence rows and by roadsides. This species is often very injurious to vegetation.

C. pellucida is widely distributed all over Nova Scotia and has caused damage to agricultural crops. It occupies third position after *Melanoplus bilituratus bilituratus* (F. Walker) and *M. femur-rubrum* (DeGeer) in destructiveness. It has been found in the adult stage from July 14 to October 2.

E. M. Walker (1915) reported this species from both Prince Edward Island and Newfoundland. It is also known from Richibucto, New Brunswick (Canadian National Collection) and specimens are on hand from MacDonald Corner, Queens County, New Brunswick.

Genus *Dissosteira* Scudder.

Dissosteira Scudder, 1876. Ann. Rpt. U.S. Chief Eng. 1876, App. JJ:511.

31. *Dissosteira carolina* (Linnaeus). Map 23; Fig. 45.
Gryllus (*Locusta*) *carolina* Linnaeus, 1758. Syst. Nat. ed. **X**:433.
Dissosteira carolina. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.
.....Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:26-27.
.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:278-281.
.....J. W. H. Rehn, 1939. Can. Ent. **71**:176.
.....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.
Common name — 'Carolina Grasshopper'.

Disc. of pronotum with front margin nearly truncate and hind margin obtuse-angled; median carina high, cut before the middle by a deep narrow notch, front lobe almost straight, hind one arched; lateral carinae rounded and extending about one-third their length beyond the abdomen. The colour is variable, chocolate-brown, brown-black, to grey, underside lighter; tegmina brown, clouded, and spotted with darker brown; hind wings dark brown or black with a pale yellow outer border, the apex smoky with several darker spots; hind femora with inner face light, crossed by three blackish

bands, the first nearly covering the basal half; hind tibiae dirty-yellowish. Body length, males 26 to 30 mm., females 34 to 40 mm.

D. carolina ranges throughout the Transition and Upper and Lower Austral Zones, as well as the southern part of the Canadian Zone. It is found from coast to coast in Canada and the United States. It frequents dry, sandy areas such as dusty roads.

D. carolina is rather common all over the mainland of Nova Scotia. No collections have been made on Cape Breton Island but I have observed this species at Pleasant Bay, Inverness County, and at Baddeck Victoria County. The earliest and latest capture dates are July 24 and October 28.

Genus *Circotettix* Scudder.

Circotettix Scudder, 1876. Bull. U. S. Geol. Geogr. Surv. Terr. **2**:264.

32. *Circotettix verruculatus* (Kirby). Map 24.

Locusta verruculata Kirby, 1873. Fauna Boreale Amer. **4**:250.

Oedipoda rugosa. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:731. (*nec* Scudder).

.....F. Walker, 1872. Can. Ent. **4**:31.

Oedipoda sulphurea. F. Walker, 1870. Cat. Derm. Salt. Brit. Mus. **4**:729-730. (*nec* Fabricius)

.....F. Walker, 1872. Can. Ent. **4**:31.

Circotettix verruculatus. Piers, 1896. Trans. N. S. Inst. Sci. **9**:214.

Circotettix verruculatus. Gooderham, 1917. Proc. Ent. Soc. N. S. **1916**:26-27.

.....Piers, 1918. Trans. N. S. Inst. Sci. **14**:281-285.

.....J. W. H. Rehn, 1939. Can. Ent. **71**:177.

.....J. W. H. Rehn, 1939a. Fragm. faun. Mus. Zool. polon. **4**:262.

Common name — 'Snapper' or Eastern Crackler'.

Pronotum flattened on top, right angled to acute angled behind; median carina elevated in front and notched by two sulci before the middle, the front notch usually less distinct; wings and tegmina about as long as total body length; hind wings with three enlarged radial veins. The colour is

variable, usually blackish above, with underparts brown; tegmina greyish to brownish-grey, blotched with black; hind wings semi-transparent, pale yellow on basal half, followed by a blackish band, then by a semi-clear area with blackish veins; some radial veins deep yellow at bases, costal margin dusky; hind femora greyish with four blackish bands; eyes black or black spotted with grey. Body length, males 24 to 25 mm., females 25 to 28 mm.

Its range is very wide and more northern than *D. carolina.* It is found in the Canadian and Transition Zones, and in elevated parts of the Upper Austral Zone. It prefers dry sandy areas.

C. verruculatus is common in Nova Scotia and has been reported from nearly all areas. The earliest and latest dates recorded are July 18 to October 18. It has also been reported from Moncton, New Brunswick by E. M. Walker (1915) and from Port-aux-Basques, Newfoundland by J. W. H. Rehn (1939).

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