

THE ORTHOPTERA (COCKROACHES, LOCUSTS, GRASSHOPPERS AND CRICKETS) OF NOVA SCOTIA; WITH DESCRIPTIONS OF THE SPECIES AND NOTES ON THEIR OCCURRENCE AND HABITS.—BY HARRY PIERS, Curator of the Provincial Museum of N. S., Halifax, N. S.

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PART 1.—INTRODUCTION.

*Purpose of this paper.*—Twenty-one years ago I published in the Transactions of the Nova Scotian Institute of Science, volume ix, some preliminary notes on the Orthoptera of Nova Scotia. Since then other species have been found here, additional information has accumulated, and the nomenclature, in some instances, has changed. It now seems an opportune time to prepare a fuller paper which will contain all that can be gathered regarding these injurious insects in our province. Further investigation will add considerably to our information, will show the presence

of a few other forms, and disclose any errors that may have crept into this contribution; but in the meanwhile it will present what is now known on the subject.

One, and possibly the chief reason, why so very little attention has been given in this province, as well as elsewhere, to the study of these noxious insects, is the scarcity of works dealing with the whole order. In fact no general manual on the Orthoptera of North America is available, and the student has to consult many monographs in order to determine his specimens and to learn their habits. This has made the subject one which can only be taken up by a specialist; whereas, it should be possible for any intelligent farmer, after a little practice, to ascertain just what Orthoptera occur on his land, and which species are most liable to cause damage, for it is well known that many of them do great injury to crops.

In order, therefore, to help the beginner here, I will give descriptions of all our Nova Scotian species, with "keys" to more readily assist in identification, and notes on general distribution, in addition to more detailed observations on the occurrence and habits of the various species as observed in this province. All this will be useful in assisting those who really should know more than they do about insects of such economic importance, and who, no doubt, would gladly inform themselves on the subject if they had literature bearing directly on conditions in their own region. Orthopterists in general will also be interested in knowing what forms extend this far north, as it will aid them in working out the geographic range of the various North American species.

The purposes of this paper, therefore, are to enumerate all the species or forms known to occur here; to describe them so that the agriculturist, the local economic entomologist, and others, may be able to readily distinguish them; to present information as to their habits; to indicate what

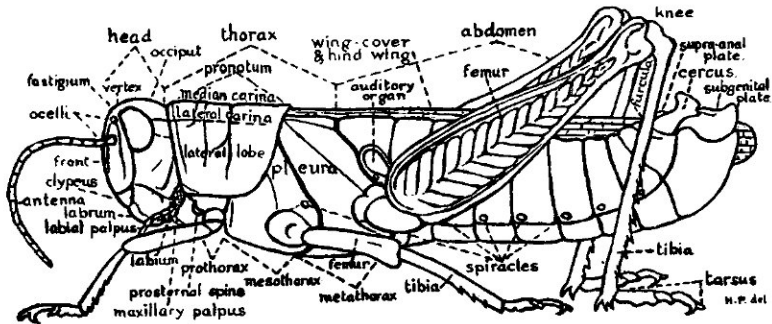
kinds are most liable to cause damage and how their depredations may be prevented; and, finally, to supply scientific men with data regarding the extension of the known geographic range of the various forms and with observations generally on these insects as found in Nova Scotia.

*Lack of knowledge regarding Orthoptera*—It is truly remarkable what little knowledge ordinary men have of our Orthoptera, although those insects are yearly pilfering many thousands of dollars from the hard-working agriculturist. Of the common indigenous species, even the intelligent layman knows almost nothing, except that he lumps together in his mind a number of different kinds of hopping insects which he sees in the grass, and vaguely terms them "grasshoppers," and the myriads of black crickets are to him just "crickets" and nothing more definite. Some of our most abundant species, such as *Scudderia pistillata*, with its remarkable form, bright green colour and strident call, are unknown to him by sight, and the greatest surprise is evinced when one is shown. How can we deal intelligently with orthopteran pests, when such ignorance is everywhere prevalent except among a few specialists? Nor is this true of our own province only, for similar conditions prevail fairly generally throughout America. No doubt the lack of convenient manuals for study, has had very much to do with the scant knowledge that exists in the public's mind regarding so many of the lower forms of life.

#### ORTHOPTERA IN GENERAL.

*External anatomy of a locust*.—At least a moderate knowledge of the superficial structure of a locust is necessary in order to understand descriptions. Very briefly, the external anatomy of a typical insect of this kind is as follows: There being no internal skeleton, the outside of the body is composed of a framework or exoskeleton of protective plates of cuticle hardened by "chitin" secreted by the cells of

the cuticle or skin. Thus the insect is defended very much like a knight of the gothic period. Besides being a defense, these plates are also a support for the whole insect's structure and serve for the attachment of muscles. Breathing is performed through several openings ("spiracles") on each side of the body, connected with a series of internal ramifying tubes. The organs of touch, and supposedly of smell also, are called "antennæ" and project like flexible horns from the front part of the head. The auditory organs or ears, when present, are in the basal segment of the abdomen in the *Acrididæ*, or in the fore tibiæ (rarely in the prosternum) in the *Tettigoniidæ* and *Gryllidæ*. The eyes consist of two large compound eyes and also usually three isolated simple ones ("ocelli").



The Principal External Parts of a Locust, *Melanoplus bivittatus*, male.  
The left wings removed. Magnified about  $3\frac{1}{2}$  times.

The body is divided into three main sections, (1) the "head," (2) the "thorax" which bears the organs of locomotion (wings and legs), and (3) the "abdomen." The part of the head behind the eyes is the "occiput", and that between and in front of the eyes is the "vertex"; the front of the head is the "face" or "front", and below is the mouth with its upper lip ("labrum") and lower lip ("labium") and the various parts of the jaws. The thorax is divided into three sections: (1) the front one is the "prothorax", and is covered

above and on the sides by the "pronotum", the upper and lateral surfaces of the latter being respectively its "disk" and its "lateral lobes", and the undersurface of the prothorax is the "prosternum" and bears the first pair of legs; (2) the middle section is the "mesothorax" which bears the fore-wings or "wing-covers" (when present), and the undersurface of the mesothorax is the "mesosternum" which carries the middle pair of legs; and (3) the hinder section is the "metathorax", and bears the thin "hind wings" (when present), and the undersurface of the metathorax is the "metasternum" and carries the hind legs which are usually stout and long and well adapted for leaping.

The wing-covers or tegmina act as shields for the hind-wings, and are leathery or parchment-like plates of chitin, strengthened by a network of "nerves" or "veins", the spaces enclosed by the nerves being termed "cells". The hind wings, used for flight, are thin and also strengthened with nerves or veins, but when not in use they are folded like a fan beneath the wing-covers. A few species have no wings or only rudimentary ones, and others have only the wing-covers. Many species are dimorphic as regards the length of the wings, both long- and short-winged variants being known. When reference is made to the front or "costal area", or to the hind or "anal area" of the wings, the supposed aspect is such as would be if the wings were extended sideways, at right-angles to the length of the body, not that of the wing when folded at rest. The hinder or leaping legs are the ones usually referred to in descriptions. Leaving out subordinate basal parts, their chief divisions are (1) the "femur", a long, stout, club-shaped segment, (2) the "tibia," which is also long but very slender, and (3) the "tarsus" or jointed foot. The joint between the femur and tibia is sometimes called the "knee".

The abdomen is composed of several segments, each made up of a "tergum" or dorsal part, and a "sternum" or ventral

part. The sides of the first abdominal tergum in short-horned locusts (*Acrididæ*) bear the "auditory organs" or ears. Along the sides of the abdomen are several "spiracles" or small external openings of the respiratory air-passages. The terminal abdominal segments are modified in each sex, as there are located the generative organs. The last tergum of the male locust is a triangular plate called the "supra-anal plate", at the base of which are usually a pair of minute processes called "furcula"; and to the second last tergum are attached two appendages called "cerci" which extend on either side of the supra-anal plate, and the form of which is sometimes, particularly in the *Melanoplæ*, an important character for the identification of species. The under portion of the last abdominal segment of the male is termed the "subgenital plate". The abdomen of the female ends in two pairs of plates, the "valves of the ovipositor"; and between them is the "ovipositor" proper or organ for depositing eggs.

In passing, it may be merely remarked that one of the most frequent questions regarding locusts asked by many people is, What is the so-called grasshopper "molasses" which most species readily exude from the mouth when handled? This brown-coloured fluid is secreted by salivary glands situated near the mouth-opening. It is also probably defensive in character.

*Stridulation.*—The call-notes of many species of Orthoptera are the most common insect sounds of late summer and autumn. Males alone possess musical organs which they use to call the opposite sex. Such organs, when present at all, are only in species which have wings, and wingless species also lack auditory organs. These call-notes are not vocal as many suppose; for owing to their peculiar mode of breathing through body spiracles and tubes without attached vibratory organs, insects have nothing which corresponds to a mammal's voice. The sound is produced

- Interspace.—Space between certain borders or adjoining spaces.
- Knee.—Joint between femur and tibia.
- Labium.—Lower lip.
- Labrum.—Upper lip.
- Lateral lobes of pronotum.—Bent-down portions covering sides of prothorax.
- Macropterous.—Having long wings. (Opposed to Brachypterous in dimorphic forms).
- Maxillary palpus (-i, pl.).—Moveable jointed organ attached to the maxilla, near mouth.
- Mesonotum.—Upper surface of mesothorax.
- Mesosternum.—Under surface of mesothorax.
- Mesothorax.—Middle section of thorax, bearing wing-covers and middle pair of legs.
- Metanotum.—Upper surface of metathorax.
- Metasternum.—Under surface of metathorax.
- Metathorax.—Hind section of thorax, bearing hind wings and hind legs.
- Metazona.—Hind dorsal part of pronotum.
- Nerves.—Large longitudinal ribs or veins of wing-cover and wings. The smaller connecting veins are nervules or veinlets.
- Nymph.—Immature insect, active and feeding in larval and pupal stages, as in the Orthoptera. This constitutes what is known as Incomplete Metamorphosis. (Older nymphs may be distinguished from adults, or imagos as they are called, by having the wings small and apparently attached in an upside-down position, and by having the rudimentary hind wings outside of the fore wings, instead of beneath them as in the adult state).
- Occiput.—Hinder part of head.
- Ocellus (-i, pl.).—Simple eye, of which there are usually three, as distinguished from the large compound eye.
- Ovipositor.—Female organ at end of abdomen, for depositing eggs.
- Palpus (-i, pl.).—Moveable jointed organ attached to maxilla or labrum, near mouth; the former called maxillary palpus, the latter labial palpus. They are in pairs.
- Pleuron (-ra, pl.) or Pleurite.—Side piece of mesothorax or metathorax, called respectively "mesopleuron" and "metapleuron," each of which is subdivided into an "episternum" (anterior part) and an "epimerum" (posterior part).
- Pronotum.—Shield covering front part of thorax.
- Prosternal spine.—Spine projecting from prosternum, between first pair of legs.
- Prosternum.—Lower surface of prothorax.
- Prothorax.—Front segment of thorax, bearing first pair of legs.
- Prozona.—Front dorsal part of pronotum.
- Pulvillus (-i, pl.).—Pad between claws of tarsus or foot.
- Rugose.—Wrinkled or rough.
- Segment.—Ringlike division.
- Sinus.—Scooped-out marginal form.

in various ways, by a sawing or rasping movement of parts on each other, as follows:—(a) By rubbing a series of minute elastic teeth situated near the lower margin of the inner surface of the hind femur, against a roughened vein of the wing-cover. This is done by raising and lowering the femur while the insect is otherwise at rest. This fiddling method is the one characteristic of most of the subfamily *Locustinae* (Spine-breasted Locusts) and the subfamily *Acridinae* (Oblique-faced Spineless Locusts), and may be readily observed in the case of *Chorthippus curtipennis*. Such species stridulate or call only during the daytime and the note is not loud. (b) By rubbing the under surface of the wing-cover against the upper surface of the front margin of the hind wings. This is performed only during flight, and in daytime, and is the usual method with the sound-producing members of the subfamily *Ædipodinae* (Vertical-faced Spineless Locusts). It produces such notes as the cracking of *Circotettix verruculatus*. (c) By rubbing a particular vein or scraper-like part at or near the base of one wing-cover, against a file-like vein which crosses a resonant area at or near the base of the other wing-cover. This is performed by night as well as by day, by parting and closing the wing-covers while the insect is otherwise at rest. It is the method employed, with slight modifications as to the apparatus, by the sound-producing members of the family *Tettigoniidae* (Long-horned Grasshoppers, omitting the silent Stone and Camel Crickets) and the family *Gryllidae* (Crickets). Familiar examples are the strident call of the Katydid and the shrilling of the Ground and Field Crickets. Interesting records of orthopteran call-notes, many reduced to musical notation, will be found in two papers by Dr. S. H. Scudder, "Notes on the Stridulation of Some New England Orthoptera" (Proc. Bost. Soc. Nat. Hist., xi, 306-313, Bost., 1868) and "Songs of Our Grasshoppers and Crickets" (Ann. Rep. Ent. Soc. Ont., xxiii, 62-78, Toronto, 1893).



*Terms used.*—In preparing the descriptions in the following pages, as little use as possible has been made of technical terms, although a few will be found to constantly occur. These, with others of much less frequent use, are included in the following list of brief definitions, which will be convenient for reference, particularly when consulting other works wherein their use is more prevalent.

**Abdomen.**—Posterior part of body.

**Adult.**—The imago or perfect winged stage.

**Antenna** (-æ, pl.).—Elongated jointed organ of touch and possibly of smell attached to upper front part of head.

**Apex.**—Terminal portion of any part of body.

**Basal.**—Nearest to the body.

**Brachypterous.**—Having short or aborted wings in adult stage. (Opposed to Macropterous.)

**Carina** (-æ, pl.).—A ridge or keel.

**Cercus** (-i, pl.).—Appendage situated alongside of upper part of last abdominal segment.

**Costal margin.**—Front margin of wing-cover or wing when extended sideways.

**Crest.**—Sharp ridge or keel.

**Dimorphic.**—Exhibiting two forms, such as the long- and short-winged forms of a species.

**Disk.**—Middle portion of a surface, such as the disk of the pronotum, of the wing, or of the femur.

**Dorsal.**—Relating to the back or upper surface.

**Dorsum.**—Upper surface of thorax, abdomen, etc.

**Elytron** (elytra, pl.).—Wing-cover.

**Fastigium.**—Extreme point of front or vertex of head.

**Femur** (femora, pl.).—Thigh.

**Foveola** (-æ, pl.).—Small depression.

**Front.**—Face.

**Furcula.**—A pair of small backward-directed appendages of the last dorsal segment of male, and overlying the base of the supra-anal plate.

**Fuscous.**—Dark brown.

**Glabrous.**—Smooth.

**Granulated.**—With minute prominences which give a grainy surface.

**Habitat.**—Natural home or habitation of an animal or plant.

**Hibernate.**—Spend the winter in torpid state.

**Hind wings.**—Second pair of wings; the ones used for flight in Orthoptera.

**Humeral.**—Pertaining to the humerus or front upper corner or angle of the thorax or wing-cover. The subcostal vein of the wing-cover is also called the humeral vein.

**Imago.**—The adult or perfect winged stage.

- Spiracle.**—External orifice of breathing tube (situated on sides of the thorax and abdomen of an insect).
- Sternum.**—Under surface of body segment.
- Stridulate.**—To produce a shrill sound, by grating or rasping certain organs, as in the Orthoptera which do not produce vocal notes.
- Subgenital plate.**—Ventral portion of last abdominal segment of male, consisting of an upturned, spoon-shaped piece.
- Sulcus** (-i, pl.).—A linear groove.
- Supraanal plate.**—A triangular plate, the upper portion of the last abdominal segment.
- Suture.**—An impressed line; usually referring to the junction of two plates.
- Tarsus** (-i, pl.).—The foot, beyond the tibia; it consists of three divisions.
- Tegmen** (tegmina, pl.).—Wing-cover or front wing.
- Tergite.**—Upper portion of a body segment; tergum.
- Testaceous.**—Brick-coloured; dull yellowish brown.
- Thorax.**—Middle division of an insect's body, bearing the wings and legs; subdivided into prothorax, mesothorax, and metathorax.
- Tibia** (-æ, pl.).—Section of leg between femur and foot or tarsus.
- Tubercle.**—Small rounded projection.
- Valves of the ovipositor.**—Four horny plates at extremity of female abdomen.
- Veins.**—Same as the nerves or ribs of the wing.
- Ventral.**—Pertaining to the under abdominal surface.
- Vertex.**—Upper front part of head, between and before the eyes.
- Wing-covers.**—Front wings, tegmina, or elytra; not used for flight in Orthoptera, but serving as covers for the more delicate hind-wings.
- Wing-pads.**—Undeveloped wings, as seen on the nymph. From the wings of perfect or adult individuals (imagos) they may be distinguished by being seemingly in an upside-down position, and by the rudimentary hind wings being outside the front wings.

*Life history.*—Generally the eggs of our Orthoptera are deposited late in the summer or early in the autumn. Most species lay them in a puncture in the ground formed by the ovipositor; but sometimes they are placed on the outside of twigs, as in the *Phaneropterinae*, and occasionally in the pith of twigs, as in the Tree Cricket (*Æcanthus*). The eggs of most of our species then lie dormant until the next season when the small young insect, called a "nymph", emerges. This hatching, in the case of some species at least, such as *Camnula pellucida* and *Circotettix verruculatus*, takes place in western Nova Scotia about the first of June; but about Halifax it is apparently considerably later, *Melanoplus bivittatus* there hatching about the latter part of that month.

The eggs of the Grouse-locusts (*Acrydinæ*) are laid much earlier in the season than those of most Orthoptera, and hatch in about three weeks, and the young reach maturity by the autumn, and then hibernate in the adult form, coming forth again early the next spring, about the middle of April in western Nova Scotia.

The Orthoptera have an incomplete metamorphosis, and do not pass through grub and chrysalis stages as many insects do. From the time they are hatched, they resemble the adult and are active and feeding, and merely grow and change in some minor details. In the first stage the nymph is wingless, but as it increases in size it moults its skin five times; and the wings, when they are to be present, gradually develop at these periods, but differ from those of the perfect insect in being seemingly placed upside-down and in having the rudimentary hind wings outside of the fore-wings. By these "wing-pads" the nymphs may be readily distinguished from adults. After the final or fifth moult, which takes place several weeks after hatching, they emerge as perfect insects or "imagos" as they are called, cease growing, and are ready to propagate their species and to continue the role of destructors of vegetation, until they finally die, usually when the harder frosts of autumn occur. Adults of the non-hibernating species begin to appear near Halifax towards the middle of July and about the first week of that month in the western counties. Nymphs are still seen for a few weeks after the adults begin to appear. Although the various call-notes of Orthoptera form a charming autumnal chorus in the country, and one which we would be very loath to lose, and they themselves are often clad in glad raiment and fair to look upon, yet they are a band of inveterate evil-doers, and deserve scant mercy from the economic entomologist and the farmer.

*Parasites and other enemies.*—Among the parasites which attack Orthoptera is a fungus, *Empusa grylli*, which is most

prevalent in wet seasons, and causes death. Many locusts are also attacked by a red mite, *Trombidium locustarum*, which clings to the body, and which no doubt is the species I have observed about Halifax infesting the underside of the base of the hind wings of *Melanoplus bivittatus* and *M. femur-rubrum* in August. Some species are also attacked by a hair-worm, a species of *Gordius*. They have likewise various insect enemies, as well as others among the reptiles, batrachians, small mammals, and birds. Unfortunately in Nova Scotia one of their least active enemies is their indirect victim man, except in the case of household pests such as the cockroaches. Among their friends we may possibly include those who, having no crops to be injured, love them for their notable contribution to the sweet sounds of nature, particularly during the hush of night.

*Injury caused by Orthoptera.*—All of our Orthoptera are more or less injurious, some species doing great damage to agricultural crops and pasture-lands, particularly during a succession of dry seasons when the insects thrive and multiply rapidly, and the grass and other vegetation suffers directly from the drought. While this damage is no doubt not so great in Nova Scotia as in many parts of the United States, still it is quite extensive enough to seriously affect the farmer and more so than he has any idea of. Although, fortunately, that arch-devastator, the migratory Rocky Mountain Locust (*Melanoplus spretus*), does not range into eastern America, yet it has in these parts a very able representative in the closely related Lesser Migratory Locust (*M. atlantis*) which has a great potentiality for doing harm, and which, during some favourable seasons, is liable to produce much damage, a very serious instance of which occurred over twenty years ago on Sable Island, off the coast of Nova Scotia, to which fuller reference will be made when treating of the species. Had this insect not abated its ravages there, the grass which binds down the sand of which the island is composed, would

certainly have been ultimately destroyed, and the loose arenaceous deposit would then have drifted continually at the mercy of the prevailing southwesterly wind. In such a case, if this condition were not artificially checked, the island would in a comparatively few years have shifted eastward and become lower very much more rapidly than under normal conditions, and it would thus have ultimately gone beneath the sea-level, forming sandbars of tenfold greater menace to shipping than even the island is now.

The Red-legged Locust (*M. rubrum-femur*), existing everywhere in our pastures in vast numbers, must also do thousands of dollars' worth of damage yearly in the province; and the Yellow-striped Locust (*M. bivittatus*) no doubt produces considerable injury, as also the small Striped Ground-cricket (*N. fasciatus*) which in myriads infests our pasture lands, and its larger relative the Pennsylvanian Field-cricket (*G. pennsylvanicus*). The Clear-winged Locust (*C. pellucida*) is a pest in parts of the western counties, where in some seasons at least it is very abundant and harmful. Such species as frequent uncultivated lands and devour waste vegetation, may of course be considered as not of much economic importance, as their great voracity does not directly affect man to any noticeable extent. Cockroaches are serious pests in some city dwellings, bakeries and storehouses, but are very seldom if ever seen about cottages in the rural districts.

*Methods of control.*—The eggs of the Short-horned Locusts or *Acrididæ*, which (with the exception of the Grouse-locusts) are laid in the ground late in the season and remain dormant until the following spring, may be killed by plowing the land in the autumn after the period of oviposition, so as to expose the eggs to the full effects of frost; etc. Poisoned bait may also be spread over the fields, as more fully described under *Melanoplus femur-rubrum*. Probably one of the very best and easiest methods is, when possible, to keep a

flock of poultry, particularly turkeys, the latter of which destroy vast numbers of locusts or grasshoppers, and such fowls command a ready sale. Methods of dealing with Cockroaches in houses and other buildings are described in the following pages where those species are described. A circular (No. 5) on the control of locusts in eastern Canada, by Arthur Gibson, was issued in 1915 by the Entomological Branch of the Canadian Department of Agriculture, Ottawa, and may be obtained on application to that department; and many thorough state reports on the subject of orthopteran control are published by the agricultural experiment stations of the United States.

*Preserving Orthoptera for scientific purposes.*—Specimens may be taken with an entomological hand-net, or in the manner known as sweeping; but it very frequently happens that they have to be stalked and captured by hand. The notes of many species draw attention to their whereabouts, and then by obtaining two cross-bearings the exact location of the individual can be ascertained, upon which it can be cautiously approached and taken. Further reference to this method will be found in the remarks on *Scudderia pistillata*, which is difficult to get in any other way. Specimens can be killed in a corked bottle of alcohol or in an entomological cyanide killing-bottle. The former is the safest for beginners to handle. On reaching home the insects should be either preserved in labelled vials in dilute alcohol or formaldehyde, the first of which, while it keeps the parts somewhat flexible for examination and prevents attacks by insect pests, will ultimately destroy some of the colours; or else pinned with insect pins such as are used for entomological purposes, and afterwards systematically arranged

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\*Labels written with Higgins' waterproof drawing ink, black, may be placed into alcohol immediately after being written, and will not run or fade and are very much more legible than pencil-written labels. This I discovered many years ago and have used it in museum work ever since. So far I have not heard of others using this waterproof ink to supplement the lead-pencil for writing such labels, and the matter is one which should be of interest to all who have to deal with specimens preserved in jars where it is necessary to have a label within the jar in case the gummed label on the outside becomes detached.

in some form of tight insect-box or cabinet. The pin should be placed through the thorax, and the right-hand wing-cover and wing expanded horizontally and at right-angles to the body, so as to show their form and markings, while the left wing-cover and wing remain in a folded position. The legs should be neatly set in position so as to dry in a uniform posture. The long antennæ of some species are very liable to be broken when dry, and in such cases should be laid backward over the body where they will be less subject to injury. Some large-bodied species, such as *M. bivittatus*, are apt to discolour when dried, and therefore the contents of the abdomen should be removed through a small slit in the underside, and a little cotton-wool inserted to prevent collapse. On the pin, beneath the specimen, must be a small paper label having the specific name, if known, and always the place and date of capture. Without such data specimens are scientifically useless. Other general notes and observations should be recorded in a note-book, of which probably the loose-leaf ones are the best, as being expansive. Certain pages may be reserved for notes on each species, so that the information collected will always be orderly and readily available. I use such loose-leaf books, in which the notes are arranged systematically according to species, so that new records or observations are added directly under their proper heads, and new leaves are inserted whenever required. This method saves much labour in afterwards assembling one's notes.

#### ORTHOPTERA OF NOVA SCOTIA.

*Historical notes.*—So far as I can ascertain, nothing definite regarding the Orthoptera of Nova Scotia was published until 1869-70. Walter Bromley's anonymous "General Description of Nova Scotia", new edition, Halifax, 1825, page 33, gives a list of what he terms "most of the insects of Nova Scotia", the whole list consisting of only thirty-one common names, among which are merely mentioned the

“cockroach, grasshopper, cricket, and locust”, the last probably referring to the Cicada. Haliburton, in his chapter on the natural history of the province, in his history of Nova Scotia, 1829, gives practically nothing about insects. J. W. Dawson’s “Hand Book of the Geography and Natural History of Nova Scotia,” third edition, Pictou, 1852, page 82, under the order Orthoptera dismisses the subject with a mere general reference to “the crickets and the grasshoppers, of which there are several species, all very injurious to vegetation.”

Lieutenant Redman, many years ago, had collected a number of specimens in the province for the cabinet of the British Museum. He must have been here at least prior to 1848, as he is referred to as having obtained specimens of flies from Nova Scotia in Walker’s “List of Dipterous Insects in the British Museum,” the first volume of which was published in that year. Who this Lieut. Redman was, I have been able to conjecture with a large degree of certainty, for no doubt he was in the army, and if so the only man who could be he in the Army Lists from 1822 to 1849, is Lieut. Richard Sparrow Redman, who was commissioned lieutenant in the 60th (Royal American) Regiment of Foot in 1809 and served in that corps till 25th July, 1822, when he was placed on the half-pay of the 12th Light Dragoons, and died in 1833. From old Halifax almanacs, we find that “R. S. Redman” is named as senior lieutenant of the 2nd (lately the 3rd) Battalion, 60th Regiment, and that he was at Halifax in that corps from about 1820 (almanac for 1821) till at least the end of 1821 (almanac for 1822), so that no doubt he was here until placed on half-pay in July, 1822. Whether he thereupon returned to England is not known; but as we have said he died in 1833. We can therefore be quite reasonably certain that this was the “Lieut. Redman” who collected here, and that his collection



must have been made between about 1820 and 1822, unless he continued to reside here after he retired, which is not at all likely.

Francis Walker, F. L. S., when re-arranging the Orthoptera in the British Museum, studied and named Lieut. Redman's Nova Scotian Orthoptera, and references to them, twelve nominal species, was made in the former's "Catalogue of the Dermaptera Saltatoria in the British Museum," published in five parts at London, 1869 to 1870. This was the first real contribution to our knowledge of such insects in Nova Scotia; and Lieut. Redman is entitled to the credit of being the first to collect and F. Walker of being the first to make known our orthopteran fauna. In the "Canadian Entomologist," London, Ont., for February, 1872, vol. iv, No. 2, pp. 29-31, Walker published a list of the "Hemiptera, Heteroptera and Dermaptera (Orthoptera) of America to the North of the United States," the list of Orthoptera being on pages 30 and 31. In this list, which was merely selected from his previous larger work, he gives twelve nominal species of Orthoptera as occurring in Nova Scotia. Unfortunately Walker's determinations were occasionally erroneous, and so, owing to lack of confidence in his identifications and nomenclature, but very little use has been made of his list by recent American orthopterists. I have lately had Walker's Nova Scotian specimens re-examined at the British Museum, through the courtesy of Mr. B. M. A. Cummings of that institution, and am thus able in the present paper to assign for the first time, nearly all of his names to their proper species.

From the dates of Walker's lists until 1896 nothing apparently appeared on the subject, except a mere note on crickets at Windsor, N. S., by the present writer in the Transactions of the N. S. Institute of Science, vol. viii, p. 410, 1894. In August, 1895, I took up the study of these insects and collected about Halifax, the result being a pre-

liminary paper published in the Transactions of the Institute, vol. ix, pp. 208-218, 1896, which listed fourteen nominal species observed by myself, but which took no notice of Walker's records as the validity of his names were too doubtful in some instances to render quotation advisable. The determination of nearly all the forms listed by me were verified by the most noted of American orthopterists, the late Dr. Samuel H. Scudder of Cambridge, a gentleman who will long be remembered for his scientific knowledge, his general culture, and his refined and delightful personality. Other claims upon my time have since arisen; but many additional notes have been made, which with changes in nomenclature, have made it desirable that a revised list be prepared.

In the spring of 1913, Mr. Charles Benjamin Gooderham of the Agricultural College, Truro, N. S., began, under the direction of the then Provincial Entomologist, Dr. Robert Matheson, the collection and study of Orthoptera about that town and the western counties of Nova Scotia, where the faunal conditions are considerably different from those of the Atlantic seaboard. He has since continued this work, and in 1914 founded the orthopteran collection at the before-mentioned college and has likewise built up a collection of his own. He has just published a paper on the Acrididæ of Nova Scotia in the Proceedings of the Entomological Society of Nova Scotia for 1916, no. 2 (Jan., 1917), pp. 21-30, which lists thirteen forms. To the kindness of Mr. Gooderham, who has most courteously placed many of his notes at my disposal, we are indebted for the inclusion in our list of some interesting species which I have not met about Halifax, and through his observations the relative abundance of species in the eastern and western sections is better understood. Mr. Gooderham was lately assistant provincial entomologist at Truro.\* Mr. E. Chesley Allen,

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\*In 1917 he was transferred to the Central Experimental Farm at Ottawa as Assistant Dominion Apiarist.

now of Truro, has also collected to some extent in our southernmost county of Yarmouth, and references to his work will likewise be found in my paper. I have also examined such small entomological collections as are shown at the Provincial Exhibitions to ascertain what Orthoptera they contain.

*Bibliography.*—The following publications deal more or less fully with Nova Scotian Orthoptera or contain original records of occurrences in this province. Bromley's and Dawson's very brief references, beforementioned, are too short and general to list.

1869-70 [71].—Walker, Francis, F. L. S., etc. Catalogue of the Specimens of Dermaptera Saltatoria in the Collection of the British Museum. 8vo.

[Part I.] Gryllidæ, Blattariæ, Locustidæ. Pp. 1-224. Lond., 1869.

Part II. Locustidæ (continued). Pp. 225-423. Lond., 1869.

Part III. Locustidæ (continued), Acrididæ. Pp. 425-604. Lond., 1870.

Part IV. Acrididæ (continued). Pp. 605-809. Lond., 1870.

Part V. Tettigidæ. Supplement to the Catalogue of Blattariæ, Supplement to the Catalogue of Dermaptera Saltatoria (with remarks on the Geographical Distribution of Dermaptera). Pp. 811-850; 1-43; 1-116. Lond., 1870 [1871].

In this work 12 nominal species are noted as having been collected in Nova Scotia, the original labels showing that they were taken by the beforementioned Lieut. Redman, who was here at least some years prior to 1848 and probably from 1820 to 1822. (See page 216).

1872.—Walker, Francis, F. L. S. Hemiptera, Heteroptera and Dermaptera (Orthoptera) of America to the

North of the United States. Dated Jan., 1872. Canadian Entomologist, London, Ont., vol. 4, no. 2 (Feb., 1872), pp. 29-31. (The list of "Dermaptera [Orthoptera]" is on pp. 30-31.)

Lists 12 nominal species as occurring in Nova Scotia, the same as noted in his previous Catalogue.

- 1892.—Scudder, Samuel H[ubbard]. The Orthopteran Genus *Hippiscus*. Psyche, vol. 6, Cambridge, 1892, pp. 265-274, 285-288, 301-304, 317-320, 333-336, 347-350, 359-363.

On page 303 is a reference to "*H. tuberculatus*" [= *H. apiculatus* Harris] as occurring in Nova Scotia, with the name of "Jones" attached. It is the sole record for its occurrence here as far as known. See remarks in the present paper, under *H. apiculatus* (No. 11).

- 1894.—Piers, Harry. Notes on Nova Scotian Zoology; no. 3. Trans. N. S. Inst. Sc., vol. 7, Halifax, 1894, pp. 395-410.

On page 410 is a brief note on Crickets, "*Acheta abbreviata*" (= *Gryllus pennsylvanicus neglectus*) and *A. vittata* (= *N. fasciatus vittatus*) at Windsor, N. S.

- 1896.—Piers, Harry. Preliminary Notes on the Orthoptera of Nova Scotia. Trans. N. S. Inst. Sc., vol. 9, Halifax, 1896 (separates issued Nov.), pp. 208-218.

Annotated list of 14 nominal species collected about Halifax in 1895-6.

- 1899.—Scudder, Samuel H. North American Species of *Orphulella*. Can. Entomologist, vol. 31, no. 7, London, Ont., July, 1899, pp. 177-188.

On p. 184 is the only record of *Orphulella speciosa* having been taken at Halifax by Piers. See remarks on this doubtful record in the present paper. From 1896 until Scudder's death in May, 1911, many of his papers contained references to the occurrence

of various species in Nova Scotia, all based on my paper of the former date, but there is no need to refer to them here, as they are merely secondary references, not original records.

- 1917.—Gooderham, C[harles] B[enjamin]. The Acrididæ of Nova Scotia. Proc. of Entomological Society of Nova Scotia for 1916, no. 2, [Truro], Jan., 1917, pp. 21-30, and 1 plate.

Lists 13 nominal species, with keys and descriptions. The material for this paper was collected during 1913 and 1914 and it was founded on the author's thesis for his degree of B. S. A. at Macdonald College, Ste. Anne de Bellevue.

*Reference works.*—Among the available literature which will probably be most useful to a student of the Orthoptera of this section of Canada, may be mentioned the following papers of recent dates, from which it will be seen that there is no general manual on the subject, and one is therefore forced to rely upon various scattered sources of information. 1894-98.—Morse, Albert P. Notes on the Acrididæ of New England. Psyche, vol. 7 (Cambridge, 1894-97), vol. 8 (1897-98).

- 1897.—Scudder, Samuel H. Guide to the Genera and Classification of North American Orthoptera. Cambridge, 1897. (Keys to the various genera, without reference to species. Contains a bibliography.)
- 1897.—Scudder, S. H. Revision of the Orthopteran Group Melanopli. Proc. U. S. Nat. Mus., vol. 20, Wash., 1897, pp. 1-421, pl. 1-26. (A very thorough monograph of an important group.)
- 1898.—Scudder, S. H. The Orthopteran Group Scudderidæ. Proc. Am. Acad. Arts and Sc., vol. 33, no. 15, Bost., 1898, pp. 269-290, with plates. (Clears up this hitherto chaotic group.)

nominal species in 18th Ann. Rep. Ent. Soc. Ontario for 1887, Toronto, 1888, pp. 59-72 (Sess. Papers Ont. for 1888, pt. 4, no. 21). Caulfield's list gives no Nova Scotian records.

For general purposes our student will probably find Blatchley's "Orthoptera of Indiana" (1903), and Walden's "Euxileoptera and Orthoptera of Connecticut" (1911) the most useful guides in the determination of species, etc.

*Life zones represented in Nova Scotia.*—Two of the recognized Life Zones are represented in this province, namely (a) the *Canadian Zone* and (b) the *Alleghanian division of the Transition Zone*. The former is the southern portion of the Boreal Region, and the latter is the northeastern transitional portion of the Austral Region. The Canadian Zone, with its more northern fauna and flora, includes Cape Breton Island (excepting doubtless the valleys of the Margaree and Middle Rivers) and the Atlantic slope of Nova Scotia proper, southeast of a line, of irregular course, roughly drawn from near Antigonish to Grand Lake and thence to near Yarmouth. It may therefore be taken to approximately comprise the greater part of Cape Breton Island, and the Atlantic seaboard counties of Guysborough, Halifax, Lunenburg, Queens and Shelburne, and perhaps is most typically represented from Halifax eastward. It is quite possible that the highlands of northern Inverness and Victoria Counties, Cape Breton Island, may contain a fauna and flora approaching somewhat more to that of the Hudsonian Zone; and at any rate in that district will be met life of the most northern type to be found in Nova Scotia.

Westward and northwestward of the above-defined area occurs a fauna and flora of a more southern tendency, belonging to the Alleghanian or humid division of the Transition Zone. The Alleghanian division roughly includes such sheltered valleys, apparently, as those of the Margaree and Middle Rivers, in Inverness and Victoria Counties, (Cape Breton Island), and all or most of the counties of Antigonish,

now of Truro, has also collected to some extent in our southernmost county of Yarmouth, and references to his work will likewise be found in my paper. I have also examined such small entomological collections as are shown at the Provincial Exhibitions to ascertain what Orthoptera they contain.

*Bibliography.*—The following publications deal more or less fully with Nova Scotian Orthoptera or contain original records of occurrences in this province. Bromley's and Dawson's very brief references, beforementioned, are too short and general to list.

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Part III. Locustidæ (continued), Acrididæ. Pp. 425-604. Lond., 1870.

Part IV. Acrididæ (continued). Pp. 605-809. Lond., 1870.

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In this work 12 nominal species are noted as having been collected in Nova Scotia, the original labels showing that they were taken by the beforementioned Lieut. Redman, who was here at least some years prior to 1848 and probably from 1820 to 1822. (See page 216).

1872.—Walker, Francis, F. L. S. Hemiptera, Heteroptera and Dermaptera (Orthoptera) of America to the

- 1904-5.—Walker, E. M. Notes on the Locustidæ of Ontario. *Can. Ent.*, vol. 36, Lond., Ont., 1904, pp. 325-330, 337-341; vol. 37, 1905, pp. 34-38, 113-119. (Useful for comparative purposes. Lists 26 nominal species with notes on habits, etc.)
- 1911.—Walden, Benjamin Hovey. The Euplexoptera and Orthoptera of Connecticut. Part 2 of Guide to Insects of Connecticut, *Conn. State Geol. and Nat. Hist. Surv.*, Bulletin 16, Hartford, 1911, pp. 39-169, with illustrations. (A useful work with simple keys, descriptions, and illustrations.)
- 1914.—Somes, M. P. Acridiidæ of Minnesota. *Univ. of Minn. Agric. Expt. Station*, Bulletin 141, St. Paul, 1914, 98 pp., with coloured plates. (Contains keys for determination of species, and notes on occurrence and habits.)
- 1915.—Walker, E. M. Notes on a Collection of Orthoptera from Prince Edward Island and the Magdalen Islands, *Que. Can. Ent.*, vol. 47, Lond., Ont., Oct., 1915, pp. 339-344. (The specimens listed were collected by Bayard Long, a botanist, in P. E. Island in 1912, and in Quebec in 1910. It furnishes the only list of species occurring in Prince Edward Island, of which it enumerates 11 nominal forms, and therefore is of unusual interest to students in this region.)

For some original descriptions one is thrown back to Scudder's "Materials for a Monograph of North American Orthoptera," listing 78 species, in *Journ. Bost. Soc. Nat. Hist.*, vol. 7, Bost., 1862, pp. 409-480, which is now difficult to obtain. Sidney I. Smith's "Orthoptera of Maine," in *Proc. Portland Soc. Nat. Hist.*, vol. 1, Portland, 1869, pp. 143-151, lists 38 nominal forms, but is out of print; as is also C. H. Fernald's "Orthoptera of New England," Boston, 1888, pp. 61, illustrated, and F. B. Caulfield's "Sketch of Canadian Orthoptera", containing a preliminary list of 76



Pictou, Colchester, Cumberland, Hants, Kings, Annapolis, Digby, and Yarmouth, with various subsidiary offshoots or tongues, such doubtless as the valleys of the Shubenacadie, Stewiacke, and Musquodoboit Rivers, etc., and probably the district about the headwaters of rivers like the LaHave. Generally it embraces the counties on Northumberland Strait and the Bay of Fundy, with outlying areas in sheltered inland districts. This region is probably most typical from Truro, through the Annapolis Valley, to Yarmouth. Outliers of the Canadian Zone will no doubt be found in some elevated districts in this Alleghanian region. A detailed delineation of the life zones of this province is greatly needed, and most certainly should be prepared through the cooperation of our local biologists.

Thus we find in the western parts of the province a number of species which are rare or wanting on the Atlantic side and which are more southern in range. It is in this western area that we are more likely to find species of Orthoptera which have not yet been reported from the province; species which form the last northern outposts of some of the New England forms. As Maine embraces similar life zones to those of Nova Scotia, it is the common species in that state which are most likely to be found extending into Nova Scotia until they arrive at the northernmost limit of their distribution. These considerations explain to a large extent the variation in the relative abundance of certain species in the eastern and western sections of our province, to which reference will be made later. The passing out of species of more southern range, and the lack of any augmentation from species of more northern distribution, have made our orthopteran fauna a very scanty one when compared with that of regions to the south of us. (See further remarks under the heading "Number of species in Nova Scotia", page 233.)

*The distribution of Nova Scotian Orthoptera according to life-zones* may be very roughly and quite tentatively set down as follows, although sufficient is not yet definitely

known regarding the relative abundance of some species to make the grouping at all definitive. It is therefore merely a suggestive grouping, prepared specially to court subsequent revision which will bring us nearer the facts.

Canadian Zone.

(Atlantic seaboard and eastern Nova Scotia).

<i>Chorthippus curtipennis</i> †	<i>Melanoplus bivittatus</i> (phase
<i>Dissosteira carolina</i> †	<i>femoratus</i> )†
<i>Circotettix verruculatus</i> †	<i>Scudderia pistillata</i> †
[ <i>Podisma glacialis</i> . Hypo- thetical.]	<i>Conocephalus fasciatus fasciatus</i> †
<i>Melanoplus atlantis</i> †	<i>Nemobius fasciatus</i> (variant
[ <i>Melanoplus fasciatus</i> . Hypo- thetical. †]	<i>vittatus</i> )†
<i>Melanoplus femur-rubrum</i> †	<i>Gryllus pennsylvanicus</i> (variant
	<i>neglectus</i> )†

All these species also occur commonly in the Alleghanian (western) section of the province, except of course the two species which are merely hypothetically included in our fauna. *Podisma glacialis*, if actually found here in the future, will most likely occur in the Canadian Zone; and *Melanoplus fasciatus*, another hypothetical inclusion, should certainly be associated with the same zone.

Alleghanian Division of the Transition Zone.

(Western Nova Scotia).

<i>Nomotettix cristatus</i> *	<i>Hippiscus apiculatus</i> †
<i>Acrydium granulatum</i> †	<i>Melanoplus extremus</i>
<i>Acrydium arenosum angustum</i>	<i>Scudderia curvicauda borealis</i>
<i>Orphulella speciosa</i> (although actually only reported from Halifax; a very doubt- ful record).*†	<i>Scudderia furcata furcata</i> (a <sup>l</sup> though actually only re- ported from Halifax).*†
<i>Mecostethus lineatus</i> *†	<i>Ceuthophilus maculatus</i> †
<i>Mecostethus gracilis</i> *	<i>Ceuthophilus terrestris</i>
<i>Camnula pellucida</i> *†	<i>Nemobius carolinus</i> †

Those species marked with an asterisk \* have also been reported from eastern Nova Scotia, and therefore pass into the more northern Canadian fauna, but they appear to me to be more particularly associated with the Transition group. *Scudderia furcata* and *Orphulella speciosa*, although only reported from Halifax (the latter on the authority of Scudder who states I collected it here), seem to have greater relationship to the more southern fauna of western Nova Scotia, and are so grouped for the present. The occurrence of *Hippiscus apiculatus* and *Orphulella speciosa* is open to very considerable doubt, but we would expect them to pertain to the Transition Zone.

The species marked with a † apparently range, in other parts of the continent, still further downward into areas believed to belong to the Carolinian division of the Upper Austral Zone, although their supposed presence in that zone may sometimes be explained by the existence in those parts of small unmapped outlying areas of Transition fauna.

*Influence of climate and periodical phenomena on Orthoptera.*—As the hatching of orthopteran eggs and the final autumnal disappearance of a species, as well as its abundance to a large extent, are dependent upon climatic conditions, the following relevant data for Nova Scotia are furnished, which may be useful to future students.

Mean annual temperature.....	Fah. 44.4°
Maximum temperature.....	94.4°
Minimum temperature.....	-16.9°
Mean temperature, spring months.....	40.3°
Mean temperature, summer months.....	62.3°
Mean temperature, autumn months.....	49.1°
Mean temperature, winter months.....	25.8°
Warmest months,.....	July, 64.9°; Aug. 64.5°
Coldest months,.....	Feb., 23.7°; Jan. 24.4°
Mean annual precipitation, inches.....	57.40
Least precipitation, July, mean, inches.....	3.66

The above data refer to Halifax, and is only approximately correct for the province generally, as the western section is considerably warmer in summer, and also differs somewhat in other meteorological features.

The dates of certain periodical phenomena for several recent years may be given approximately as follows, for Nova Scotia in general:\*

Grass begins to sprout at Halifax about 18th April (extremes 14—24 Apr.).

Ploughing, first, 24 April (extremes, 15 Ap.—3 May); becoming common, 5 May (extremes, 28 Ap.—19 May).

Sowing, first, 7 May (extremes, 27 Ap.—19 May); becoming common, 14 May (extremes, 6-19 May).

Haycutting, first, 16 July (extremes, 11—25 July); becoming common, 26 July (extremes, 20 July—3 Aug.).

Last snow, to whiten ground, 21 Ap. (extremes, 13—26 Ap.); to fly in air, 4 May (extremes, 26 Ap.—20 May).

Last spring frost, hard, 13 May (extremes, 4—20 May); hoar, 3 June (extremes, 29 May—9 June).

First autumn frost, hoar, 20 Sept. (extremes, 13—29 Sep.); hard, 16 Oct. (extremes, 5—31 Oct.).

First snow, to fly in air, 20 Oct. (extremes, 14—27 Oct.); to whiten ground, 6 Nov. (extremes, 31 Oct.—14 Nov.).

We have said that the temperature of the western section of Nova Scotia, where the Alleghanian fauna is found, is higher than that of the Atlantic seaboard and eastern section, where occurs the Canadian fauna; and one may expect something like a week's difference in the dates of periodical phenomena when the two districts are compared. This must be borne in mind when considering the dates of the first and last appearances of our Orthoptera in various counties.

No Orthoptera, either hibernated adult or nymph, can emerge until after the ordinary winter's frost is out of the

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\*Compiled from Dr. A. H. MacKay's Phenological Observations, in Trans. N. S. Inst. Sc.

ground, and we take it for granted that no eggs hatch till after the last hard spring frost which occurs about the 13th May. It is even probable that hatching does not take place generally till after the last hoar frosts of about 3rd June, unless it be in the case of a very few hardy species such as *M. atlans*, *M. femur-rubrum*, and *C. curtipennis*.

The earliest species of Orthoptera to appear as adults are those of the subfamily *Acrydiinæ* or Grouse-locusts. These insects are peculiar, inasmuch as oviposition takes place early in the season and the young hatch and reach maturity by the autumn, and then hibernate as adults, to reappear the next spring. Of these, *Acrydium granulatum* and *Nomotettix cristatus* have been taken in western Nova Scotia on 15th April, just as the grass was beginning to sprout, which is not very long after the winter's frost has come out of the ground, and long before the last hard spring frost which occurs about 13th May (4—20th May). Other species of *Acrydium* are also very early in appearing, as they all belong to the hibernating *Acrydiinæ*.

The non-hibernating species, which embrace about eight-ninths of our forms, hatch and appear as nymphs and adults at a much later date than the hibernated adults of the *Acrydiinæ*. The first newly hatched orthopteran nymphs noted by C. B. Gooderham about Truro in 1915, when he was observing the hatching of the eggs fairly closely, were seen on 3rd June, which is about the usual time of the last hoar frost. The tiny hoppers could then be seen in very warm places. They were chiefly *Camnula pellucida* with a few *Circolettix verruculatus*. Other species were present but were not determined. About Halifax the date would be considerably later. On 1st July, 1917, I collected the nymph of *Melanoplus bivittatus* in the second stage, near Halifax. It must have hatched about the middle or latter part of June.

The adults of most species appear during July, our warmest month; while *Scudderia* and a very few others come in

later, about the first week of August. For a considerable time, nymphs and adults of the same species may be collected together, showing that the period of hatching extends over a considerable number of days. August and most of September are the months when the song-making species are most loudly heard, although the notes of some species are still heard in October, but are then less vehement. Oviposition probably takes place fairly generally in September, but we have little data on this point. In the case of the Grouse-locusts (*Acrydiinæ*) it must be much earlier, as these insects pass through the egg stage and come to maturity in the same season before hibernating.

Generally speaking, the first hoar-frost of about 20th Sept. (13—29th Sept.) has little effect upon our Orthoptera, unless it is to lessen the volume of their notes; except in the case of the very frail *Conocephalus fasciatus* which succumbs to the lowering temperature in the middle of that month. The first hard frosts which usually occur about 16th Oct. (15—31 Oct.), appear to be the critical factor which determines the existence of a large number of our Orthoptera, although the Crickets, our hardiest species, often survive as late as about the middle of November, and in one instance, in 1916, four inches of snow fell only two days after the last Ground Crickets (*Nemobius*) were seen. The middle of November is therefore the close of our orthopteran year which had opened in the middle of April and had reached its culmination about the last part of August and the first part of September. A few individuals, in rare instances, are able to casually survive sometime longer by getting into hay-ricks or other sheltered nooks, from which they languidly crawl on a sunny day.

A succession of dry summers and perhaps of winters when the soil is not much affected by thaws and severe frost, seem favourable to the multiplication of Orthoptera; the largest numbers, I believe, being met after such conditions.

*Melanoplus atlantis*, a species which should be closely watched because of its latent destructive abilities, is liable to appear in vast numbers after such seasons. The dry summers of 1889, 1891 and 1894, even though a fairly wet one intervened in 1893, seem to have had something to do with the plague of that species on Sable Island which began about 1891; and the wet season of 1896 suddenly caused its disappearance. Meteorological records show that Nature has fortunately provided a counteracting influence in such matters, as periods or years of great drought are soon succeeded by years of abnormal rainfall. For the suppression of many pests we apparently owe more to the balancing efforts of Nature, exerted in various ways, than to man's own exertions; although it must be admitted, inversely, that it is often the cause of the periodical multiplication of such pests.

*Earliest and latest appearance of adults.*—The following provisional table of the earliest and latest dates on which adults of the various commoner species have happened to have been noted in Nova Scotia, is inserted chiefly that it may be a convenient reference list for students who have data which may modify the dates here given. One of its purposes, therefore, is to court correction, and another is to assist the student by cautioning him beforehand when to look for the appearance and disappearance of the various species. No doubt considerable changes can be made in some parts of the table by further investigation. Some rare forms are not included, as the dates on which they have been taken manifestly could not be considered as earliest or latest occurrences.

Species	First appearance		Last appearance	
	Date	Place	Date	Place
<i>Nomotettix cristatus</i> { hibernating	15 Apr.	Truro	20 Aug.	Truro
<i>Acrydium granulatum</i> } species	15 Apr.	Truro	4 Oct.	Truro
<i>Melanoplus atlantis</i> . . . . .	30 June	Truro	26 Oct.	Lawrence- town, Hx. co.
<i>Melanoplus femur-rubrum</i> . . . . .	3 July	Greenfield, Qu. Co.	28 Oct.	Halifax
<i>Melanoplus extremus</i> . . . . .	7 July	Truro		
<i>Chorthippus curtispennis</i> . . . . .	5 July	Truro		
<i>Camnula pellucida</i> . . . . .	6 July	Truro	26 Oct.*	Lawrence- town, Hx. co.
	27 July	Halifax		Cow Bay, Hfx. Co.
	14 July	Truro	2 Oct.	
<i>Circotettix verruculatus</i> . . . . .	16 July	Truro		
	18 July	Halifax	18 Oct.	Halifax
<i>Nemobius fasciatus (vittatus)</i> . . . . .	17 July	Halifax	12 Nov.	Halifax
<i>Gryllus pennsylvanicus (neglectus)</i> . . . . .	17(?) July	Halifax	5 Nov.	Halifax
<i>Ceuthophilus terrestris</i> . . . . .	18 July	Truro		
<i>Conocephalus fasciatus fasciatus</i> . . . . .	18 July	Halifax	12 Sept.	Halifax
			13 Sept.	Truro
<i>Melanoplus bivittatus (femoratus)</i> } . . . . .	22 July	Truro		
	1 Aug.	Halifax	27 Oct.	Halifax
<i>Dissosteira carolina</i> . . . . .	24 July	Halifax	28 Oct.	Halifax
<i>Scudderia pistillata</i> . . . . .	1 Aug.	Halifax	21 Oct.	Halifax
<i>Mecostethus gracilis</i> . . . . .	9 Aug.	Truro	2 Oct.	Cow Bay, Hx. Co.
<i>Scudderia curvicauda borealis</i> . . . . .	12 Aug.	Truro	8 Oct.	Truro
<i>Mecostethus lineatus</i> . . . . .			26 Oct.	Lawrence- town, Hx. co.

The Truro dates above-mentioned were furnished by C. B. Gooderham. The first appearances at Truro are usually considerably earlier than those at Halifax; the difference, I would judge, being about a week or, in some cases perhaps ten days. At Annapolis and Yarmouth the differences would be greater. The first sign of Orthoptera hatching at Truro in 1915 was noted on 3rd June, when the tiny nymphs of *C. pellucida* and *C. verruculatus* could be seen in very warm places. Newly hatched nymphs of Crickets were observed at the same place on 5th June, 1915. Nymphs of *M. bivittatus* in the second stage have been noted at Halifax on 1st July. The young of *M. atlantis* were reported

\*A single *Chorthippus curtispennis* taken at Halifax on 18 Nov., 1917, is an unusual survival, too abnormal to record in this table.



to have been seen on Sable Island, N. S., by 28 May, 1896, and it was stated that they were a month later than in 1895 (*vide* letter of Supt. R. J. Boutillier, of 28 May, 1896, referred to under *M. atlantis*).

From the foregoing table we see that the dates of the appearance of non-hibernating adults range from about 30 June (*M. atlantis*) to about 12 Aug. (*S. curvicauda borealis*), the warmest period of the year; and averages about 18 July. The autumnal disappearance of these adults ranges from about 12 Sept. (*Conocephalus fasciatus*), which is the approximate time of the first hoar-frost (13-29 Sept.), to about 12 Nov. (*Nemobius fasciatus*) which is about the time when the first snow whitens the ground (31 Oct. - 14 Nov.); and averages 19 Oct., which is about the average date of the first hard frost (16th Oct.).

*Number of species in Nova Scotia.*—The passing out, to the south of us, of species less northerly in range, and the paucity of strictly boreal forms, has resulted in our orthopteran fauna being a very scanty one as regards the number of species, when compared with that of regions to the south of us. This is just as would be anticipated. The present list contains 28 species (two of which are inserted hypothetically, as almost certain to occur here because they have been taken to the north and to the south of us), 18 genera (one of which is included hypothetically), 10 subfamilies, and 4 families. Of species which may possibly occur this far north, as they are found more or less commonly in Maine, I have referred to about 15 in footnotes, and of these no doubt less than 7 will ever actually be taken here; so that it may perhaps be fair to surmise that about 35 species is the utmost we can ever hope to expand our list to, and even that is probably an excessive estimate.

Now as compared with 28 species from Nova Scotia (with a possibility of something less than 35 in the future), we find that:

A similar comparison of the Subfamilies of the largest Family, *Acrididæ*, gives the following result:—

Subfamilies	Actual numbers		Percentages	
	Nova Scotia	New England	Nova Scotia	New England
Acrydiinæ (Tettiginæ).....	3	5	17.64	10.64
Acridinæ (Tryxalinæ).....	4	9	23.53	19.15
Ædipodinæ.....	4	15	23.53	31.91
Locustinæ (Acridinæ).....	6	18	35.30	38.30
Totals.....	17	47	100.00	100.00

We thus see how sparse our orthopteran fauna is in species, and this, as before stated, is just as might be expected considering our geographical position and climatic conditions. E. M. Walker's preliminary list of Prince Edward Island Orthoptera, consisting of 11 nominal species, is doubtless fairly well under the actual number which will yet be found there, but it is very unlikely that that list will ever go over 20 species. Regarding New Brunswick we have almost no data at present; but its species should slightly exceed in number those of Nova Scotia, owing to the much more ready passage inward of forms from the adjoining state of Maine. From Newfoundland only six species have so far been reported (Hebard, Ent. News, xxvi, p. 306, 1915).\*

It may be here noted that the two species admitted to my present list on hypothetical grounds, namely *Podisma glacialis* and *Melanoplus fasciatus*, have been included because they have been reported both from Prince Edward Island on the north and from Maine to the south, and therefore it is hardly possible that they will not yet be found here in certain favourable localities. No species of more southern range only, have been thus admitted; and all references

\*The species reported by Hebard from Newfoundland (G. P. Englehardt collector, Aug. 1912) are, *Chorthippus curtispennis* (Har.), *Mecostethus gracilis* (Scud.), *Circolettia verruculatus* (Kirby), *Melanoplus fasciatus* (Walk.), *Melanoplus femoratus* (Burm.), and *Ceuthophilus terrestris*, Scud.

Hebard, for Newfoundland, in 1915, reported 6 species.  
Walker, for Prince Edward Island, in 1915, reported 11 species.

Smith, for Maine, in 1869, reported 38 species.

Walker, for Ontario, in 1898-1904, reported about 87 species.

(This is exclusive of *Blattidæ*. Of the latter he reported, in 1912, 11 species, only 2 of which are natives.

This makes a total of about 98 species.)

Caulfield, for Canada, in 1888, reported 76 species.

Scudder, for New England, in 1900, reported 98 species.

Walden, for Connecticut, in 1911, reported 109 species.

Beutenmüller, for New York, in 1894, reported 114 species.

Blatchley, for Indiana, in 1903, reported 148 species.

Scudder, for the whole of United States and Canada, in 1901, reported 856 nominal species.

The known Orthoptera of the world has been estimated as over 10,000 nominal species.

That is, Nova Scotia has, so far as known, only about  $3\frac{1}{4}$  per cent. of the species known to occur in the United States and Canada.

A numerical comparison between the Orthoptera of Nova Scotia (Piers, 1917) and of New England (Scudder, 1900), may be tabulated by Families thus:—

Families	Actual numbers		Percentages	
	Nova Scotia	New England	Nova Scotia	New England
Forficulidæ . . . . .	0	2	0	2.04
Blattidæ . . . . .	2	11	7.13	11.23
Phasmidæ . . . . .	0	1	0	1.02
Acrididæ . . . . .	17	47	60.72	47.96
Tettigoniidæ . . . . .	6	23	21.43	23.47
Gryllidæ . . . . .	3	14	10.72	14.28
Totals . . . . .	28	98	100.00	100.00

to species which may possibly extend into this province from a more southerly range, but which have not yet been taken here or to the north of us, are placed in footnotes.

*Relative abundance of Nova Scotian Orthoptera.*—Although the number of our species is small, yet certain species are very numerous in individuals, and thus make up to some extent for the paucity of kinds. The relative scale of abundance I have adopted, and the approximate placing of the various species in the divisions of the scale, are about as follows; although it must be borne in mind that some species may be quite common in particular localities and yet more or less rare in others. Some seasons also affect the relative abundance.

The following table of relative abundance refers to the vicinity of Halifax, on the Atlantic coast of the province, the fauna of which belongs to the Canadian Zone:—

Excessively common.—*Nemobius fasciatus*; *Melanoplus femur-rubrum*.

Very common.—*Melanoplus bivittatus*; *Chorthippus curtipennis*; *Conocephalus fasciatus*; *Circotettix verruculatus*; *Scuddaria pistillata*.

Common.—*Dissosteira carolina*; *Gryllus pennsylvanicus neglectus*; *Blattella germanica* (in town houses).

Rather common.—*Blatta orientalis* (in town buildings).

Rather uncommon.—*Melanoplus atlantis* (on one occasion excessively common on Sable Island).

Rather rare.—*Mecostethus gracilis*; *Camnula pellucida*; *Scudderia furcata*.

Rare.—*Mecostethus lineatus*; *Nomotettix cristatus*.

Very rare.—

Hypothetical.—*Podisma glacialis*; *Melanoplus fasciatus*.

For comparison with this, C. B. Gooderham has furnished, at my request, the following similar table of relative abundance of species about Truro, Col. Co., which may be taken as

fairly representative of the western section of the province, the fauna of which belongs to the Alleghanian Division of the Transition Zone:—

Excessively common.—*Gryllus pennsylvanicus neglectus*; *Nemobius fasciatus*; *Chorthippus curtipennis*; *Camnula pellucida* (during some years at least).

Very common.—*Melanoplus atlantis*; *Circotettix verruculatus*; *Melanoplus bivittatus*; *Conocephalus fasciatus*.

Common.—*Melanoplus femur-rubrum*; *Dissosteira carolina*; *Acrydium arenosum angustum*; *Mecostethus gracilis*.

Rather common.—*Scudderia pistillata*; *Scudderia curvicauda borealis*; *Nomotettix cristatus*; *Acrydium granulatum*.

Rather uncommon.—

Rather rare.—

Rare.—*Blattella germanica*; *Melanoplus extremus*.

Very rare.—*Ceuthophilus maculatus*; *Ceuthophilus terrestris*; *Nemobius carolinus*.

*Commonest species.*—The nine most prevalent species, all of which anyone is certain to note during a single walk about the outskirts of Halifax in late summer or early autumn, are the following: *Nemobius fasciatus* and *Melanoplus femur-rubrum* in every pasture; *Melanoplus bivittatus* in the long grass of meadows and the rank-growing vegetation about the edges of fields; *Chorthippus curtipennis* about vegetation along fences, etc.; *Conocephalus fasciatus* in long grass in damp places; *Circotettix verruculatus* and *Dissosteira carolina* on hot, dusty roadsides, railways, and stony places generally; *Gryllus pennsylvanicus neglectus* on stone-strewn earthy slopes about roadsides, etc.; and *Scudderia pistillata* on alders and occasionally other small bushes about damp places and the edges of clearings. The last-named species will probably only come to notice through its loud rasping calls heard mostly at evening and night.

*Common names.*—For insects which are so abundant, so much in evidence about cultivated districts, and so detrimental to agriculture, it is very remarkable that hardly any species has a distinctive popular name applied to it by ordinary people. The English names assigned to many of the species in works on the Orthoptera, are almost invariably mere appropriate “book-names”, which it is hoped will be adopted by readers and so gradually become current. This, however, has not yet taken place. Ordinary people in Nova Scotia distinguish, of course, the two species of Cockroach, and speak in very general terms of “grasshoppers” and “crickets”, and country children occasionally call a locust or grasshopper a “molasses bug”, because of the brownish salivary fluid it ejects from the mouth when handled, and this name perhaps more specially applies to the familiar *Melanoplus bivittatus*. The only true local name, however, which I have heard specifically applied to our many native species, is the very appropriate one of “Cracker”, or less often “Snapper”, for the familiar roadside species, *Circotettix verruculatus*; the first-mentioned name being pretty general among country people throughout the province, and one well worthy of general adoption.

*Remarks on the present list.*—My previous annotated list of fourteen species, published in 1896, was made up solely of such forms as I had myself collected, almost entirely about Halifax, in the seasons of 1895 and 1896. At that time Francis Walker’s unreliable lists of 1869-72 (see bibliography) were the only other existing contributions to a knowledge of our local Orthoptera, and they were of such a character that it was considered advisable to disregard them. In the present paper I have revised the nomenclature so as to bring it up to date, have made full use of all available sources of information, including C. B. Gooderham’s valuable notes from the western part of the province, and have incorporated many additional observations of my own. Subspeci-

fic names, when at all in use, are noted, but this in a very subsidiary way when they are founded on mere trivial distinctions between intergrading long- and short-winged forms. Other trinomial names, as in the case of well defined geographical races, are of course accepted. It is perhaps well, in a local paper like this, to as clearly as possible designate in all cases just what particular form or variant is found here. Some may possibly criticize any prominence whatever given to dimorphic forms through the use, even very subordinately, of special names to distinguish their various phases; but their occasional use helps towards preciseness and at least cannot lead to confusion. Appended to the scientific name, is the name of the original describer of the species, his name being printed in parentheses when the species is now placed in a different genus from that to which it was first assigned by that authority. Following the scientific name and the so-called "common name", which as we have seen is usually not a common name at all, appear references to the names used by writers in papers dealing with Nova Scotian Orthoptera in any way. These latter articles are such as may be called original sources of information as far as this province is concerned. No attempt has been made to present a general synonymy of the species, which may be seen in the writings of authors such as Blatchley and Scudder.\*

As one has frequently to go from one monograph to another to get descriptions of all our species, which is always laborious and in fact impossible for many who have not such literature at hand, and as I strongly believe that this difficulty which besets a beginner is one of the very reasons why we have given so little attention to this highly important order

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\*Beginners may be reminded that names of families end in *-idae* and those of subfamilies in *-inae*. It will aid the student in pronouncing these names to know that the *i* in *-idae* in family names is short, and therefore the accent falls on the syllable preceding that letter; while the *i* of *-inae* in subfamily names is long and consequently accented.

of destructive insects, I have given descriptions of all the species, the structural portions being usually modified from various writers, while the descriptions of colour, which varies much more than structure, have in almost every instance been prepared anew directly from Nova Scotian specimens. The colour terms used are those of Ridgway's "Nomenclature of Colors," 1886. Measurements have either been adopted from other writers, or made from local specimens when considered more advisable, in which latter case it is so stated. The particulars as to geographic range have mostly been compiled anew, with considerable labour, from very many articles, as recent writers have extended or modified the range as formerly known.

Under the heading of "Occurrence in Nova Scotia" will be found all that more particularly relates to the species as found here. The subject-matter of these local notes on each species is arranged thus, although without actual distinctive headings: (1) By whom first reported from Nova Scotia and when; (2) abundance; (3) particular localities reported from; (4) habitat or natural haunt; (5) seasonal dates of occurrence; (6) habits and call-notes; (7) economics, destruction caused and preventive measures. Analytical keys have been given to assist in identification, and these have been modified from various writers to suit our local requirements, the publications of Prof. Blatchley, B. H. Walden, Dr. Scudder, and others being largely drawn upon for the purpose. Very brief descriptions of species which might occur here, because of their commonness in the state of Maine, are placed in footnotes, and no doubt they will prove helpful when unrecorded species are met with. They will also serve to stimulate students to search for such additional forms.

*Measurements* are given in millimetres, about 25.4 of which equal one inch. The length of body is taken from the fastigium or apex of the head to the apex or end of the



subgenital plate (that is, the extremity of the under portion of the last abdominal segment) in both sexes. It thus does not include such appendages as the ovipositor, anal bristles, or antennæ. The length of the ovipositor is taken from the ventral apex of the basal plica, or fold, to the extremity of the ovipositor. In making careful measurements it will be found most convenient to use fine spring dividers with screw adjustment, operated by a milled wheel between the legs of the instrument, which wheel is easily turned by one of the fingers. Strong hand lenses, and on rare occasions a compound microscope, are required for examining specimens in detail; but for general examination and for use when making measurements, I find by far the most convenient arrangement is an ordinary spectacle lens, of three inches focus, or stronger if desired, mounted in the right-hand side of a common spectacle frame, which may be very cheaply obtained at any optician's. This leaves both hands entirely free for manipulation, which is a very great convenience; and the left eye may be used for normal vision when desired. Such a lens I have found of the very greatest service in much general biological work, whenever it is necessary to use both hands and a low-power glass is suitable. Strange to say, I have never found this simple and remarkably convenient device mentioned by any writer.

*Desiderata.*—We require further data regarding the occurrence and abundance of species in Cape Breton Island, regarding which too little is yet known. Until fuller information on these points is available, we will not be able to deal as definitively as we would wish with the Orthoptera of Nova Scotia as a whole, for very likely a few species do not extend their range into the northern portions of that island. However, this is merely a matter bearing on local distribution and relative abundance, for it is not likely that unrecorded species will be found in that region. These we would rather expect from our southern and western districts. The high-

lands of the Cobequid and North Mountains might also repay investigation. More information is desired regarding the time of hatching of various species in Nova Scotia, as we have very little data on that subject. I have already referred to the need of a detailed delineation of the boundaries of our life zones, and this is a matter which interests every biologist.

*Acknowledgments.*—Finally, I wish to acknowledge particular indebtedness to Mr. Charles Benjamin Gooderham, B. S. A., late assistant entomologist, Agricultural College, Truro, N. S., who since 1913 has made a study of our Orthoptera, for very many notes with which he has furnished me, they more particularly relating to the western section of the province, in which I have had fewer opportunities for collecting.\* To the writings of the late Dr. S. H. Scudder, Prof. W. S. Blatchley, B. H. Walden, and many others whose names will be mentioned from time to time in the text, I am also under obligations. Dr. Scudder, in the generous manner which characterized that delightful personage, verified my determinations of nearly all my earlier species of 1895-6. His death on 17th May, 1911, removed the most prominent figure in North American orthopterology. Mr. James A. G. Rehn of the Academy of Natural Sciences, Philadelphia, and Dr. E. M. Walker of the University of Toronto, have kindly answered various enquiries.

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\*Mr. Gooderham has very recently been transferred to the Central Experimental Farm, Ottawa, as assistant to the Dominion Apiarist, Bee Division.

PART 2.—SYSTEMATIC DESCRIPTION OF NOVA SCOTIAN  
ORTHOPTERA.

## REFERENCE LIST OF SPECIES.

## Order ORTHOPTERA.

## Suborder NON-SALTATORIA (Non-leaping Orthoptera).

## Family BLATTIDÆ (Cockroaches).

Subfamily **Pseudomopinæ** (Cockroaches, in part).

1. *Blattella germanica* (Linnæus). Croton Bug; German Cockroach; "Yankee Settler."

Subfamily **Blattinæ** (Cockroaches, in part).

2. *Blatta orientalis* Linnæus. Oriental Cockroach; Black Beetle.

## Suborder SALTATORIA (Leaping Orthoptera).

## Family ACRIDIDÆ (Short-horned Locusts).

Subfamily **Acrydiinæ** (Grouse Locusts).

## Group Tettigiæ.

3. *Nomotettix cristatus* (Scudder). Crested Grouse-locust. (Short-pronotumed form).
4. *Acrydium granulatum* Kirby. Slender Grouse-locust. (Long-pronotumed form).
5. *Acrydium arenosum angustum* (Hancock). (Short-pronotumed form).

Subfamily **Acridinæ** (Oblique-faced Spineless Locusts).

## Group Orphulæ.

6. ? *Orphulella speciosa* (Scudder), [Very doubtful].

## Group Stenobothri.

7. *Chorthippus curtipennis* (Harris). Short-winged Brown Locust.

## Group Epacromiæ.

8. *Mecostethus lineatus* (Scudder).
9. *Mecostethus gracilis* (Scudder).

Subfamily **Ædipodinæ** (Vertical-faced Spineless Locusts).

## Group Ædipodini.

10. *Camnula pellucida* (Scudder). Clear-winged Locust.
11. *Hippiscus apiculatus* (Harris). Coral-winged Locust.
12. *Dissosteira carolina* (Linnæus). Carolina Locust.
13. *Circotettix verruculatus* (Kirby). "Cracker".

Subfamily **Locustinæ** (Spine-breasted Locusts).Group **Melanopli.**

14. [*Podisma glacialis* (Scudder). Hypothetical occurrence.]
15. *Melanoplus atlantis* (Riley). Lesser Migratory Locust.
16. [*Melanoplus fasciatus* (Barnston-Walker). Hypothetical occurrence.]
17. *Melanoplus femur-rubrum* (DeGeer). Red-legged Locust.
18. *Melanoplus extremus* (F. Walker). (Short-winged form.)
19. *Melanoplus bivittatus* (Say). Yellow-striped Locust. (Red-legged phase, sometimes called *M. bivittatus femoratus* [Burmeister]).

Family **TETTIGONIIDÆ** (Long-horned Locusts).Subfamily **Phaneropterinæ** (Katydids, in part).Group **Scudderiæ.**

20. *Scudderia pistillata* Brunner. Northern Katydid.
21. *Scudderia curvicauda borealis* Rehn & Hebard. Broad-winged Curved-tailed Katydid.
22. *Scudderia furcata furcata* Brunner. Northern Fork-tailed Katydid.

Subfamily **Conocephalinæ** (Cone-headed and Meadow Grasshoppers).Group **Xiphidiini.**

23. *Conocephalus fasciatus fasciatus* (DeGeer). Eastern Slender Meadow Grasshopper.

Subfamily **Stenopelmatinæ** (Stone and Camel Crickets).Group **Ceuthophili.**

24. *Ceuthophilus maculatus* (Harris). Spotted Camel Cricket.
25. *Ceuthophilus terrestris* Scudder.

Family **GRYLLIDÆ** (Crickets).Subfamily **Gryllinæ** (Ground and Field Crickets).

26. *Nemobius fasciatus* (DeGeer). Striped Ground Cricket. (Short-winged form, sometimes called *N. fasciatus vittatus* [Harris].)
27. *Nemobius carolinus* Scudder. Carolina Ground Cricket.
28. *Gryllus pennsylvanicus* Burmeister. Pennsylvanian Field Cricket. (Shortest-winged form, sometimes called *G. pennsylvanicus neglectus* Scudder.)

## Order ORTHOPTERA.

(Cockroaches, Locusts, Grasshoppers, Crickets, etc.)

The Orthoptera are insects with incomplete metamorphosis (group *Heterometabola*). The young, when hatched from the egg, are entirely wingless, but of the general form of the adult. They moult their skin five times as they grow, and the wings gradually develop, there being no well defined separation between the larval and pupal stages as in other orders of insects. The young in all stages are known as "nymphs"; but when they emerge from the final moult as perfect insects, they are called "imago". The mouth-parts project and are fitted for biting. Wings, when present, four in number; the first pair membranous or leathery and usually with many veins, thicker than the hind wings which are folded lengthwise like a fan (whence the name of the order, from *orthos*, straight, and *pteron*, a wing). The wings of a few species are absent, while others have only the wing-covers present. If wings are absent, the labium (lower lip) is cleft. Nearly all Orthoptera are vegetable feeders and injurious, some species doing immense damage.

## KEY TO SUBORDERS OF ORTHOPTERA.

- a. Legs of nearly equal size, the hind femora not enlarged for leaping; sound-producing organs absent; wing-covers and wings of nymphs (immature insects), when present, in normal position; ovipositor concealed. . . . .  
NON-SALTATORIA, p. 245.
- aa. Legs of unequal size, the hind femora thickened for leaping, usually much longer than middle femora; sound-producing organs usually present in males; wing-covers and wings of nymphs, when present, in a reversed position (as if they were upside down and with the rudimentary wing-covers inside the wings); ovipositor usually plainly visible. . . . .  
SALTATORIA, p. 251.

Suborder NON-SALTATORIA (Non-leaping Orthoptera).

(For characteristics see key just given).

Recent writers have placed the family *Forficulidæ* (Ear-wigs) in a new order, *Euplexoptera*, entirely distinct from the Orthoptera, with which it was formerly united, as they differ somewhat radically from the members of the latter order. The *Forficulidæ* have a short, narrow body; head

with mouth in front; wing-covers leathery, very short, and without veins; tarsi five-jointed; the abdomen ending in a horny, forceps-like appendage. No species of the *Forficulidæ* are known to occur in Nova Scotia, although *Labia minor* (Linnæus), the Little Earwig, coloured black and yellowish-brown, with last abdominal segment and forceps reddish-brown, and about 5 mm. long, may yet be detected here, as it is the most northern species and occurs in the United States and Canada east of the Rocky Mountains, as far north as Maine, New Hampshire, Vermont, Quebec and Ottawa. It might easily have been overlooked by our collectors. Joseph Perrin of McNab's Island, Halifax Harbour, informs me that he was familiar with it in England, and thinks he saw several in the spring some years ago about his garden on that island; but he preserved no specimens and consequently it is merely a matter of opinion. According to his recollection the insects he saw were about half an inch in total length, which would be too long for the total maximum length (8 mm.) of this species. C. B. Gooderham, of Truro, has never seen or heard of the species in the western part of Nova Scotia.

No species of the family *Mantidæ* (Praying Mantids) occur even as far north as the New England States; and of the *Phasmidæ* (Walking-sticks), *Diaperomera femorata* (Say) has been taken commonly in most of the New England States, but not in Maine, and therefore cannot be expected to extend into Nova Scotia.

#### Family BLATTIDÆ (Cockroaches).

Head almost concealed beneath pronotum; body short, broad, oval and flattened; pronotum shield-shaped; wing-covers usually parchment-like or leathery and thickly veined; abdomen ending in cerci, but these not distinctly forceps-like; tarsi five-jointed.\* Only introduced species are known to occur in Nova Scotia.

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\*There has just appeared a thorough revision of this family by Morgan Hebard, entitled "The Blattidæ of North America, north of the Mexican Boundary," *Memoirs of Am. Ent. Soc.*, No. 2, Phila., 1917, 284 pp., 10 plates.

## KEY TO SUBFAMILIES OF BLATTIDÆ.

- a. Last ventral segment of female abdomen **plane**, without a ridge and undivided; fore femora rarely **armed** beneath on inner margin with many spines; when **so** armed, the subgenital styles unequal or wanting. PSEUDOMOPINÆ, p. 247.
- aa. Last ventral segment of female compressed so as to form a ridge on its under side, and divided so as to be bivalved; fore femora armed beneath on inner margin with many spines.....BLATTINÆ, p. 249.

Subfamily **Pseudomopinæ** (Cockroaches, in part).

(*Blattellinæ* of former writers.)

So far only a single representative of a single genus, *Blattella*, and that an introduced species, has been found in Nova Scotia. Another large North American species, *Ischnoptera pennsylvanica* (De Geer), the female of which is believed to be what has been called *Phyllodromia borealis* (Saussure), has been reported under the latter name from Maine and Massachusetts, and under the former name from Ontario, and possibly, but not at all likely, may occur here. The males and females of this species are so unlike that many have considered them to be separate species.

1. **Blattella germanica** (Linnæus). CROTON BUG; GERMAN COCKROACH; "YANKEE SETTLER" (local name in Nova Scotia).

*Phyllodromia germanica*. Piers, Trans. N. S. Inst. Sc., ix, 209 (1896); Halifax.

*Description*.—Size small; body rather long, sides slightly narrowing in male and almost parallel in female; wing-covers fully developed in both sexes, membranous or somewhat leathery, as long or longer than abdomen in both male and female; subanal plate of male with styles rudimentary or wanting.

*Colour*.—Yellowish-brown, females often darker; legs lighter; pronotum with two dark brown longitudinal stripes separated by one of yellowish.

*Measurements*.—Male: body, 13 mm.; width of body, 4 mm.; antennæ, 14 mm.; wing-covers, 9-10 mm. Female: body, 10 mm.; antennæ, 13 mm.; wing-covers, 11 mm.

*Range*.—Native of Europe; introduced into America where it has spread abundantly almost everywhere, especially in dwellings in towns, although seldom found in numbers in country districts. It made its appearance in New York in numbers about 1842 when the Croton aqueduct was completed, and hence is often called the Croton Bug.

*Occurrence in Nova Scotia*.—When this troublesome insect first appeared in Nova Scotia, there is no data to show, as it was not reported from here by scientific writers until

1896. Walker did not include it in his list of Canadian Orthoptera of 1872, but the Nova Scotian references in that catalogue were founded on collections made here by Lieut. Redman prior to 1848, and probably about 1821. The common name, "Yankee Settler," which is usually applied to it in Halifax, shows that in the popular mind at least it was believed to have been an incomer from the New England states.

It is very common in some houses in Halifax and doubtless occurs also, but less commonly, in other large shipping towns in the province. C. B. Gooderham has taken it only once at Truro, Col. Co. where he reports it rare. I am also informed that it occurs in Oxford, Cumb. Co. It is very rarely, if ever, seen in the country districts. It is less often found in dirty surroundings than the larger Oriental Cockroach (*B. orientalis*), and therefore is more liable to be met with in the better class of dwellings. It delights in warm, moist places, such as the vicinity of fire-places and hot-water pipes, and is less strictly nocturnal than the Oriental Cockroach. When it has once gained an entrance, it is extremely difficult to exterminate, as its small size and flat body permit it to hide and breed in small cracks where the larger cockroach could not penetrate. The rapidity with which it propagates also adds to its seriousness as a household pest in cities.

It is careful to avoid poisoned food placed to tempt it. A most thoroughly effective means of ridding premises of this pest, is fumigation with hydrocyanic gas. This gas, however, is extremely poisonous to human beings, and its use by inexperienced persons should never be thought of. Fumigation with a poisonous gas such as bisulphide of carbon is somewhat more suitable and quite effective when rooms or ship's holds can be vacated and sealed up, and the liquid exposed therein in open vessels at the rate of one pound to every 1,000 cubic feet of room space. When left for twenty-four hours all roaches and every other kind of vermin will be



Its large size makes it easier to exterminate than the German Cockroach, as it cannot hide in narrow crevices. The remedies noted under that insect, may also be used against this species; but simpler ones are likewise employed. A deep jar, partially filled with stale beer or ale, with a number of sticks placed against it and bent over so as to project into the interior for a few inches, may be used as an effective trap. The roaches climb up the sloping sticks to get the beer, and then slip off into the jar. Another household remedy is a saucer containing a dry mixture of plaster-of-paris with three or four parts of flour, and another plate containing water, placed near, with bridges to give easy access, and one or two pieces of wood floating on the water and touching the margin. The insects eat the dry mixture, then go to the water and drink, whereupon the plaster sets within them and causes death. Our bakers say they largely employ powdered borax for keeping them in check, the borax being sprinkled about infested places. As they detest and avoid light, the introduction and continual burning of electric lights in our city bakeries has done much to rid them of the pests. Infested places should always be kept clean, dry, and light.\*

#### Suborder SALTATORIA (Leaping Orthoptera).

Legs of unequal size; hind femora adapted for leaping, being much thickened. Sound-producing organs usually present in male. Wing-covers and wings of nymphs, when present, in a reversed position.

##### KEY TO FAMILIES OF SALTATORIA.

- a. Antennæ much shorter than body; tarsi 3-jointed; calling organs, when present, usually on hind femora and lower border of wing-covers; ovipositor of two pairs of short plates, with tips diverging.....  
(Short-horned Locusts) *ACRIDIDÆ*. p. 252.

\**Periplaneta americana* (Linnaeus), the American Cockroach, a large species which is a native of tropical America but has become cosmopolitan, is common along the seaboard of New England, especially in city buildings and warehouses, and quite likely will be found introduced by shipping into some of our waterside storehouses. The length of body is 27 mm. in male, and 30 mm. in female, and the wing-covers in both sexes are large, extending 10-12 mm. beyond the end of abdomen. The general colour is reddish brown, the pronotum margined with yellow. It belongs to the subfamily *Blattina*. It is probably the large cockroach which is said to be sometimes brought to Halifax with cargoes of sugar from the West Indies, and may have insinuated itself into some of the warehouses of our sugar refineries. Other southern species are liable to be casually introduced with bunches of bananas.

destroyed. As it is also poisonous to higher animals, the building should be vacated during the fumigation, and afterwards very thoroughly aired before re-occupation. It must be borne in mind that bisulphide of carbon is violently explosive in presence of fire, and the very greatest precaution should be taken that no fires or lights whatever are about the premises until after they are thoroughly freed of every trace of gas. The fumigation had better be done, in any case, only by experienced persons. When possible, superheating is a comparatively simple and very effective means of destroying cockroaches as well as other household insects. Cockroaches cannot withstand a temperature of 120° F. for more than a few minutes, and the maintenance of a temperature of from 150° to 160° F. for several hours should result in killing every insect in a building. Sodium fluoride, pure or mixed with equal parts of plaster-of-paris, strewn about the haunts, is a simple and very effective means of control. Temporary relief from the roaches may be gained by the liberal use of fresh pyrethrum powder (Persian insect powder), which is quite safe. The dead and paralyzed roaches may afterwards be swept up. Flowers-of-sulphur is also a good repellent. (For other information on this subject, see L. O. Howard's circular No. 46, 2nd series, U. S. Dept. of Entomology, Wash.; also E. P. Felt's "Household and Camp Insects", bulletin No. 194, N. Y. State Museum, Albany, 1917.)

Subfamily **Blattinæ** (Cockroaches, in part).

(*Periplanetinæ* of former writers.)

Wing-covers and wings variable in different species; last ventral segment of female compressed so as to form a ridge on its under side, and divided so as to be bivalved; fore femora armed beneath on inner margin with many spines; subgenital styles of equal length.—This subfamily contains our larger cockroach, an introduced species like the one last mentioned.

2. **Blatta orientalis** Linnæus. ORIENTAL COCKROACH;  
BLACK BEETLE; "COMMON COCKROACH".

*Stylopyga orientalis*. Piers, Trans. N. S. Inst. Sc., ix,  
210 (1896); Halifax.

*Description*.—Size rather large, male shorter and narrower than female; distance between eyes less than length of last joint of maxillary palpus; wing-covers of neither sex reaching end of abdomen, but fairly well developed and covering about three-quarters of abdomen in male, and rudimentary and covering about one-third in female.

*Colour*.—Dark, mahogany-brown; legs and underside of body somewhat lighter; pronotum without light margin or other markings.

*Measurements*.—Male: body, 22 mm.; length of pronotum, 5.5 mm.; width of pronotum, 7.5 mm.; wing-covers, 13-14 mm. Female: body, 27 mm.; length of pronotum, 6.5 mm.; width pronotum, 8.5 mm.; wing-covers, 5 mm.

*Range*.—A native of Asia, carried by shipping from one country to another until it has become cosmopolitan. Found over the most of America, especially in city dwellings by the seaboard.

*Occurrence in Nova Scotia*.—This large noxious cockroach was doubtless introduced into Nova Scotian ports by shipping at a very early period in our history, although not actually recorded scientifically until recent years. Without doubt it is the cockroach mentioned by Walter Bromley in his "General Description of Nova Scotia", 1825, page 33. It is common in some houses in the older parts of Halifax, and doubtless also in other large shipping towns along our coast, but in the country districts it seems to be very rarely met with. C. B. Gooderham has not so far found it at Truro, Col. Co., or along the Bay of Fundy, although he has heard of its occurrence. When once it gains a foothold in a dwelling it is liable to become one of the most disgusting and troublesome of household pests, and one rather difficult to get rid of in spite of persistent efforts to exterminate the pest. It is nocturnal in habit and devours almost anything. Unlike the German Cockroach or Croton Bug, it delights in dampness, dirt and darkness, its favourite habitat being the holds of vessels, cellars and basements. Despite its abundance, it develops slowly, as from three to five months are required to arrive at maturity.

- aa. Antennæ much longer than body; tarsi 3- or 4-jointed; calling organs, when present, on dorsal area of wing-covers; ovipositor usually much elongated.
- b. Tarsi 4-jointed; wing-covers with sides sloping; ovipositor usually flattened, sword-shaped. . . . . (Long-horned Locusts) TETRIGONIDÆ.
- bb. Tarsi 3-jointed; wing-covers flat above, with sides bent abruptly down; ovipositor a nearly straight or upcurved needle. . . . . (Crickets) GRILLIDÆ.

Family ACRIDIDÆ (Short-horned Locusts).

This family is readily distinguished by the antennæ, which are much shorter than the body. The species are usually simply called "grasshoppers", no attempt being made by the ordinary individual to apply special names to the many species. The males only, as in other Orthoptera, have stridulating or sound-producing organs. In the subfamilies *Locustinæ* (Spined Locusts) and *Acridinæ* (Oblique-faced Spineless Locusts) this call-note is produced by rubbing the inner surface of the minutely-toothed hind femora, over veins of the wing-covers, this being done when the insect is otherwise at rest. In the subfamily *Ædipodinæ* sound is usually produced while in flight, by rubbing together the upper surface of the front edge of the wings and the under surface of the wing-cover, thus producing a sharp, cracking sound, which is very familiar in the case of *C. verruculatus*.

The *Acrididæ*, with the exception of the members of the hibernating subfamily *Acrydiinæ*, pass the winter in the egg stage; the eggs, 30 to 60 in number, being deposited during the autumn, usually in a hole which the female forms in the ground, the cavity being then covered with earth. If the succeeding winter is an open one with many changes of temperature, many eggs are destroyed. Next season the young hatch and are at first wingless. Five times the nymph moults its skin, the wings and body increasing in size each time, and after the fifth moult it emerges a mature insect or imago.

KEY TO SUBFAMILIES OF ACRIDIDÆ.

- a. Size very small; *pronotum* extending backward, tapering, to or beyond end of abdomen; wing-covers represented by small oval lobes on sides. (Grouse Locusts) ACRYDIINÆ. p. 253.

- aa. Larger; pronotum not extending over abdomen; wing-covers usually well developed, but sometimes abbreviated or even wanting.
- b. No spine on prosternum between front legs.
- c. Face usually very oblique; median carina of pronotum never raised as a crest, or cut by more than one notch. . . . .  
(Oblique-faced Spineless Locusts) ACRIDINÆ. p. 263.
- cc. Face nearly or quite vertical; median carina of pronotum usually raised as a crest and usually cut by more than one notch.  
(Vertical-faced Spineless Locusts) ŒDIPODINÆ, p. 273.
- bb. A prominent conical spine on prosternum between front legs. . . . .  
(Spine-breasted Locusts) LOCUSTINÆ. p. —.

Subfamily **Acrydiinæ\*** (Grouse Locusts).

(*Tettiginæ* of former writers.)

The members of this subfamily are our smallest Acridians, and are easily recognized by the pronotum which extends to or beyond the end of the abdomen. Most, if not all, of the species are dimorphic as regards length of pronotum and hind wings. Wings are usually developed; but the wing-covers are rudimentary (small lobes near base of wings), what looks like them being an unusual development of pronotum. Males are usually narrower than females. Individuals of a species vary much in colour and markings, which must not be taken as diagnostic. Grouse Locusts are remarkable as being the only members of the *Acrididæ* which normally pass the winter as adults, hibernating under rubbish, loose bark, fence-rails, etc., and are therefore the first Orthoptera to appear in the spring, being seen on sunny hillsides in Nova Scotia as early as the middle of April. The eggs are laid in ground early in the season, and hatch in about three weeks, and the young usually reach maturity by autumn. They are very inconspicuous insects, as their colour harmonizes with the surroundings. Dry sunny hillsides or boggy places along lakes and streams are favourite habitats. Their food consists of vegetable mould, tender sprouting grass, and

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\*The application of such very similar names as *Acrydiinæ* and *Acridinæ* to two sub-families of the family *Acrididæ*, which have lately been known as the *Tettiginæ* and *Tryxalinæ*, is a most confusing contretemps, but as J. A. G. Rehn says, there is apparently no escape from this unhappy situation. *Acrydium* (Geoffr., 1762) is a far older name for the genus which has usually been called *Tetrix* (Latreille, 1802) or *Tettix* (Charpentier, 1841), and *Acrida* (Linn., 1758) is the oldest known genus of the group that has been termed *Truxalinæ* or *Tryxalinæ* (Genus *Truxalis*, Fabricius, 1775).

germinating seeds. Despite the similarity of the name of this subfamily with that of the *Acridinæ*, the beginner must be careful to discriminate between the two names (see footnote or preceding page).

The use of trinomial names, such as *Acrydium ornatum ornatum* and *A. ornatum triangulare*, to distinguish the so-called long- and short-winged extreme phases of dimorphic species such as often occur in this subfamily, is discouraged by late writers, as being of but little if any real value, as the two extreme forms intergrade and interbreed. This is evident to those who have examined a large series of specimens from many regions or even from one locality.

KEY TO NOVA SCOTIAN GENERA OF ACRYDIINÆ (GROUSE LOCUSTS).

- a. Antennæ 12—13-jointed; median carina of pronotum high and crest-like, arched longitudinally; upper lateral sinus of pronotum about half as deep as lower one.....NOMOTETTIX. p. 254.
- aa. Antennæ usually 14-jointed; median carina of pronotum low and rather flat when viewed from side; upper lateral sinus of pronotum nearly as deep as lower one.....ACRYDIUM. p. 256.

Group Tettigiæ.

3. **Nomotettix cristatus** (Scudder). CRESTED GROUSE-LOCUST. (Short-pronotumed form.)

*Nomotettix cristatus*. Gooderham, Proc. Ent. Soc. N. S. for 1916, 23, 27 (1917); Colchester Co.

*Description*.—Nova Scotian specimen. This is the smallest of our Orthoptera, and may be readily recognized by the high arched pronotum, or bowed outline of the dorsal line when viewed from the side. Body finely granulate, most noticeable on pronotum. Antennæ of 12-13 joints. Vertex .8 mm. wide, projecting beyond eyes, the front margin rounded when seen from above, and anterior end of median carina forming a small median projection; pronotum with the front margin produced in an angle over back of head to posterior quarter of eye; median carina raised as a high crest and arched lengthwise for about three-fourths its length, then sloping down and more nearly horizontal near apex; upper notch or sinus on hind margin of lateral lobe of pronotum very shallow, less than half as deep as lower sinus; pronotum reaching to apex of hind femora (abbreviated form, sometimes called *C. cristatus cristatus\**); front femora more or less compressed, carinate above.

*Colour*.—Nova Scotian specimen. Grayish fuscous-brown, slightly lighter below posterior lateral carina of pronotum and on hind tibia, the dark colour continuing for a short distance below knee; on each side of disk of pronotum are two irregularly shaped black marks enclosing a small gray

\*The long-pronotumed form, sometimes called *N. cristatus carinatus* (Scudder), in which the pronotum is further elongated by a couple of millimeters, has not been found in Nova Scotia.

area, the anterior mark being 3 mm. behind the vertex and the posterior one  $4\frac{1}{2}$  mm.; elsewhere on pronotum are small, obscure, blackish dots; and on upper outer side of hind femora are three obscure, blackish diagonal bands. (The colour and markings, as in other related species, are subject to considerable variation.)

*Measurements.*—Nova Scotian specimen. Female: body, 8.25 mm.; greatest depth of body, 3.4 mm.; antennæ, 2.7 mm.; width of vertex, .8 mm.; length of pronotum, 8.7 mm.; anterior width of pronotum, 2.0 mm.; greatest width at shoulders, 3.7 mm.; greatest width of disk, 2.7 mm.; hind femora 5.5 mm.; width of hind femora, 2.1 mm.; hind tibiæ, 4.2 mm.; ovipositor, 1.0 mm.

*Range.*—Eastern United States and southeastern Canada: Nova Scotia, Toronto (Ont.), Maine, and south through New Eng. (common locally), to New Jers. and North Carol. at least.

*Occurrence in Nova Scotia.*—This very small and inconspicuous species, a hump-backed midget and the smallest Orthopteran found in Nova Scotia, was not reported in my paper of 1896. The only specimen so far taken about Halifax and the first collected in the province, is a female which I obtained on a sunny, stony path, alongside of the seashore, on the southern side of Dead Man's Island Cove, close to Melville Island, at the head of the North West Arm, near Halifax, on 7 August, 1897. As it is the only specimen I have taken, it is doubtless rare in this locality, although it may be less scarce in some particular localities. About Truro, Col. Co., it is rather common, and C. B. Gooderham has a number of specimens, taken by himself at that place, on 5 and 31 July, and 20 Aug., 1913; 5 July, 1914; and 22 June, 1915; and in the Agricultural College is one also taken at Truro on 18 July, 1913. Mr. Gooderham has observed it as early as 15 April, 1917, just as the grass was beginning to sprout, and he took five specimens on 22 April of that year. He reports it as apparently very abundant at Truro during that spring. As this species, as well as other members of the subfamily of Grouse Locusts, hibernates as a perfect insect, it may be expected to occur from April until autumn. So far it has only been reported from Halifax and Colchester counties.

The Halifax and Truro specimens are all of the abbreviated form, *N. cristatus cristatus*, with the pronotum extending no further backward than about the end of the femora.

Dr. E. M. Walker of Toronto and Mr. J. A. G. Rehn of Philadelphia confirm the determination of these specimens. The extended form, sometimes designated *N. cristatus carinatus* Scudder, in which the pronotum is further prolonged (measuring 9.8-11.5 mm. in male, and 9.5-10.7 mm. in female), has not so far been met with in Nova Scotia. The species has, I believe, only once before been reported from Canada, Caulfield having taken it (*Batrachidea cristata*) at Toronto, Ont. (Can. Rec. Sc., ii, 402, 1887). Bayard Long did not observe it on Prince Edward Island, so that this may be the northern limit of its range.

It is an active little species, jumping vigorously with its thick hind femora, as one will find out on attempting to capture it; and its very small size and inconspicuous colour when on the ground, make it extremely difficult to detect and capture. It appears, like allied species, to frequent dry, sandy soil, lightly covered with fine debris, and dry sunny banks in scant pastures. In New England, where it is locally common, it is found, according to Morse, on light soils, but especially in dry pastures.

KEY TO NOVA SCOTIAN SPECIES OF ACRYDIUM.

(*A. ornatum* is included for comparative purposes and because it is liable to occur.)

Median carina of pronotum low, its dorsal outline rather flat when viewed from side; upper lateral sinus of pronotum nearly as deep as lower one (*Acrydium*).

- a. Median carina of pronotum more or less distinctly elevated along entire length; dorsal surfaces of pronotum higher in middle, sloping on sides.
  - b. Body very slender, especially in male; front margin of vertex obtusely angulate when viewed from above, its median carina not projecting or only very slightly; hind part of pronotum long-drawn-out, its apex narrowly acute, in extended form surpassing hind femora and in extralimital abbreviated form reaching near their end.....4. *granulatum*. p. 257.
  - [bb. Body more robust; front margin of vertex rounded, its median carina distinctly projecting; apex of pronotum in extended form considerably surpassing hind femora and in abbreviated form (*triangulare*) reaching about their end.....*ornatus* (See nomenclatural remarks under *arenosum angustum*).]
- aa. Median carina of pronotum indistinct, a little elevated on its anterior third; dorsal surface of pronotum flat or nearly so; body rather robust in abbreviated form; front margin of vertex very slightly



rounded, its median carina projecting very slightly; apex of pronotum in extralimital extended from reaching considerably beyond hind femora, and in abbreviated form reaching only very little beyond them.....5. *arenosum angustum*, p. 259.

Supposing that only two species occur in Nova Scotia, beginners may roughly separate them as follows; but too much dependence must not be placed on these distinctions, in case other forms should occur here.

- a. Front margin of vertex, viewed from above, distinctly but obtusely angulate.....4. *granulatum*.  
 aa. Front margin of vertex very slightly rounded....5. *arenosum angustum*.

4. **Acrydium granulatum** Kirby. SLENDER GROUSE-LOCUST. (Long-pronotumed form.)

*Acrydium granulatum*. Gooderham, Proc. Ent. Soc. N. S. for 1916, 23, 27 (1917); Col., Kings, Hants, Ann., and Yar. Cos.

*Description*.—Form very slender, especially in male. Front of vertex, viewed from above, projecting forward considerably in a *distinct but obtuse angle*, its median carina projecting but little if any beyond sides; pronotum almost truncate in front, its posterior part long, attenuate, and passing considerably beyond hind femora in the typical long-pronotumed form (sometimes called *A. granulatum granulatum*),\* its median carina prominent throughout its length, but not crested; hind wings reaching about apex of pronotum, and with a delicate network of veins. Pronotum and legs finely granulated, and dorsal surface of former with short wrinkles. Readily recognized from our other related species by the prominent angulate form of front margin of vertex.

*Colour*.—Variable, but usually described by writers as grayish or reddish brown, sometimes blackish, often with a whitish median band along the full length of the pronotum; inner wings in life bluish or bottle-green in colour. A female specimen from Deerfield, Yar. Co., N. S., (3 June, 1915), the only Nova Scotian specimen I have seen, is blackish-brown, with a narrow, cream-coloured border along sides of head and continued along dorsal margins of pronotum; femora dark, with very slightly lighter transverse bands, and a cream-coloured line along upper edge; tibiae blackish; hind wings transparent, except anterior margin which is dark.

*Measurements*.—Male: body, 8.5-13.5 mm.; pronotum, up to 11.5 mm.; hind femora, 6 mm. Female: body, 11-15.3 mm.; pronotum, up to 15.5 mm.; hind femora, 7 mm. (The Deerfield, N. S., female specimen is 12 mm. from vertex to end of pronotum).

*Range*.—Eastern and northern North America, north of about lat. 38°: from Nova Scotia, Maine, Montreal, Ont., Man., Sask., Alb., and Vancouver (B. C.), south to New Jers., Ind., Kans., and Colo. Probably occurs throughout all of New England, preferring sedgy meadow lands and swales on sandy soil occasionally flooded by rains or freshets and perpetually moist

*Occurrence in Nova Scotia*.—This marsh-loving, slender grouse-locust was first reported from western Nova Scotia by C. B. Gooderham in 1917 (Proc. Ent. Soc. N. S. for 1916,

\*A form with the pronotum and wings more or less abbreviated, and in extreme cases not passing the hind femora, has sometimes been called *A. granulatum variegatum* Hancock. It has not been taken in Nova Scotia.

p. 23). I have not detected it so far about Halifax, where the marshy tracts best suited to it, are not so common as in some of the western parts of the province. Still it should be looked for in marshy and boggy areas or low wet woods.

In the western parts of Nova Scotia it is rather common in suitable wet localities in Colchester, Hants, Kings, Annapolis, Digby, and Yarmouth counties. Only the typical long-pronotumed form (*A. granulatum granulatum* Kirby) has so far been taken; although the form sometimes called *variegatum*, with the pronotum and wings more or less abbreviated, may yet be met. In C. B. Gooderham's collection, Truro, there are twelve specimens (4 males and 8 females) taken by himself, E. C. Allen, G. F. Collingwood, and Miss V. L. Tarris, at the following localities: Truro, Col. Co. (female, 15 April, 1917, and two others seen; one 22 April, 1917; female, 30 May; male, 18 June; female, 23 July, all in 1915); McNutt's Creek, Col. Co. (female, 16 May, '14); Kennetcook, Hants Co. (male, 6 June, '14); Windsor, Hants Co. (female, 22 July, '14); Wolfville, Kings Co. (female, 29 Aug., '12); Kentville, Kings Co. (female, 28 May, '16); and Yarmouth (2 males, 25 May, '14; 4 Oct., '04). In the Agricultural College collection, Truro, are two females, one taken 2 June, '16, and the other from Smith's Cove, Digby Co., 4 June, '15. In E. C. Allen's own collection is a female collected at Deerfield, Yar. Co., 3 June, '15. Total number, 4 males and 11 females. In these localities are found the wet, marshy conditions and sandy soil to which the species is adapted. It is quite likely that it will be detected, but more rarely, in some of the fewer similar areas which are situated on the Atlantic side of the province. The dates given above, show that it occurs at least from 15 April (when the grass is beginning to sprout) to 4 October. Like other species of the subfamily, it hibernates in the adult form, and thus is one of the earliest species to be met with in the province. The determination of Mr. Gooderham's specimens

has been verified by specimens examined by Dr. E. M. Walker of Toronto, Prof. W. S. Blatchley of Indianapolis, and J. A. G. Rehn of Philadelphia, all of whom agree as to their being *A. granulatum*.

Mr. Gooderham also has a single male long-pronotumed specimen taken at Truro, on an unrecorded date, which is somewhat abnormal. Prof. Blatchley stated it was *Acrydium ornatum ornatum* of Say, and I think Dr. E. M. Walker concurred in this. It was also submitted to Mr. J. A. G. Rehn of Philadelphia, who after carefully examining it, found that the front of the head is deformed, giving it the appearance of having a projecting median carina such as is present in *ornatum* but not normally in *granulatum*.

5. ***Acrydium arenosum angustum*** (Hancock). (Short-pronotumed form.)

?*Tettix ornata*. F. Walker, Cat. Derm. Salt. Brit. Mus., v, 813 (1871); Nova Scotia, etc.—Do., Can. Ent., iv, 31 (1872); Nova Scotia, etc.

*Acrydium ornatum* (not of Say). Gooderham, Proc. Ent. Soc. N. S. for 1916, 23, 27 (1917); Col., Kings, Hants, Ann., and Yar. Cos.

*Description*.—Nova Scotian specimens. Body rather robust; greatest width contained in length  $2\frac{1}{4}$  times in male and  $2\frac{1}{2}$  in female; greatest vertical depth of thorax contained in same length 3 times in male and  $3\frac{1}{2}$  in female; apex of pronotum exceeding femur by about length of head; hindwings to about end of pronotum or slightly shorter. Head, pronotum and legs granulated; abdomen less so; carinae with larger and closely-set granulations. Median carina of face grooved; profile of face projecting before vertex, rather strongly hollowed before eyes, arching out strongly between antennae, then gently curving in, and finally rising very slightly above the clypeus. Vertex nearly as wide as its length, very slightly concave between carinae, its front margin only very slightly convex (being approximately a curve struck with the centre located at about front margin of pronotum), slightly indented in middle, and projecting in front of eyes for only  $1/7$  to  $1/10$  of width of vertex. Median carina of vertex on anterior three-quarters or all of head, but slightly raised, faintly convex in profile, its anterior end projecting very little beyond margin of vertex. Pronotum truncated and narrowed in front, nearly twice as broad at shoulders, lateral lobes constricted at  $\frac{1}{2}$  distance between anterior margin and shoulders. Disk of pronotum in shoulder region nearly flat transversely. Median carina distinguishable throughout entire length, but has slight prominence, except at the anterior eighth of its length where it rises and forms a sort of hump, anterior to which it is somewhat compressed. Anterior lateral carinae separated about width of vertex, and become obsolete posteriorly at a distance a little less than

length of vertex. They re-appear behind this, but twice as wide apart, diverge to the shoulders and then converge to the apex, there being offshoots about midway which pass diagonally outward. The dorsal profile of pronotum at first rises until it forms the beforementioned hump whose greatest elevation is situated at about  $\frac{1}{8}$ th of its length; then it is depressed, and again rises extremely slightly at about  $\frac{1}{3}$ rd of the length, posterior to which it is nearly straight (with a slight tendency to concavity) to the apex. Lobe of rudimentary wing-cover elliptical,  $2\frac{1}{2}$  times as long as broad. Femur robust, 3 times as long as its greatest breadth.

*Colour*.—Nova Scotian specimens. Cinnamon-coloured, sometimes obscurely fuscous on disk of pronotum between shoulders; hind wings transparent, slightly iridescent in some lights, front edge gray-brown, veins dusky; legs cinnamon, more or less mottled with fuscous. (The colour and markings, as in other related species, are subject to considerable variation).

*Measurements*.—The following detailed measurements I have very carefully taken microscopically from the three above-described specimens from Truro, N. S., viz. a male collected 17 July, 1913, a female taken on an unknown date, and another female dated 6 Aug. 1913. The last has the apex of the pronotum missing.

	Male 17-7-13	Female	Female 6-8-13
	mm.	mm.	mm.
Total length to apex of pronotum.....	8.95	10.00	.....
Length of body to end of abdomen.....	7.23	9.25	9.40
Vertical thickness of thorax.....	2.45	3.00	2.85
Head, length.....	.90	1.00	1.08
Distance between extreme convexity of eyes....	1.50	1.75	1.75
Width of vertex.....	.70	.90	.87
Vertex projects in front of eyes.....	.11	.09	.12
Pronotum, length.....	7.90	9.00	.....
"    anterior width.....	1.67	2.00	2.15
"    width at shoulders.....	3.23	3.90	3.90
Lateral carinae of pronotum, separation at anterior end.....	.85	1.10	1.00
Lateral carinae of pronotum, separation at shoulders.....	2.35	2.90	2.80
Front of pronotum to more prominent hump of median carina.....	.95	1.25	1.15
Front of pronotum to less prominent hump of median carina.....	2.30	3.00	2.90
Pronotum extends beyond abdomen.....	1.65	1.40	.....
Lobe of rudimentary wing-cover, length.....	1.62	1.75	1.85
"    "    "    width.....	.63	.75	.78
Hind wing.....	6.20	6.50	.....
Hind femur, length.....	4.85	5.60	.....
"    "    width.....	1.65	1.90	.....
Hind tibia.....	4.10	4.70	.....
Valves of ovipositor.....	.....	1.10	1.28
Apex of femur to apex of pronotum.....	1.00	1.10	.....

*Range*.—The range of this northern race of *A. arenosum* has not been fully worked out, but it occurs in Nova Scotia, New Hamp., and Mass. (Hebard coll.), southern Ont. (Walker, as *obscurum*), Minn. (Somes, as *ob*

*scurum*), Ill. (Hancock, type locality), Ind. (Blatchley, as *obscurum*), and in the higher regions from New Jers. and Penn. south to North Carol. and Geo.; and no doubt will be found throughout the Alleghanian Division of The Transition Zone. (The southern typical race, *arenosum arenosum* of Burmeister, occurs in the lower country of the Carolinas [the type locality] and Georg., all of Flo. and on the Gulf Coast and westward, and thus is more restricted to the Lower Austral Zone.)

*Occurrence in Nova Scotia.*—The common, stout, short-pronotumed grouse-locust of western Nova Scotia, which we have described, is here placed under the name *Acrydium arenosum angustum* of Hancock (1896) on the definite authority of J. A. G. Rehn, the well-known systematic orthopterist of the Philadelphia Academy of Natural Sciences, who has specially examined a number of specimens from this province. The geographic race *angustum* is the northern member of the *arenosum* species complex, of which the typical race (*arenosum arenosum* of Burmeister) is found in the lower country of the southern United States. Hancock's *obscurum*, as well as others of his so-called forms, such as *inflatum*, etc., are mere transitory variants of his *angustum*, the latter name having page priority in his original paper (Trans. Am. Ent. Soc., xxiii, 1896, 235-244), although some writers have incorrectly grouped the synonymy under *obscurum*. Hancock's *angustum* was a slender-bodied form, whereas, as a matter of fact our Nova Scotian insect agrees more closely with his stouter variant *inflatum* or *obscurum*, names which have been retired to the synonymy. The race *angustum* has been found in both a long- and a short-pronotumed or abbreviated form, the latter being the only one which has been collected in Nova Scotia.

In general appearance this abbreviated form has a close resemblance to *A. ornatum triangulare* of Scudder (1862) which is reported as occurring rather commonly in sedgy meadow-land in New England, and two of Mr. Gooderham's Truro specimens were given that name by Prof. W. S. Blatchley of Indiana who forwarded a specimen of *obscurum* for comparison. Dr. E. M. Walker of Toronto, however, had

identified them as *obscurum*, which, as we have said, is now held to be merely a stouter variant of *angustum*. On specimens being finally submitted to Mr. Rehn, the latter positively determined them as *A. arenosum angustum*, not *ornatum*. In a letter to me of 7 Nov., 1917, after having once more carefully examined our specimens, he reaffirms this, and says they are perfectly typical when compared with numerous specimens in the Hebard and other collections from the higher regions of North Carolina and northern Georgia, north to Pennsylvania and New Jersey, and that he has also before him material from Massachusetts and New Hampshire. Knowing the high standing of this gentleman as an authority on North American systematic orthopterology, and the very extensive collections to which he has access, we accept his decision. Personally I may say that, after comparing specimens with Hancock's original description, I consider Mr. Rehn's identification to be correct, our form being merely a more robust variant of *angustum*, such as Hancock termed *inflatum*.

No New England writer, I think, has included *A. arenosum angustum* in his published list, Scudder in 1900 mentioning only *granulatum* and *ornatum*, the short form of the latter being his *triangulare*. The present finding, therefore, has a bearing on conditions in New England, where *angustum* has probably been included in *ornatum*. There is, of course, no reason why the latter species should not occur here also, and it should be looked for.

F. Walker in 1871 (Cat. Dem. Salt., v, 813) reported "*Tettix ornata* Harris" as occurring in Nova Scotia, from a single specimen collected, probably about 1821, by Lieut. Redman. This specimen is still in the British Museum, and B. M. A. Cummings informs me that it is correctly determined as *T. ornatus*. Walker's name must refer to a long-pronotumed form, as he also recognized and listed *T. triangularis*, although not reporting the latter from Nova

Scotia. All that can be done at present, is to very doubtfully refer Walker's record to the form now under consideration, until *ornatum* can be verified as occurring here or Walker's specimen has been re-examined. Mr. Gooderham has a single Truro specimen which had been determined as the long-pronotumed form of *ornatum*, but it has since been identified as a deformed specimen of *A. granulatum* as stated under that species.

Leaving nomenclatural questions to be a subject for further investigation, we will now deal more particularly with the occurrence of *A. arenosum angustum*, short-pronotumed form, in Nova Scotia. This broad-shouldered, robust grouse-locust, with the pronotum extending to about the end of the hind femur, has so far not been found by me near Halifax. It is, however, common about Truro, Col. Co., and is more or less so in suitable localities in other parts of the western section of the province. There are three specimens in the collection of the N. S. College of Agriculture, and Mr. Gooderham has a number of others collected at various dates from 18 June to 20 August, at Truro, and in Hants, Kings, Annapolis and Yarmouth counties. He reports it as very common about Truro, where it occurs mostly along the banks of streams and in boggy places; and as it hibernates like other species of the genus, it should be about from early spring, probably the middle of April, until autumn, although the earliest and latest dates so far actually noted are, as we have said, the middle of June and the latter part of August.\*

Subfamily **Acridinæ** (Oblique-faced Spineless Locusts)†

(*Tryxalinæ* of former writers.)

Size rather large; pronotum never extending back over abdomen; *no spine or tubercle on prosternum between front*

\*Besides the possibility of *Acrydium ornatum* of Say occurring here, more thorough search may disclose the rare presence of *Tettigidea parvipennis* (Harris), which occurs north to Mass., Maine and Ont., being abundant in New England in moist, grassy and sedgy meadows. It may be recognized by its 22-jointed antenna and by the front femur being grooved along its upper margin.

†See footnote regarding the unfortunate similarity in the names of the subfamilies *Acrydiniæ* and *Acridinæ*, on page 253.

This species is very abundant throughout New England, where it reaches maturity early in July, and is found nearly everywhere on dry, sandy or loamy soils of pastures and cultivated fields; and therefore its occurrence in Nova Scotia in similar situations is not by any means a thing to be entirely unexpected.\*

Group Stenobothri.

7. **Chorthippus curtipennis** (Harris). SHORT-WINGED BROWN LOCUST.

*Stenobothrus curtipennis*. F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 754 (1870); Nova Scotia.—Do., Can. Ent., iv, 31 (1872); Nova Scotia.—Piers, Trans. N. S. Inst. Sc., ix, 213 (1896); Nova Scotia.

*Chorthippus curtipennis*. Gooderham,, Proc. Ent. Soc. N. S. for 1916, 25, 27 (1917); Col., Kings, Hants, Ann., Digby, Yar., and Queens Cos.

*Description*.—Nova Scotian specimens. *Foveolæ of vertex plainly discernible from above* as linear depressions; median carina of pronotum not high or sharp, cut somewhat *behind the middle*, lateral carinæ incurved; wing-covers of male usually reaching end of abdomen, and of female usually covering about two-thirds of abdomen, although they may be longer or shorter in each sex; wings slightly shorter than wing-covers; hind femora rather slender.

*Colour*.—Nova Scotian specimens. Variable; green, greenish-olive-gray, and brownish colour-phases being found in this province. The difference between these three phases mainly depends on the colour of the sides of head and of pronotum, which are of one of these tints. There are varying degrees of intensity of these colours, but a number of specimens can be fairly easily placed in the three groups. Descriptions of these phases, from adults taken at Halifax, 14 Aug., 1917, are as follows:—

Green phase.—Upper part of head, of pronotum, and of abdomen pale vinaceous-cinnamon. Face, sides of head, of pronotum, and of thorax pale chromium-green, which gives this variant its predominant colour. Sides of abdomen vandyke-brown. Under parts brownish yellow. Often two black lines on upper part of head between eyes; but these sometimes wanting. Narrow black line from eye to pronotum, continued on latter as presently described. Lateral carinæ of pronotum whitish; margined outwardly by a black line (a prolongation of that from the eye), which extends to beyond the middle of pronotum; and margined inwardly by a shorter black line on the posterior two-fifths of the disk. Thus the whitish sinuous line of the lateral

\**Chlosyllis conspersa*, Harris, the Sprinkled Locust, is not uncommon near dry woodland in New England, north to Maine, and also has been reported from Ont., Man., and Alb., and might possibly be found in southern Nova Scotia. The antennæ are long (10-12 mm.); male wing-covers well developed, with the scapular area dilated; female wing-covers usually abbreviated to half length of abdomen, and wings aborted. The males resemble those of *Chorthippus curtipennis* but may be distinguished by the absence of the foveolæ, the broader black bar on sides of pronotum, and the larger and more robust body.



*legs*; face oblique and usually meeting vertex at an acute angle; *median carina of pronotum never raised as a crest or cut by more than one tranverse linear groove*; wings never brightly coloured or with dark band.—The winter is passed in the egg state, oviposition taking place in early autumn. Stridulation is produced by rubbing the hind femora against the roughened intercalary vein of the wing-covers, when at rest. Despite the similarity of the name of this subfamily with that of the *Acrydiinæ*, beginners must be careful to distinguish between the two names.

KEY TO NOVA SCOTIAN GENERA OF ACRIDINÆ (TRYXALINÆ).

- a. Antennæ linear; lateral foveolæ (small depressions) of vertex small and *not visible from above*.....ORPHULELLA, p. 264.
- aa. Antennæ linear; foveolæ of vertex plainly *visible from above* as linear depressions between the eyes and the apex.
  - b. Median carina of pronotum not high, and *not cut in front of middle by principal sulcus* (transverse groove), the notch so formed being a little behind the middle.....CHORTHIPPUS, p. 266.
  - bb. Median carina of pronotum rather high and sharp, and plainly *cut somewhat in front of middle by principal sulcus*.....MECOSTETHUS, p. 269.

Group Orphulæ.

6. ? *Orphulella speciosa* (Scudder).

*Orphulella speciosa*. Scudder, Can. Ent., xxxi, p. 184 (July 1899); "Halifax, N. S., Piers."

*Description*.—Face very oblique; vertex blunt, rounded, obtuse in female, right-angled in male; central depression close to apex; *foveolæ indistinct and not visible from above*; lateral carinæ of pronotum very little incurved, the distance between them little greater at hind margin than at front; principal sulcus cuts median carina of pronotum somewhat behind middle; wing-covers usually reach ends of hind femora although varying from 3 mm. short to 3 mm. beyond them in male, and from 1.5 mm. short to 2 mm. beyond in female.

*Colour*.—Very variable, the more striking variations being (a) head, disk of pronotum and wing-covers green (b) head and disk of pronotum green, tegmina rose-red; (c) head and pronotum brown, wing-covers rose-red, and (d) head, pronotum, and wing-covers brown. A dark line from behind the eye reaches back onto the pronotum, along the lateral carinæ, the latter being whitish. Wing-covers with a few small spots, sometimes wanting; hind femora greenish or brownish, not banded; hind tibiæ dull brown or yellowish, without pale ring near base.

*Measurements*.—Male: body, 13-14 mm.; antennæ, 4.5-6.5 mm.; wing-covers, 10-13 mm.; hind femora, 8.5-10 mm. Female: body, 16-21 mm.; antennæ, 5-6.5 mm.; wing-covers, 9-16 mm.; hind femora, 10-12 mm.

*Range*.—Eastern and central North America: from Nova Scotia (??) (Scudder, probably an erroneous record), Maine, St. Anne de Bellevue, P. Q. (Gooderham MS.), and southern Ont., south to Texas, and west to Minn. and Nebr. Very abundant in New Eng.

*Reported occurrence in Nova Scotia.*—Dr. Samuel H. Scudder, in his paper on "North American Species of Orphulella", in the Canadian Entomologist, London, Ont., vol. xxxi, page 184 (July, 1899), says of *Orphulella speciosa*, "I have before me a series of specimens from Halifax, N. S., Piers; Moosehead Lake, Scudder; Norway, Smith;" etc.; and in his "Catalogue of the Described Orthoptera of U. S. and Canada" (Proc. Davenport Acad. of Sc., viii, 24, 1901), he gives its range as "Nova Scotia to Texas," a statement which has been copied by other writers. I have no recollection whatever of this specimen to which Scudder attaches my name, or when it was taken; although I sent him various specimens from Halifax during 1895. I am absolutely certain that Scudder never reported to me that this species was among those I sent him, and the record must be open to the very greatest doubt.

Mr. Gooderham informs me that he has never taken or heard of *O. speciosa* being taken in Nova Scotia. He has a single specimen collected at St. Anne de Bellevue, Quebec province, and has compared it with ninety-six specimens of *Chorthippus curtipennis* from Nova Scotia. In all his Nova Scotian specimens the foveolæ are present and easily seen from above, so that there can be no doubt that the specimens from this province generally have been correctly determined as *C. curtipennis*. I have had the same experience in examining many specimens taken by myself about Halifax, and Dr. E. M. Walker confirms our determination of *C. curtipennis*.

Taking all the circumstances into consideration, I feel reasonably confident that Scudder made some mistake in his record, and it is merely included here on his authority as before quoted. The occurrence should at least be verified by a new record before fully accepting *O. speciosa* as a member of our fauna, and supposed specimens of *C. curtipennis* should be examined to see if *Orphulella* is included among them.

carina seems to pass diagonally across a black line which therefore adjoins it first on one side and then on the other. Wing-covers brownish cream-buff. Hind femora pale vandyke-brown on disk, upper edge chromium-green, lower edge yellowish, knee black; hind tibiæ pale vandyke-brown, narrowly blackish at base.

Greenish olive-gray phase.—Upper parts of head and pronotum cream-colour; upper part of abdomen cream-buff with a black spot on anterior part of each segment. Face whitish; sides of head and of pronotum tea-green (greenish olive-gray), which gives this variant its predominant colour; sides of abdomen black, more or less marked with yellowish. Under parts canary-yellow. Sometimes two black lines on top of head; a black bar from eye to pronotum. The white lateral carinæ of pronotum, and adjoining velvety-black lines, are disposed in precisely the same manner as those of the green phase. Wing-covers cream-buff on dorsal area, wood-brown on lower area; veined with fuscous. Hind femora brownish olive-green on disk, canary-yellow on basal half of lower edge, knees black; hind tibiæ wood-brown, narrowly banded with black at extreme base; spines black.

Brownish phase.—This resembles the greenish-olive-gray and green phases, except that the sides of head and pronotum are brownish or yellowish-brown.

Of 9 specimens (5 adults and 4 nymphs) taken on the beforementioned date, 3 were green, 2 were olive-gray, and 4 were brownish. Of the males, 2 were green, 2 were olive-gray, and 1 was brownish; and of the females, 1 was green, and 3 were brownish. The two black lines on top of head were wanting on 2 (females) of the brownish lot, and also on 1 (male) of the green lot. In the adult males the wing-covers reach to the end of the abdomen, and in the adult females they cover about two-thirds of it.

*Measurements.*—Nova Scotian specimens. Male: body, about 15 mm.; antennæ, 8.7 mm.; pronotum, 3 mm.; wing-covers, about 9.5 mm. (2.2 mm. short of end of hind femora, but varies); hind femora, 10 mm.; hind tibiæ 9.5 mm. Female: body, about 18.5 mm. (but varies); antennæ, 6.7 mm.; pronotum, 3.5 mm.; wing-covers, about 9 mm. (5.2 mm. short of end of hind femora, but varies); hind femora, 12.2 mm.; hind tibiæ, 11 mm. Writers have described a short- and a long-winged form (the latter sometimes called var. *longipennis*), but they intergrade. In the former the wing-covers are usually about 2.5 mm. (males) or 4 mm. (females) short of end of hind femora; while in the latter they reach the end of femora or slightly surpass them. In Nova Scotian males they mostly reach the end of the abdomen, and in females they usually cover about two-thirds of it; that is in the former their apex is about 2.2 mm. short of the apex of the hind femora, and in the latter about 3 mm. short of the end of the abdomen and about 5.2 mm. short of the femoral apex.

*Range.*—Northern United States and Canada east of Sierra Nevadas and mostly north of lat. 40°: from southern Nfld., P. E. Island, Man., Sask., and Alb., south to N. Caro., Ill., Neb., Colo., and Nev. It is thus mostly confined to the Canadian and Transition Zones and probably the northern portion of the Upper Austral. One of the commonest species in New England and other parts of its range.

*Occurrence in Nova Scotia.*—This very common species was first recorded from Nova Scotia by F. Walker in 1870. In Aug., 1912, B. Long collected 31 specimens in the neighboring province of Prince Edward Island, and also took it at Moncton, N. B. (E. M. Walker, Can. Ent., 47, 1915).

As we have seen, the green, the olive-gray, and the brownish colour phases are found in Nova Scotia. The species is very abundant throughout the province in somewhat damp places well covered with succulent grasses, and also about dryer meadows and thick growths of roadside ferns, such as the sweet Hay-scented Fern (*Dicksonia punctilobula*), in dry locations. Hundreds rise from about the feet when walking through short grass. Despite its numbers, it probably does not do very much damage to crops which are of value. I have noted it about Halifax, Lawrencetown (Hx. Co.), Westville (Pict. Co.), Tatamagouche (Col. Co.), Windsor (Hants Co.), Kentville (Kings Co.), Lunenburg Co., etc.; and C. B. Gooderham states that it is excessively abundant about Truro, Col. Co., and also reports it from the additional counties of Annapolis, Digby, Yarmouth, and Queens. Although there happens to be no records of its occurrence in Cape Breton Island, yet, no doubt, it is also abundant there.

It is a fairly early species, and probably hatches about Halifax in the latter part of June, as I have observed many nymphs, from 6 to 8 mm. long, and of about the third stage, in grass about damp places near Halifax on 7 July, 1917, which was a backward season. Adults are met with from about the latter part of July or first of August about Halifax (27 July, 1897, Halifax; earliest date at Truro, 6 July, 1914)\*, until about 25 October (19 Oct. '95, 25 Oct. '96, 26 Oct., '97, 26 Oct. '17, at and near Halifax). At noon on 18 Nov., 1917, a sunny warm day with a temperature of 49°, I took an active male (greenish olive-gray phase) in a very sheltered warm spot covered with grass and fallen leaves, at the edge of a wood in the archbishop's grounds, Dutch Village, Halifax, although the frost had previously been so severe that on 15 Nov. the head of the North West Arm was frozen over. This must only be taken as a mere casual survival of an individual in a peculiarly favourable situation.

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\*In 1917 the first adults and first stridulation of this species were noted at Halifax on 14th August.

The stridulation or call of this very common locust sounds like the lispings syllables *thru, thru, thru*, repeated from about seven to ten times, and lasting altogether three or four seconds. It is a soft, dreamy, lulling sound of the country, and quite characteristic of a quiet, hot forenoon in August and September, and is still heard in October. The insect may be seen producing the notes by raising the hind legs and grating the thighs against the outer surface of the wing-covers. These notes are heard from about the beginning of August, or perhaps earlier, and as long as the adults are about; but the sound is quite faint at the end of the season,—in fact the species calls most frequently during hot sunny days. The male is a fairly active and noiseless flier, but the female usually escapes by leaping.

#### Group Epacromiæ.

##### KEY TO NOVA SCOTIAN SPECIES OF MECOSTETHUS.

- a. *Scapular area of wing-covers with a pale (yellow) streak; intercalary vein of male wing-cover with very obscure, low teeth*.....8. *lineatus*, p. 269.  
 aa. *Scapular area of wing-covers without a pale streak; intercalary vein of male with minute, sharp, elevated teeth*.....9. *gracilis*, p. 271.
8. **Mecostethus lineatus** (Scudder).

*Mecostethus lineatus*. Gooderham, Proc. Ent. Soc. N. S. for 1916, 25, 27 (1917); Kings and Yar. Cos.

*Description*.—Foveolæ of vertex visible from above; pronotum with three distinct carinæ, the median rather high and sharp, plainly cut by principal sulcus somewhat in front of middle; lateral carinæ distinctly divergent behind; prozona (front part of pronotum) shorter than metazona (hind part); *intercalary vein of male wing-cover with very obscure, low teeth*; wing-covers and wings well developed, surpassing end of femora by about one-third of tibia.

*Colour*.—Nova Scotian female. General colour brownish with yellow markings; beneath yellowish-green; wing-covers with a pale yellowish streak. Head and pronotum dark vandyke-brown, the latter liver-brown on the lateral lobes; labial region light olive-buff. Pronotum liver-brown on lateral lobes, lighter on disk; under parts of prothorax oil-green. Abdomen dark clove-brown (nearly black) above and on sides, beneath light apple-green; a pale yellow, somewhat broken line along each side of upper part of abdomen, and three similarly coloured spots on sides of abdomen. A distinct, pale canary-yellow narrow line extends from near upper part of eye, along side of head, and continues, somewhat broader, on the lateral carinæ of the pronotum. A pale, canary-yellow dash, rather broad, extends diagonally across posterior part of cheek and anterior part of pronotum. Wing-covers pale cinnamon-colour, darker at base and on sides. From the base a *distinct pale canary-yellow line extends near the lower (anterior) edge* until it reaches about the middle of the length of the wing-cover; the apical part of this line is broken up and so

extends on the uneven lines of the veins. This yellow line appears as a continuation of the similarly-coloured one from the eye along the lateral carina of pronotum. Hind wings brownish along anterior (lower) part, and pale yellow on posterior (upper) part. Fore and middle legs liver-brown or bay above. Hind femur olive on outer face, becoming blackish near apex, and a group of three whitish spots, about midway, on outer face; upper edge of femur brownish, and lower edge light maroon, with two black marks, separated by a yellow one, near apex. Hind tibia buff-yellow with faint dusky annulation near base and also dark near apex.

*Measurements*.—Male (vide Blatchley): body, 26 mm.; wing-covers, 25 mm.; hind femora, 17 mm.; hind tibiæ, 16.5 mm. Female (Nova Scotian): body, 36.7 mm.; wing-covers, 32 mm.; hind femora, 20 mm.; hind tibiæ, 19.2 mm.

*Range*.—Northern United States and southern Canada east of the Great Plains, north of about lat. 40° and east of about long. 100°: from Nova Scotia, P. E. Island, Maine, Que., Ont., and Man., south to New Jers., Ind., Iowa, and Neb. It thus occurs in the Canadian, Transition, and probably the northern part of the Upper Austral Zones. It is generally a rather uncommon species and reported but a few times in a district; but Morse states it is rather common in southern New England in wet, sedgy meadows, and in Mass. and Maine it occurs at elevated points.

*Occurrence in Nova Scotia*.—This large, handsome species, with its bold, graceful outlines, seems to be somewhat rare in Nova Scotia, and is doubtless local in occurrence. The wet meadows of the western part of the province should be more favourable to it than the Atlantic coast where such places are less frequent. I had not found it when I published my paper in 1896, but on 26 October, 1897, I collected the first specimen, a female, in wet sea-marsh grass, on the West Marsh, Lawrencetown, Halifax Co., a description of which has been given. This is the only one I have met with here. In C. B. Gooderham's collection are two specimens taken by E. C. Allen, viz., a male from Yarmouth Co. (Deerfield?), and a female from Kings Co. (Wolfville?), but without dates. I understand that Mr. Gooderham has also seen two which had been taken at Yarmouth on 29 Aug. Bayard Long took six specimens at four localities in Prince Edward Island in Aug. and Sept., 1912 (E. M. Walker, Can. Ent., 47, 341, 1915), so that the northern limit of its range is not in Nova Scotia. Dr. E. M. Walker has found it quite plentiful in Ontario, in low, wet, sedgy meadows bordering lakes and slow streams (Can. Ent., 30, 125, 1898). Further search in suitable wet localities in Nova Scotia may show it to be

less rare than supposed. It should be looked for among the stems of tall grasses and sedges in low, boggy ground. The male is shy and difficult to approach, and is active, flying rapidly and noiselessly; while the female is more sluggish and secretive. It probably occurs in the mature state from about the latter part of July to near the end of October, the Lawrencetown date of 25 Oct. being no doubt representative of the very last days of its existence.

### 9. *Mecostethus gracilis* (Scudder).

*Mecostethus gracilis*. Piers, Trans. N. S. Inst. Sc., ix, 215 (1896); Halifax and Cow Bay (Hx. Co.).—Gooderham, Proc. Ent. Soc. N. S. for 1916, 25, 27 (1917); Col., Kings, and Yar. Cos.

*Description*.—This, like *M. lineatus*, is a handsome species, with trim lines and pleasing colouration, the dash of light red on the femora giving it a jaunty, attractive appearance. In general description it very closely resembles *M. lineatus*, except that the intercalary vein of the male wing-cover has sharp, elevated, minute, closely-set teeth.

*Colour*.—In colour also it fairly well resembles *M. lineatus*, except that the scapular area of the wing-cover is without the pale yellow streak which is so noticeable in that species. The hind femora of *gracilis* are yellowish with some small brownish markings, and the apex black with a yellow line on top; the lower edge of the hind femora is a striking, bright red. Hind tibiae yellow with a black annulation at base and another on the basal third, the apex being dusky. Fore and middle legs yellowish. It may very readily be separated from *M. lineatus* by the absence of a pale yellow streak along the scapular area of the wing-covers.

*Measurements*.—Nova Scotian specimens. Male: body, 21 mm.; wing-covers, 20-20.5 mm.; hind femora, 14.5-15 mm.; hind tibiae, 12.5-13.7 mm.; antennae, 11 mm.

*Range*.—Northernmost United States and southern Canada, east of about long. 100°: has been reported from southern Nfld., Nova Scotia, P. E. Island, Maine, New Hamp., Mass. (northern and elevated parts of New Eng. from summits of White Mtns. to Berkshire Hills), Ont., Man., Sask., Alb., New Jers., Minn., Nebr., and Dak. Chiefly confined to the Canadian and Transition Zones. Its distribution to the south seems somewhat irregular.

*Occurrence in Nova Scotia*.—This species was first recorded from Nova Scotia by the present writer in 1896, and it was the first record for Canada exclusive of Scudder's original (1862) record for Manitoba. On 26 Aug. 1912, Bayard Long collected one male at Dundee in northern Prince Edward Island, and so extended its eastern range northward (Walker

Can. Ent., 47, p. 341, 1915), and recently it has been taken in southern Newfoundland. In Nova Scotia the species is no doubt rather uncommon to common, according to localities. It is probably local in distribution, as about Truro, Col. Co., Mr. Gooderham reports it as common, while so far I have only collected four specimens near Halifax, all the latter being males. The first of these was taken in long grass in a dry location on the summit of Blockhouse Hill, near Fairview, Halifax, on 1 Sept., 1895. The remaining three were all captured in a damp, grassy spot on the roadside near Cow Bay Bridge, Cow Bay, about seven miles southeast of Dartmouth, Hx. Co., on 2 Oct., 1895. The determination of one of these specimens was verified by Dr. S. H. Scudder.

C. B. Gooderham has since collected the species at Truro, Col. Co., and also noted it from Kings County and Yarmouth. He took eight males at Truro, in Aug., 1913, and two males at the same place on 16 Aug. 1915. Some males were also sent to him from Kings County, where he has also seen it alive, and E. Chesley Allen gave him a broken male from Yarmouth. He has never captured a female, as the latter is said to be very sluggish and seldom takes to wing, whereas the male is an active flyer. The species, he says, does not appear to be very common in the western part of the province, and it is only found there among long grass and sedges in swampy places. Generally it is to be expected to occur in such habitats, although one of my Halifax specimens was from a moderately high (175 feet) and quite dry situation. The earliest and latest dates on which it has happened to have been taken, are 9th August (Truro) and 2nd October (near Halifax); but no doubt these dates do not correctly represent the full period of its occurrence with us as an adult. They may, however, assist others in defining the period more accurately. One would expect to find it from the latter part of July to the latter part of October.



Subfamily **Œdipodinæ** (Vertical-faced Spineless Locusts).

Size rather large; colour dull brown or grayish; pronotum not extending over abdomen; no spine or tubercle on prosternum between front pair of legs; face nearly or quite vertical; median carina of pronotum usually *raised as a crest and usually cut by more than one transverse linear groove*, wings usually brightly coloured. Most species are peculiar, in that they stridulate when in flight; the cracking or rattling notes being produced by rubbing the under surface of the wing-covers against veins on the upper front surface of the hind wings. Other species stridulate as in the subfamily *Acridinæ* by rasping a series of teeth on the hind femora against a roughened vein of the wing-covers. The winter is passed in the egg state.

KEY TO NOVA SCOTIAN GENERA OF ŒDIPODINÆ.

- a. Disk of hind wing transparent, not bordered by black; median carina of pronotum faintly cut by one sulcus (notch).....CAMNULA, p. 274.
- aa. Disk of hind wing opaque, coloured.
  - b. Disk of hind wing black, bounded by a pale greenish-yellow border, apex smoky and having a few darker spots; median carina of pronotum cut by one deep sulcus.....DISSOSTERRA, p. 278.
  - bb. Disk of hind wing yellow, with a broken dark median transverse band, apex dusky; median carina of pronotum cut by two sulci. CIRCOTETIX, p. 281.

The student is cautioned that the above very artificial key only refers to such genera as have so far been reported from Nova Scotia, and that it will not answer should the number of represented genera be increased here. As it is quite probable that other genera may yet be found in the province, the following key has been extended so as to embrace those of possible occurrence here, the names of which are inclosed in square brackets.

KEY TO GENERA OF ŒDIPODINÆ FOUND OR LIABLE TO BE FOUND IN NOVA SCOTIA.

- a. Median carina of pronotum raised as distinct crest and not notched by principal sulcus. (Inner wings bright sulphur-yellow on basal two-thirds, beyond which is a broad curved dusky band with a dark offshoot extending to near base).....[ARPHIA\*].

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\**Arphia sulphurea* (Fabricius). Sulphur-winged Locust.—Common in pastures in New England, north to Maine and southern Ont., and may possibly yet be taken in south-western Nova Scotia. In this species, which is generally of a yellowish-brown or brown colour, the median carina of pronotum is *not* notched at all by the principal sulcus; and the hind wings have the basal two-thirds bright sulphur-yellow and the outer third covered by a curved dusky band with a dusky offshoot extending to near base. Length, male, 18 mm.; female, 27 mm. F. Walker in 1870 reported *Œ. sulphurea* from Nova Scotia (Cat. Derm. Salt., iv, 731; and Can. Ent., iv, 1872) but his specimen proves on re-examination to be *Circotetix verruculatus* (see that species).

- aa. Median carina of pronotum less prominent and in female always notched by one or more sulci.
- b. Median carina of pronotum notched by only *one sulcus*.
- c. Disk of hind wing nearly transparent, not distinctly bordered by black.
- d. Disk of pronotum roof-shaped, front margin angulate. (Hind wings transparent, yellowish at base, remaining two-thirds smoky, paler at apex, a dark bar along middle of front margin).....[*CHORTOPHAGA\**].
- dd. Disk of pronotum flat, front margin truncate.
- e. Median carina of pronotum prominent, higher in front than behind. (Hind wings transparent yellowish at base, outer half smoky and apex darker) ..... [ENCOPTLOPHUS†].
- ee. Median carina of pronotum low, of equal height throughout, faintly notched by principal sulcus. (Hind wings transparent with dark nervules.)  
CAMNULA, p. 274.
- cc. Disk of hind wing opaque, coloured (red or yellow bordered with fuscous, or black bordered with yellow).
- f. Pronotum with lateral carinae extending in front of principal sulcus and not cut by it; disk of pronotum usually with numerous tubercles; body robust, large. (Hind wings red or yellow, margined with fuscous)...HIPPISCUS, p. 277.
- ff. Pronotum with lateral carinae extending only to principal sulcus and cut by it; its disk with few if any tubercles; body slender, smaller. (Hind wings black with yellow border.) ... DISSOSTEIRA, p. 278.
- bb. Median carina of pronotum notched by *two sulci*, front notch often less distinct than hind one; hind wings with two or three radial veins greatly enlarged. (Hind wings yellow, with a dark median transverse band widening behind.) ..... CIRCOTETIX, p. 281.

Group *Ædipodini*.

10. *Camnula pellucida* (Scudder). CLEAR-WINGED LOCUST.  
*Camnula pellucida*. Piers, Trans. N. S. Inst. Sc., ix, 214 (1896); Halifax and Cow Bay (Hx. Co.).—Gooderham, Proc. Ent. Soc. N. S. for 1916, 26, 27 (1917); Col., Kings, Hants, Ann., Digby, Yar., Queens, Vict., Inver., and Cumb. Cos.

\* *Chortopaga viridifasciata* (De Geer). Green-striped Locust.—Abundant everywhere in New England and generally distributed in southern Ont. and may possibly yet be taken in southwestern Nova Scotia. Median carina of pronotum cut by principal sulcus; pronotum disk roof-shaped, sides sloping, dorsal front margin angulate; and hind-wings transparent, yellowish at base, with apical two-thirds smoky, paler at apex, and a dark bar along middle of front margin. General colour is green or brown. Length, male, 17-20 mm.; female 22-32 mm.

† *Encoptolophus sordidus* (Burmeister). Clouded Locust.—Very common throughout New England and occurring north to Montreal and southern Ont., and may possibly yet be taken in southwestern Nova Scotia. Colour rusty-yellow or brown, mottled with darker or lighter shades of brown. Disk of pronotum flat, the dorsal front margin truncate; median carina of pronotum prominent, higher in front, distinctly notched by principal sulcus; hind wings transparent yellowish at base, outer half smoky, darker at apex. Length, male, 20 mm.; female, 24-35 mm.

*Description*.—Size rather smaller than most of the *Ædipodinæ*. Head compressed; antennæ short; pronotum with disk flat and smooth, much wider behind, truncate in front, obtusely angled behind, its median carina low, of equal height throughout, faintly cut once by principal sulcus in front of middle; sides of pronotum deeper than long; wing-covers narrow, reaching beyond abdomen.

*Colour*.—General colour light brown; antennæ pale at base, darker toward apex; a dark triangular spot behind eye, and a vertical dark spot on the front half of the lateral lobe of pronotum; wing-covers smoky-brown, with several dark and light patches on sides; the dorsal surface of covers dark brown with a yellowish stripe along each humeral angle; inner wings transparent, with dark nervules; hind femora yellowish brown with the apical part darker, and faintly marked with dark bars; hind tibiæ yellowish brown; abdomen yellowish beneath, sides darker.

*Measurements*.—Male: body, 17-21 mm.; antennæ, 7-9 mm.; wing-covers, 16-18 mm.; hind femora, 10-12 mm. Female (Nova Scotian): body, 27 mm.; antennæ, 6.5 mm.; wing-covers, 21 mm.; hind femora, 14 mm.; hind tibiæ, 12 mm.

*Range*.—Southern Canada and northern and western United States from Atlantic to Pacific: from P. E. Isld., Nova Scotia, Montreal, Manitoba, and Br. Columbia, south to Conn., northern Ind., Nebr., Colo., New Mexico, Ariz., and Calif. It thus occurs in the southern part of the Canadian, the Transition, and probably the northern portion of the Upper Austral Zones. In northern New England it is common, often excessively so, especially on dry hillsides.

*Occurrence in Nova Scotia*.—This somewhat sober-coloured locust, which lacks the brightly-coloured inner wings of most of the *Ædipodinæ*, is apparently rather uncommon about Halifax, but is reported to vary from common to very common in the western parts of the province where it is one of the most injurious species.\* It was first reported from Nova Scotia in 1896. I captured a female, in company with *Circotettix verruculatus* (which it somewhat resembles when on the ground) in a stony place near Blockhouse (Stanford's) Pond, Fairview, Halifax, on 5 Sept. 1895; and a second female in a damp, grassy spot on the roadside close to Cow Bay Bridge, Cow Bay, about seven miles southeast of Dartmouth, Hx. Co., on 2 Oct. of the same year. The determination of the species was verified by Dr. S. H. Scudder who examined the latter specimen. Among some Orthoptera sent to me by Miss Lucy C. Eaton, was a third female taken by her at Truro, Col., Co. 23 July 1901 (Prov. Museum, Acc.

\*Mr. Gooderham's statement (*Acrididæ* of N. S., 1917, p. 26), that it is "very common all over the province, occurring wherever *M. femur-rubrum* or *M. allanæ* is found," does not at all apply to the conditions about Halifax, where it is at most only uncommon.

No. 350). I have also seen specimens from Church Street, Kings Co. In the collection of the Agricultural College, Truro, are fifteen specimens taken in July and August at Truro, Col. Co.; Kentville, Kings Co.; and Smith's Cove, Digby Co. In C. B. Gooderham's collection are others taken by himself at Truro and Berwick (Kings Co.), and by E. C. Allen at Yarmouth. Gooderham has recorded it from the following counties: Victoria, Inverness, Cumberland, Colchester, Hants, Kings, Annapolis, Digby, Yarmouth, and Queens.\*

It is probably somewhat local in distribution and its abundance varies considerably in different years. While uncommon in the vicinity of Halifax, it is common in suitable localities in the western parts of the province, and is reported as excessively common about Truro during some years and somewhat less so in other seasons. During the summer of 1913 it was so numerous at Truro, that when flushed it arose in clouds wherever there was vegetation, and in that season specimens were sent in from several counties, with complaints as to its abundance. In times of such abundance it is capable of doing considerable damage and should be closely watched. Since then, fortunately, the number has dwindled down to a large extent.

Gooderham has observed recently-hatched nymphs of this species, with a few of *Circotettix verruculatus*, in warm spots at Truro on 3 June, 1915. It has been taken in the perfect state from 14 July (Truro) until at least 2 October (Cow Bay, Halifax Co.). It should be searched for in dry situations, such as are frequented by others of the *Ædipodinae*, and such are its haunts in New England, where it is very abundant in dry, grassy pastures and on untilled ground, preferably on high land; but in Indiana it occurs in low marshy land with short grass. Mr. Gooderham of Truro

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\* In Prince Edward Island B. Long collected eleven specimens in seven localities in Aug. 1912 (Walker, Can. Ent., 47, p. 341, 1915).

*Dissosteira carolina*. Piers, Trans. N. S. Inst. Sc., ix, 214 (1896); Nova Scotia.—Gooderham, Proc. Ent. Soc. N. S. for 1916, 26, 27 (1917); Col., Kings, Hants, Ann., Digby, Yar., Queens, Lun., Pict., and Cumberland Cos.

*Description*.—Disk of pronotum with front margin nearly truncate and hind margin obtuse-angled; median carina high, cut in front of middle by deep narrow notch, its front lobe almost straight and the hind one arched; lateral carinae rounded and extending forward only to principal sulcus. Wings and wing-covers extending about one-third their length beyond abdomen.

*Colour*.—Nova Scotian specimens. General colour varies somewhat, but is generally clove-brown (brown-black) and dark hair-brown; under parts lighter and more brown in tint, with a tendency towards mummy-brown. Wing-covers broccoli-brown, much clouded and obscurely spotted with clove-brown. Hind wings dark clove-brown or black, with a primrose-yellow or pale sulphur-yellow outer border the width of which is about one-sixth of length of wing, the apex smoky with several fuscous spots. Hind femora with inner face whitish and crossed by three blackish bands, the first nearly covering the basal half; hind tibiae dirty yellowish.

*Measurements*.—Male: body, 26-30 mm.; antennae, 10-11 mm.; pronotum, 7 mm.; wing-covers, 29-34 mm.; hind femora, 13-16 mm. Female: body, 34-40 mm.; antennae, 12-13 mm.; pronotum, 10 mm.; wing-covers, 37-42 mm.; hind femora, 16-20 mm.

*Range*.—This common species is very widely distributed, occurring in Canada and the United States from Atlantic to Pacific: from Nova Scotia, New Bruns. (Point du Chene), Montreal, Ont., Man., and Br. Columbia, south to Fla., Miss., Central Amer. (?), New Mexico, and Calif. It thus occurs in the Canadian, Transition, Upper and Lower Austral zones. In New Eng. it is everywhere abundant.

*Occurrence in Nova Scotia*.—This species was first reported from Nova Scotia by Francis Walker of the British Museum in 1870, doubtless from specimens collected by Lieut. Redman about 1821. It is fairly common in all suitable localities in Nova Scotia, being found with *Circotettix verruculatus* on hot, dry, stony places, bare ground, dusty roadsides, and particularly on the ballast of railways; and it more or less resembles in colour the predominant tint of its habitat. It is much less abundant than *C. verruculatus* which it very closely resembles when on the ground, and with which it shares its habitat. Strange to say, Bayard Long did not happen to meet with it in Prince Edward Island in 1912, although it must surely occur there; but he collected it at Point du Chene, N. B., on 11 Aug., 1912 (E. M. Walker, Can. Ent., 47, p. 341, 1915).

says it is met with in his district wherever *Melanoplus femurrubrum* or *atlanis* is found. Its flight is low and direct, and usually silent, though it can also produce a slight rustling sound when on the wing.

11. **Hippiscus apiculatus** (Harris). CORAL-WINGED LOCUST.

*H. tuberculatus* of former writers.\*

*H. tuberculatus*. Scudder, *Psyche*, vi, 303 (1892); Nova Scotia, etc.

*Description*.—Large and robust especially in female; head large, with swollen cheeks; vertex considerably produced in front of eyes. Pronotum slightly flattened apically, disk flat, more or less roughened and with numerous blunt tubercles; median carina low but distinct and cut by principal sulcus; lateral carinae extending somewhat beyond the principal sulcus and not cut by it; *hind margins of pronotum acute-angled* (especially in female), *prozona (front dorsal part) much shorter than metazona (hind part)*. Wing-covers extending considerably beyond abdomen, especially in male. Hind femora very broad and flattened.

*Colour*.—General colour ash-brown, darker above; pronotum with a short longitudinal dark brown bar on its lateral lobes; wing-covers with fuscous and black blotches, the humeral angle usually light brown; hind wings usually bright coral-red (rarely yellow) at base, bordered outwardly by a curved fuscous band, with another band of fuscous along the median part of front or costal margin; outer face of hind femora with faint blackish bars, the apical half of inner face yellow crossed by a narrow black band; hind tibiae yellowish to brownish.

*Measurements*.—Male: body, 25-30 mm.; pronotum, 8 mm.; wing-covers, 25-30 mm.; hind femora, 15-17 mm. Female: body, 40-43 mm.; pronotum, 11 mm.; wing-covers, 30-35 mm.; hind femora, 20-23 mm.

*Range*.—North America east of the Rocky Mountains, rare southwardly; reported from Nova Scotia (by Scudder only), Montreal (Caulfield, as *Æ. phanicoptera*), Ont., Man., and Alberta, south to Fla., Missouri, Kans., and Colo., and west to Mont. and Wyom. Probably occurs chiefly in the Upper Austral, Transition and Canadian Zones.

*Occurrence in Nova Scotia*.—Unfortunately the sole record of the species' occurrence in this province, so far as I know, is the late Dr. S. H. Scudder's inclusion of "Nova Scotia (Jones)" in the list of localities where *Hippiscus tuberculatus* had been taken, in his monograph on "The Orthopteran Genus *Hippiscus*," in *Psyche*, vol. 6, p. 303, Cambridge, 1892. I suppose we should not throw doubt upon that record, particularly if Scudder had examined the specimen himself,

\*Rehn and Hebard (*Proc. Acad. Nat. Sc., Phila.*, 62, p. 630, 1910) point out the reason for adopting Harris's name, as Palisot de Beauvois, in 1805, had misidentified his United States material with Fabricius's *C. ryllus tuberculatus*, an Old World species belonging to another genus.

which however he does not state. There is the possibility that Jones may have sent Scudder such a specimen, but it may not have actually been taken in this province. The Mr. Jones whose name is attached to the record, was, without any doubt, the late J. Matthew Jones, a well known Nova Scotian naturalist and president of the N. S. Institute of Science, with whom Scudder was in communication about 1876, and for whom he named the species of Orthoptera listed in Jones's "Visitor's Guide to Bermuda," Lond., 1876. Jones resided at Halifax and died there in 1888.

If it does occur here, as is not impossible from its known range, it must at least be rare and local, as it is a large, distinctively coloured and very conspicuous insect, particularly when in flight, and yet it has not been observed by either C. B. Gooderham or E. C. Allen in the western and southern sections of the province, or by myself about Halifax, and Mr. Long also did not find it in Prince Edward Island. Its occurrence here very greatly needs a new record for its verification before it can be accepted with confidence. Personally I am very strongly of the opinion that some mistake was made by Scudder in his record.\*

The species is found throughout New England, but is there never very common and apparently is less abundant in the northern part of that region. It is usually found in dry, bushy pastures; and the male in flight produces a loud rattling note. In Ontario it is local in distribution, but where it does occur it forms colonies of considerable size.

12. *Dissosteira carolina* (Linnæus). CAROLINA LOCUST;  
BLACK-WINGED LOCUST.

*Ædipoda carolina*. F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 729 (1870); Nova Scotia, etc.—Do., Can. Ent., iv, 31 (1872); Nova Scotia, etc.

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\*The species might be expected to occur in Bermuda, where J. M. Jones had resided for some years before coming to Halifax, but it is not mentioned in that gentleman's list of Bermuda Orthoptera given on page 144 of his "Visitor's Guide."

I have found it common about Halifax and elsewhere; and C. B. Gooderham has specimens taken by himself at Avondale, Pict. Co., Truro and Black Rock, Col. Co., Kentville, Kings Co., and Round Hill, Ann. Co.; by W. E. Whitehead at Wilmot, Ann. Co.; and by E. C. Allen at Deerfield, Yar. Co. I have also noted specimens collected at New Glasgow and Westville, Pict. Co., (Piers), Elmsdale, Hants Co., (Piers), Church Street, Kings Co. (D. Hogan), Middleton, Ann. Co. (I. Cox), Brooklyn, Yar. Co. (D. Marrell), and Yarmouth, Yar. Co. (E. C. Allen). It has also been reported from Cumberland, Hants, Digby, Lunenburg, and Queens Counties. Several specimens are in the collection of the Agricultural College, Truro.

The first adults are noted near Halifax about 24 July (1897, North West Arm).<sup>\*</sup> In October they are seldom observed and only on fine days; the last being usually seen on a warm day about the middle of October (5 Oct., '97, 12 Oct., '15, 28 Oct., '17). In 1917 single individuals were seen about Halifax, on bright days, on 8th, 14th, and 28th Oct., the last being a very slothful, half-perished female taken at noon on a sunny day when the temperature was 53°F. Oviposition probably takes place about the middle of September, as on the 12th of that month, 1897, I observed near Melville Island, North West Arm, Halifax, a number of the species which were particularly attracted to a warm spot where a load of sand had been left and which had become overgrown by grass on some parts, and there a female was evidently engaged in depositing eggs.

Frequently this insect makes a faint rustling or fluttering sound when flying. It usually proceeds in an erratic zig-zag manner when flushed, and on alighting, is apt to select a spot of ground with which its colour harmonizes, so that it is very difficult to detect until it is again put to flight. It

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<sup>\*</sup>Strange to say, I did not happen to note adults of this species in 1917 till about the end of August at Halifax, after which a fair number was seen each fine day.



usually does not fly far, but sometimes with a favouring breeze I have known it to proceed for thirty yards. As it frequents the roads and paths of man, it is familiar to all, although no special name is applied to it here. Most people confuse it with *C. verruculatus*, which some call the "Cracker," and with which it congregates; but in flight the two may be very readily distinguished, as *Dissosteira* has a *black hind-wing* bordered by yellow, whereas *Circotettix* has a *yellow wing* with a dark median transverse band. *D. carolina* is the largest locust in Nova Scotia with the exception of some females of *Melanoplus bivittatus* and *Hippiscus apiculatus*, which latter has been very doubtfully reported from here.

13. ***Circotettix verruculatus*** (Kirby). "CRACKER" (local);  
"SNAPPER" (local).

*Edipoda rugosa* (not of Scudder). F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 731 (1870); Nova Scotia, etc.—Do., Can. Ent., iv, 31 (1872); Nova Scotia, etc.

*Edipoda sulphurea* (not of Fabricius). F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 729-730 (1870); Nova Scotia, etc.—Do., Can. Ent., iv, 31 (1872); Nova Scotia, etc.

*Circotettix verruculatus*. Piers, Trans. N. S. Inst. Sc., ix, 214 (1896); Halifax and Ann. Co.—Gooderham, Proc. Ent. Soc. N. S. for 1916, 26, 27 (1917); Col., Kings, Hants, Yar. and Queens Cos.

*Description*.—Pronotum flattened on top, right-angled to acute-angled behind, its median carina elevated in front and *notched by two sulci* before the middle, the front notch often less distinct than the hind one; wings and wing-covers about as long as total length of body, the hind wings usually with three radial veins greatly enlarged.

*Colour*.—Nova Scotian specimens. Varies somewhat, but above usually black or blackish, often more or less finely marbled with gray, particularly about sides and front of head, and sides of pronotum. Underparts seal-brown to walnut-brown. Wing-covers grayish or brownish gray, blotched and sprinkled with brownish black, the larger blotches on the basal half. Hind-wings semitransparent; *pale sulphur-yellow on basal half*, with a few of the radial veins deeper in colour; this yellow area followed by a *crescent-shaped sub-median band of blackish*, with a triangular, blackish, sub-costal offshoot with

its apex extending towards the base of the wing; beyond this a triangular, semi-clear area, veined with blackish, with its costal margin dusky; and the apex of the wing dusky. Hind femora pale smoke-gray or grayish white, with about four bands of black, the basal ones more or less merging into each other and the terminal one embracing the knee; the gray of femora most conspicuous as a subterminal annulation. Hind tibiæ pale smoke-gray or grayish white, banded at each extremity and submedially with black. Feet tawny-olive. Eyes black or black spotted with gray. Antennæ blackish.

*Measurements*.—Male (Nova Scotia): body, 24-25 mm.; antennæ 10.5 mm.; pronotum, 5-5.2 mm.; wing-covers, 25-26 mm.; hind femora, 12-12.5 mm.; hind tibiæ, 10-10.5 mm. Female (Nova Scotia): body, 25.5-28 mm.; antennæ, 9.5-10 mm.; pronotum, 5-5.8 mm.; wing-covers, 24.5-27 mm.; hind femora, 11.5-13.5 mm.; hind tibiæ, 10-11 mm.

*Range*.—Canada from Atlantic to Pacific and northern United States from Atlantic to Rocky Mountains: from Nfld. (Port aux Basques), Nova Scotia, New Bruns. (Moncton), Montreal, Quebec, Ont., Man., Athab., and Br. Columbia (Vancouver), south to New Jers., Ill., Missouri, Nebr., Dak., Mont., and Colo. Though common on bare ledges in northern New Eng. it rarely occurs as far south as Mass. (Scudder, Orth. N. E., 1900). It is common in the mountains of New York, and in the southern part of its range is found at high elevations. It thus appears to be distributed over the Canadian, Transition, and elevated portions of the northern Upper Austral Zones or perhaps outliers of the Transition in that zone. In its southern limits, and no doubt generally, it is a more northerly species than *D. carolina*.

*Occurrence in Nova Scotia*.—Many years ago this species was collected in Nova Scotia, probably by Lieut. Redman about 1821, but Francis Walker of the British Museum in 1870 and 1872 erroneously determined the two specimens then taken as *Ædipoda rugosa* (= *Hippiscus rugosus* Scudder), and *Ædipoda sulphurea* (= *Arphia sulphurea* Fabricius), species which might possibly occur here but which have not yet been otherwise reported. He makes no mention of *Ædipoda verruculata* (= *Circotettix verruculatus*) as occurring outside of Massachusetts, U. S. A. (See Walker, Cat. Derm. Salt. Brit. Mus., iv, 729-731, 1870; and Can. Ent., iv, 31, 1872). In 1916, Mr. Cummings of the British Museum, examined for me Walker's single Nova Scotian specimen of "*Æ. rugosa*" which fortunately is still in that institution's collection, and it proves to be *C. verruculatus*; and under *C. verruculatus* in the same collection, is another specimen, of Walker's determination, from Nova Scotia, which had been named by him "*Æ. sulphurea*." These two names of Walker, as far as they apply to Nova Scotian specimens,

must therefore become synonyms of *C. verruculatus*, which satisfactorily clears up a matter which otherwise would have been in doubt. This is as might have been expected, for the fact that he had not recorded the very common *C. verruculatus* from Nova Scotia, made it fairly certain that he must have misnamed it. Unfortunately F. Walker's names are apt to present considerable difficulties of this sort. *C. verruculatus* was first reported from this province under its proper name in 1896 (Trans. N. S. Inst. Sc., ix, 214). It is remarkable that B. Long did not happen to meet either this species or *D. carolina* in Prince Edward Island in 1912, where they undoubtedly must occur, although he collected them in southeastern New Brunswick (E. W. Walker, Can. Ent., 47, p. 341, 1915). The absence of *C. verruculatus* from that island would indeed be most remarkable, as it ranges north to southern Newfoundland.

*Circotettix verruculatus* is very common in Nova Scotia, in dry, warm, stony places, on bare ledges, hot and dusty roadsides and other bare, barren or burnt ground and particularly along railways. It is nearly always in company with the larger but less abundant *D. carolina*, which it much resembles when on the ground, though very easily distinguished in flight by the different colouring of the hind-wings. Its preference for places which readily come under man's eye, make it much in evidence. In this vicinity it shows no particular fondness for elevated places, as long as its habitat is very warm and dry. About Truro, Col. Co., Mr. Gooderham says it is specially abundant on old burnt land, and in that district also is more common than *D. carolina*.

In C. B. Gooderham's collection, Truro, are specimens taken by himself, E. C. Allen and others, in Colchester, Hants, Kings, Annapolis, Digby, Yarmouth, and Queens counties. I have also seen specimens from Bayfield, Antig. Co., and of course from Halifax Co. Gooderham has observed a few nymphs, just hatched, with more numerous nymphs

of *Camnula pellucida*, on 3 June, 1913, at Truro, in very warm places. Adults may be met with from about the middle of July (16 July, Truro; 18 July 1895 and 1897, Halifax), but its familiar cracking notes are not usually heard until about the end of July or first of August (25 July, '95, 6 Aug. '97, 16 Aug. '16, and 1 Aug. '17, all at Halifax). In the latter part of September as the weather becomes cool, they are less frequently heard; and they finally disappear about the middle of October. On 8 Oct., 1916, the last one was heard near the head of the North West Arm, Halifax, although we did not have a killing frost till 13 Oct., on which date there was ice one-fourth inch thick. On 14 Oct., 1897, a single one, the last, was seen and heard on a warm, sunny day, although the first light frost had occurred on 2 Oct. In 1917 the last two were noted on 18 Oct., which was a fine, sunny day after frost, the thermometer in the morning being only 34°F. This is the latest date I have observed it about Halifax. The dates of killing frosts do not seem to determine its latest appearance in a district, as in 1917 they survived fairly severe frosts. It is a lover of sunshine and heat, and during the height of their season a cloudy day will send it into hiding. But very few are seen in the earliest part of the morning, as they are late risers and wait for the sun's heat to energize them, and they disappear as the sunshine withdraws towards the end of the day.

When in flight it produces a loud, sharp snapping or cracking sound, *klip, klip, klip*, repeated usually about five or six times, which is familiar to everyone on a hot summer day. This note seems to be produced by rubbing the under surface of the wing-covers against certain veins on the upper part of the hind-wings. From this sound it is usually called "Cracker" or sometimes "Snapper" by boys and others, it thus being the only species of locust which has been favoured with a distinctive common-name in Nova Scotia. The name "Cracker" is applied to it usually about Halifax, and that name and

“Snapper” are both general in the western counties. It also sometimes flies with a rustling or fluttering sound. When on the ground it is difficult to detect, as its colour harmonizes well with that of its surroundings, but on the wing it at once proclaims itself by its note and the distribution of the yellow on its brightly coloured wings. Its flight is often in a zig-zag course. It does not always wait to be flushed, but is in the habit of taking short flights over its location, cracking as it goes, in pure exuberance of spirits.

I must say I have not much fondness for such a dusty, dirty-looking frequenter of hot, dry highways and other parched and stony places in the full glare of the sun. He delights in such dusty and arid spots, as well as the oily-smelling ballast of breezeless railway cuttings; and the hotter and more sweltering the day, the better he is pleased, the more active he becomes, and the quicker, louder, sharper and more gleefully he cracks his wings, like a man snapping his fingers derisively at the world which disagrees with him. With the ear-piercing note of the Cicada, and in a lesser degree the monotonous preaching of the Red-eyed Vireo from the tree-tops, he is an audible accompaniment and a very symbol of a stifling noon in the hottest and calmest of the dog-days. At such times one is apt to wonder if there is any region which this insect could find too warm, or what sort of after-punishment, except that of Dante's frozen Lake of Cocytus, would strike salutary terror into evil-doers among these orthopteran knights of the road! Only when he rises from earth, do we catch glimpses of the hidden gold in his sombre make-up.

Subfamily *Locustinæ* (Spine-breasted Locusts).

(*Acridinæ* of former writers).

Size variable; *prosternum* with a prominent conical spine or tubercle between the front pair of legs; pronotum not extending over the abdomen, its disk without tubercles or wrinkles,

the hind margin broadly rounded but never acute-angled, median carina low and subequal, the lateral carinæ usually rounded or obsolete; wing-covers usually well developed. This large subfamily may be readily distinguished by the presence of the distinct prosternal spine.—In this subfamily are found our most injurious orthopterans, and it is therefore of the greatest interest to agriculturalists. Oviposition takes place in autumn, and winter is passed in the egg stage from which the nymphs emerge in early summer, and July finds the voracious adults abroad until the end of October sees the last of the pests. The amount of damage caused by them is very considerable, and some species deserve to be closely watched, for in favourable seasons they are liable to occur in unexpected swarms. The damage done to Sable Island by *Melanoplus atlantis* a few years ago, is an example which we should keep well in mind, of what devastation these insects can do when they appear in prodigious numbers. The members of this subfamily rarely stridulate, and then only when at rest, by rubbing the serrated lower inner surface of the hind femora against veins on the outer surface of the wing-covers. There is considerable local variation of colour in the species.

#### Group Melanopli.\*

##### KEY TO NOVA SCOTIAN GENERA OF LOCUSTINÆ.

- a. Wing-covers wanting; interval between mesosternal lobes (those between second or middle pair of legs) distinctly broader than long, as broad or nearly as broad as the lobes themselves; prosternal spine short and conical. (Only of hypothetical occurrence in Nova Scotia) . . . [PODISMA, p. 286.]
- aa. Wing-covers present, usually well developed but sometimes short, but never wholly wanting; interval between mesosternal lobes longer than broad (not distinctly transverse).....MELANOPLUS, p. 288.

#### 14. [*Podisma glacialis* (Scudder). Hypothetical occurrence.]

*Description*.—Form of head and body about as in *Melanoplus*. Face slightly oblique; prosternal spine short and truncate; pronotum faintly constricted in middle in male, and with feebly impressed transverse sulci, its hind margin sub-truncate with a broad but very feeble emargination;

\*For an exhaustive account of this group, see S. H. Scudder's Revision of the Orthopteran Group Melanopli (Acrididae) with special reference to North America. Proc. U. S. Nat. Mus., vol. 20, Wash., 1898, pp. 1-421, pls. 1-25. The species in the present paper are arranged according to this revision.

*interval between mesosternal lobes distinctly transverse* (not longer than broad as in *Melanoplus*), as broad or nearly as broad as the lobes themselves; *wing-covers wanting*.

*Colour*.—The sexes differ somewhat in colour. Dark olivaceous green above, greenish-yellow below. Head yellowish-green with greenish streak down face; pronotum yellowish-green (male) or dark olivaceous-green (female), the lateral lobes bright greenish-yellow below, with principal sulcus black and ending below in a small black spot; above with a broad blackish postocular band which passes along head and pronotum, expanding backward, and continued as transverse streaks on abdomen. Abdomen of male black above with a series of yellowish-green spots and a triangular spot of same between middle and hind coxæ; a lateral row of greenish-yellow spots on first eight abdominal segments; beneath yellowish-green. Abdomen of female olivaceous-green. Hind femora yellowish grass-green, broadly but very obscurely bifasciate with olivaceous-green, under surface and lower half of inner surface coral-red, knee black; hind tibiæ green, the spines (8-11 in outer series) black.

*Measurements*.—Male: body, 16 mm.; antennæ, 8.5 mm.; hind femora, 9.2 mm. Female: body, 26 mm.; antennæ, 9 mm.; hind femora, 12 mm.

*Range*.—P. E. Island, Quebec, Sudbury and North Bay in Ont. (variety *canadensis*, etc.), western Maine, northern New Hamp. at high elevations, summit of Greylock in Mass., New York and Penn., usually at high elevations. Canadian Zone.

*Remarks*.—This species has not yet been reported from Nova Scotia by any collector, but it is here inserted hypothetically as it is very possible that it may occur here rarely and at a few special localities, as Bayard Long on 26 Aug. 1912, took a female of the typical race (*P. glacialis glacialis*) in Kings County, Prince Edward Island, at Dundee "east on the Prince Edward Island railway towards Douglas," in a black-spruce swamp (vide E. M. Walker, Can. Ent., 47, p. 341, 1915). It has also been collected in western Maine and northern New Hampshire at high elevations. Long's records for Prince Edward Island and St. Fabien (Quebec) are the first for the typical race in Canada, although the race *canadensis* had been previously reported by Dr. E. M. Walker.

*Podisma* is distinctly a boreal type, and its species are, so far as heretofore known, confined to high altitudes as well as high latitudes, although the elevation of Dundee in Prince Edward Island is only 103 ft. on the railway. If *P. glacialis* is in the future found in Nova Scotia, it would most likely be in the more elevated parts, and should be there searched for. Even if met with, it will doubtless be

rare and local in distribution. Scudder observed it frequenting the branches of the Dwarf Birch (*Betula nana*), and says it is rarely or never seen on the ground. It is hoped that these remarks will lead some of our local collectors to search for it.

KEY TO NOVA SCOTIAN SPECIES OF MELANOPLUS AND OTHERS LIABLE TO OCCUR.

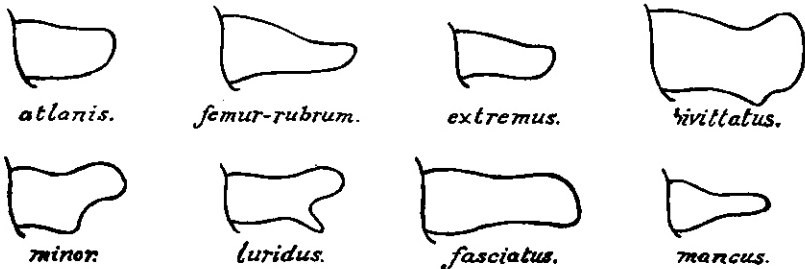
*Males.*

This key refers primarily to males, whose distinctive characters are more pronounced than those of females. As the form of the male cerci, which are to be seen near the end of the abdomen, is an important feature in the separation of species, the student will find it well to refer to the accompanying figure which shows the characteristic forms of those appendages. When the males are distinguished it is much easier to separate the other sex. Females of *femur-rubrum* and *atlanis* present great difficulty in differentiation. The names of species not yet actually reported from Nova Scotia are enclosed in square brackets. A key which is applicable to females follows this one.

- a. Wing-covers (except in female of *extremus*) about as long or longer than abdomen.
  - b. Cerci of male either *equal in breadth or tapering beyond middle*, the tip usually slender or acuminate, never forked.
    - c. Apex of subgenital plate of male with a small but distinct median *notch*; cerci short and nearly equally broad throughout, not longer than twice the breadth at middle. .15. *atlanis*, p. 290.
    - cc. Apex of subgenital plate of male *not notched*; cerci at least three times as long as middle breadth, the apical half sometimes much narrower than basal half (that is, it tapers in form).
    - d. Hind tibiæ bright red; apical half of male cerci much less than half as broad as extreme base..17. *femur-rubrum*, p. 297.
    - dd. Hind tibiæ pale red or yellowish; apical half of male cerci distinctly more than half as broad as extreme base; wing-covers not surpassing hind femora, in male reaching nearly tip of abdomen and in female shorter than abdomen (in short-winged form, sometimes called *M. extremus junius*), or else wing-covers surpassing hind femora (in extralimital long-winged form, sometimes called *M. extremus scandens*).....18. *extremus*, p. 301.



- bb. Cerci of male with *apex more or less expanded*, so as to be broader beyond middle, the tip spatulate or sub-spatulate or forked.
  - f. Size large (male length more than 25 mm.); cerci of male with apical half much enlarged, but *never distinctly forked*; furcula of male small; pronotum with light-coloured (yellow) lateral stripes along margin of disk and continued along wing-covers; hind tibiæ red (yellowish in extra-imital typical *bivittatus*)...19. *bivittatus (femoratus)*, p. 303.
  - ff. Size small (male length less than 20 mm.); cerci of male always *forked*.
    - g. Forks of cerci not very pronounced, the lower fork merely an angle or median process; furcula short slender spines. (Not yet reported from N. S.)..... [*minor*, footnote p. 307.]
    - gg. Forks of cerci nearly equally distinct and very pronounced; furcula minute triangular lobes. (Not yet reported from N. S.)..... [*luridus*, footnote p. 307.]
- aa. Wing-covers much shorter than abdomen.
  - h. Wing-covers covering two-thirds or more of abdomen, lanceolate, the inner edges overlapping; cerci of male slightly expanded at apex, the middle little narrower than base; furcula minute. (Short-winged phase sometimes called *M. fasciatus curtus*. The long-winged phase is very rare.) (Not yet reported from N. S.)... [16. *fasciatus*, p. 296.]
  - hh. Wing-covers shorter than pronotum, sub-ovate; cerci of male slender, length about four times middle breadth, the middle about half width of base; furcula well developed but short. (Not yet reported from N. S.) ..... [*mancus*, footnote p. 307.]



Distinguishing Forms of Cerci of Males of Species of *Melanophus*.  
(Enlarged about 11 times.)

*Females.*

The following key is a modification of that given by Morse. Species not yet actually reported from Nova Scotia are enclosed in square brackets.

- a. Wing-covers much longer than pronotum.
- b. Large, robust; hind femora 15 mm. or more (usually 17 mm.); two distinct yellow stripes on head, pronotum, and wing-covers. . . . .  
19. *bivittatus (femoratus)*, p. 303.
- bb. Smaller; hind femora not over 15 mm.
- c. Dovetailing interspace between mesosternal lobes (between second legs)\* longitudinal or quadrate; wing-covers usually passing hind femora; prozona not swollen.
- d. Prosternal spine nearly cylindrical, its tip bluntly rounded; cerci  $1\frac{1}{2}$  or 2 times as long as their greatest width, sharply pointed, somewhat acuminate, the converging sides slightly concave. . . . . 17. *femur-rubrum*, p. 297.
- dd. Prosternal spine tapering, its tip pointed; cerci shorter, only about  $1\frac{1}{2}$  times as long as their greatest width, rather blunt at tip, the converging sides straight or convex.  
15. *atlanis*, p. 290.
- cc. Dovetailing interspace between mesosternal lobes sub-quadrate or distinctly transverse; wing-covers not passing hind femora; prozona swollen.
- e. Wing-covers about reaching end of hind femora.
- f. Scoop of ovipositor (as seen from side) very short, deeply concave, with a single denticulation or none at base of outer edge; lower valves with tips correspondingly short and decurved; hind tibiæ usually glaucous but sometimes red. . . . .  
[*minor*, footnote p. 307.]
- ff. Scoop of ovipositor rather long and less deeply concave, the outer edge of basal half rather deeply notched, crenulate-denticulate, the tips of both pairs of valves long and evenly tapering; hind femora coral-red. . . . . [*turidus*, footnote p. 307.]
- ee. Wing-covers not reaching end of hind femora, covering about  $\frac{1}{2}$  to  $\frac{3}{4}$  of abdomen (but surpassing hind femora in rarer long-winged form).
- g. Dull grayish brown above, clay-yellow below.  
[16. *fasciatus (curtis)*, p. 296.]
- gg. Dark greenish yellow, tinged with fuscous.  
18. *extremus (junius)*, p. 301.
- aa. Wing-covers shorter than pronotum, sub-oval. . . . . [*mancus*, footnote p. 307.]

15. **Melanoplus atlanis** (Riley). LESSER MIGRATORY LOCUST.

*Melanoplus atlanis*. Piers, Trans. N. S. Inst. Sc., ix, 215 (1896); Halifax, Cow Bay (Hx. Co.), and Sable Island.—Gooderham, Proc. Ent. Soc. N. S. for 1916, 24, 27 (1917); Col., Cum., Kings, Hants, Ann., Digby, Yar., Queens, Piet., Vict., and Inv. Cos.

\*This interspace is a squarish tongue of the metasternum which dovetails forward into the middle posterior part of the mesosternum. It is situated between the second pair of legs.

ingly numerous, as it is liable to at certain periods, it is capable of producing the greatest devastation to grass and other crops. It is very closely allied to the pernicious migratory Rocky Mountain Locust (*M. spretus*) which once produced stupendous damage in the western United States; and next to that species, Scudder says it is the most destructive locust in America. *M. atlantis*, however, is only sub-migratory in habit, but in certain favourable dry seasons may migrate in large numbers and produce great harm. It is in this migratory ability that the danger lies, for it may suddenly appear in large voracious multitudes. *M. femur-rubrum*, on the other hand, is non-migratory. Sufficeit has been said to thoroughly warn agriculturists and economic entomologists to closely watch the Lesser Migratory Locust and to take precautions should it manifest any tendency to increase in numbers in this province. Fortunately on the mainland of Nova Scotia, at least in comparatively recent years, it has not generally occurred in sufficient numbers to do great damage, although the reports as to its abundance about Truro are somewhat disquieting and may indicate that it is the most destructive species in that region. I find as long ago as 7 Sept., 1762, Lieut.-Governor Jonathan Belcher, in a dispatch from Halifax to the Lords of Trade, refers to the loss of crops that year by the drought and grasshoppers, but it is impossible to say what species or different species were responsible for the damage which called for such a report, although I strongly suspect that a sudden increase in the abundance of the present species was the cause.

By far the worst plague of locusts known to us in this region, at least of late years, was the sudden appearance on Sable Island of myriads of *M. atlantis* which from 1891 to 1896 very rapidly devastated that island which is a hundred statute miles off the nearest part of the eastern coast of Nova Scotia.\*

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\*While Sable Island was thus being devastated by *M. atlantis*, that species was quite uncommon about Halifax, where I was able to find but few specimens although hundreds of *M. femur-rubrum* were taken in hope of finding the other species which closely resembles it.

*Description.*—Prosternal spine tapering, tip pointed; wing-covers much longer than abdomen (extending one-fourth or more beyond its tip), and surpassing also the hind femora (and thus relatively longer than in *M. femur-rubrum*); apex of sub-genital plate of male with a distinct, but small, median notch; male cerci short and nearly equally broad throughout, rounded at ends, their length not more than twice the middle breadth (i. e. cerci not tapering as in *M. femur-rubrum*). These characters make it possible to readily separate the males of this species from those of *M. femur-rubrum*, which otherwise it very closely resembles. Females of the two species are very much more difficult to separate, but the tapering pointed-tipped prosternal spine of the present species will distinguish it from *femur-rubrum* which has a cylindrical prosternal spine with a rounded tip.

*Colour.*—Much resembles *M. femur-rubrum*. Nova Scotian specimens: Variable; upper parts dark grayish brown (sometimes slightly reddish), under surface of abdomen yellowish; face light sage-green; mouth whitish; a blackish band extending behind the eye on the front lateral part of pronotum and sometimes broken up into small spots, especially in females; wing-covers grayish-brown, distinctly sprinkled with fuscous along the median area; hind femora dirty yellowish-brown or slightly reddish-yellow, with two oblique blackish bars across the upper and outer faces (these bars usually more distinct than in *M. femur-rubrum*); hind tibiæ dull burnt-carmine. (It will be seen that colour alone will not much assist the beginner in differentiating it from *M. femur-rubrum*, and the difference in the structural characters given above should be solely relied upon.)

*Measurements.*—Male: body, 17-21 mm.; antennæ, 6.5-9 mm.; pronotum, 4-5 mm.; wing-covers, 15-21 mm.; hind femora, 10-13 mm.; hind tibiæ, 8-9 mm. Nova Scotian male, 18 Oct., 1917: body, 18 mm.; antennæ, 6.5 mm.; pronotum, 4.1 mm.; wing-covers, 16 mm.; hind femora, 10.2 mm.; hind tibiæ, 8 mm. Female: body, 16-27 mm.; antennæ, 7-8 mm.; pronotum, 5.5 mm.; wing-covers, 15-22 mm.; hind femora, 10-14 mm. (The relatively longer wings of this species will be noticed in comparison with *M. femur-rubrum*.)

*Range.*—Most of Canada and United States, into central Mexico: from Sable Island (N. S.), Nova Scotia, P. E. Island, New Bruns., Magdalen Islds., Que., Ont., Man., Alb., Br. Col., and Alaska (Yukon River), south to Georg., Louisiana, central Mex., Ariz., Nev., and Northern Calif. In the east it occurs north to about lat. 50° (exclusive of Nfld.), and on the Pacific to about lat. 62°. It thus is found from the Canadian to the upper parts of the Lower Austral Zone—a range closely approximating to that of *M. femur-rubrum*. It is abundant everywhere in New Eng. and is sometimes destructive there. Has not been found in Newfoundland.

*Occurrence in Nova Scotia.*—This species was not separated from *M. femur-rubrum* by Riley until 1875, so that any record prior to that may refer to either species. It was first reported from Nova Scotia by Dr. Scudder in 1894 (Rept. Ent. Soc. Ont., 26, p. 64).

This destructive species is apparently rather uncommon about Halifax, being generally very much less numerous than the closely-related *M. femur-rubrum*; whereas in some other parts of the province, as about Truro, it is very abund-

ant. In some years favourable for its rapid multiplication, it has been excessively numerous in certain localities, as for example the notable onslaught in vast hordes which it made on Sable Island, N. S., from 1891 to 1896. Besides my own specimens from Sable Island and about Halifax, *atlanis* has been collected in Inverness, Victoria, Pictou, Cumberland, Colchester, Hants, Annapolis, Digby, Yarmouth and Queens Counties, by C. B. Gooderham, W. H. Whitehead, E. C. Allen and others. It thus occurs throughout the entire province. In Prince Edward Island Mr. Long obtained 39 specimens from ten localities although he only reports six specimens of *M. femur-rubrum*, which would lead one to think it is the more numerous species in that province.

This species (*atlanis*) prefers open grassland in relatively dry situations, and is therefore usually most frequently met on impoverished upland localities (such for example as Camp Hill at Halifax), and it occurs in lesser numbers in the bottoms where the conditions permit the formation of dry grasslands. I have, however, taken it in such a wet boggy locality as the West Marsh, Lawrencetown, Hx. Co., on 26 Oct., 1897. Not unfrequently it is found in company with *M. femur-rubrum*. Supt. R. J. Boutillier states that the young of *atlanis* were observed on Sable Island, N. S., by 28 May, 1896, and that they were a month later than in 1895; but I have never noted them so very early about Halifax. Adults are met with from about the first part of July in some localities, to the latter part of October. The earliest noted at Truro were taken on 30 June and 9 July, 1914; and the latest occurrence, at Lawrencetown, Hx. Co., was on 26 Oct., 1897, a lovely fine day. So far as known, it and *M. femur-rubrum* are found as adults earlier than any other species of our native Orthoptera exclusive of the hibernating Grouse Locusts (*Acrydiinae*).

*M. atlanis* is an insect of most destructive possibilities and should be very closely watched, for if it becomes exceed-

The earlier stages of this inroad were fully described by me in my paper of 1896 (Trans. N. S. Inst. Sc., ix, 216-218). Up to about 1891 the superintendent of the island had neither seen nor heard of any locusts whatever upon that isolated place. In that year, however, they suddenly made their appearance, having without doubt flown from the mainland, a distance, as has been said, of a hundred miles or more, their powers of flight being great and the prevailing southwest wind no doubt assisting them in their long journey. Their numbers very soon increased at a most alarming rate, the summer of 1892 being a dry one.\* So destructive did they become by vigorously attacking the grass, that in 1894 which was the driest season on record, only one load of hay could be cut where fourteen had previously been harvested. It was said they devoured the grass near the root. This was a most serious matter, for if the grass should disappear, nothing could prevent the wind from rapidly shifting the sand of which the island is entirely formed, and this would ultimately result, unless extraordinary and costly preventive measures were taken, in that oceanic sandbank disappearing beneath the sea, causing an already dangerous spot to become vastly more perilous to shipping. In 1895 the insects were more abundant than ever, particularly on the western parts, and destroyed the gardens as well as the cultivated and wild grass, and hay had to be imported to support the herds of wild ponies, while more of the latter had to be sent to the mainland to reduce the stock which required feeding. The locusts were swept up in bucketsful from the doorsteps, and they even entered a room and destroyed portions of a cotton window-blind. Many had disappeared for the season by 12 Oct., 1895, and a letter dated 10 Nov. stated they were by that time all dead, although in 1894 they survived very

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\*In 1888 the precipitation in July, Aug., and Sept. was above normal; in 1889 the same months were dry, it being a very dry year altogether; in 1890 July was below normal, and Aug. and Sept. above normal; in 1891 July was above normal and Aug. and Sept. below; 1892 was dry in July and Sept. and somewhat wet in Aug.; in 1893 the three months were wet; in 1894 they were very dry, it being an excessively dry year; 1895 was fairly wet, and 1896 was excessively wet.

cold weather if not frost. An examination of very large numbers of the locusts sent me in November, 1895, proved that *M. allanis* was the sole species represented on the island and the specimens were mostly females.

In a letter dated 28 May, 1896, the superintendent of the island informed me that "the locusts are with us again, but are a month later than last year (1895). The season, however, is that much later, very cold and backward, and vegetation greatly retarded. The young have appeared as yet only at the east end of the island, whereas they were much more plentiful at the west end last year." On 11 June, 1896, the young locusts appeared in millions, following a warm spell of weather, and the prospect seemed very bad as no method had been adopted to keep them in check. Most providentially, however, the year 1896 turned out to be as excessively wet as 1894 had been excessively dry, and the mild weather was succeeded by a fortnight of cold rains which destroyed the young insects, and they thus disappeared even more suddenly than they had appeared in 1891. Since 1896 no locusts have been seen on the island, much to the relief of the authorities in charge of the establishment there, among whom the plague had naturally created great consternation. Such an inroad, however, is quite liable to re-occur under similar conditions, and possibly the *deus ex machina*, in the guise of bad weather, may not then providentially interpose to end the menace before irretrievable damage is done.

I am aware of no such plague on the mainland of Nova Scotia, but there is no reason why a similar one should not occur here at any time, under the necessary favourable conditions, although the natural enemies of such insects are more likely to be met with on the mainland than on an isolated spot such as Sable Island where locusts had not previously been reported. Belcher's reference to the destruction of crops by locusts in 1762, which has been mentioned,

may refer to a somewhat similar increase in numbers in Nova Scotia proper. There can be no doubt that this species, wherever found, must be watched as a suspected hereditary criminal, whose latent destructive propensities may break forth whenever conditions are favorable for abnormal multiplication, whereby it is endowed with immense collective power for ill-doing.

As to preventive measures, Somes (Acridiidae of Minnesota, 1914) recommends as a real cure for these pests a thorough method of cultivation of the land, with a rotation system in which a thoroughly cultivated crop shall always follow cereals; although temporary relief may be obtained by spraying with sodium-arsenite, and the use of hopper-dozers. No doubt the poison bait and deep ploughing as recommended under *M. femur-rubrum* would be better suited to conditions in Nova Scotia.

16. [*Melanoplus fasciatus* (Barnston-Walker). Hypothetical occurrence.]

*Description*.—Size medium. Wing-covers in the usual short-winged form (sometimes called *curtus*) much shorter (length about 10 mm.) than the abdomen (covering about three-fourths in male, and about one-half in female) and from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  times as long as the pronotum, their form lanceolate, the inner edges overlapping. Subgenital plate of male distinctly narrower than long, its extremity strongly elevated; cerci of male nearly straight, slightly expanded at apex, the middle but little narrower than extreme base; furcula of male short, no longer than last abdominal segment to which it is attached.

*Colour*.—Variable; dark reddish-brown to dark olivaceous-gray or grayish-brown, the male darker; below yellow. A well-marked blackish band from behind eye along upper part of side of anterior part (prozona) of pronotum. Wing-covers reddish-brown, often with a few small dark spots on median area. Hind femora brownish-yellow, the outer face with two broad, oblique, blackish bars, the lower face reddish, knees black; hind tibiæ red or greenish, paler near base, spines black.

*Measurements*.—Male: body, 16-19 mm.; antennæ, 8-9 mm.; pronotum, 4.5 mm.; wing-covers, 7.5-10 mm. (form *curtus*); hind femora, 10 mm. Female: body, 17-25 mm.; antennæ, 7-8 mm.; pronotum, 5mm.; wing-covers, 8-12 mm. (form *curtus*); hind femora, 11-15 mm. In the very rare long-winged form, *volaticus*, the wing-covers measure about 17 mm. In the Magdalen Islands, Dr. E. M. Walker (B. Long coll.) reports large specimens, the males of which vary in length of body from 19-23 mm.; wing-covers, 11-14 mm.; hind femora, 11.5-12.5 mm.; and the females, body, 24.5-28.5 mm.; wing-covers, 6.5-19.5 mm.; hind femora, 12.5-13.5 mm. The Newfoundland specimens are also very robust for the species, and do not show the brilliant type of coloration sometimes found.



*Range.*—Canada and northern half of United States from Atlantic to Pacific: from Bay St. George (Nfld.), Nain (Labrador), Anticosti, Magdalen Islds., P. E. Island, Ont., Man., Sask., Alb., and perhaps Alaska, south to New Jers., northern Ind., Iowa, Nebr., Mont., and Wash. Terr. It is thus distributed from the southern portion of the Hudsonian Zone to the high northernmost portion of the Upper Austral.

*Remarks.*—Although this distinctly northern form has not yet been reported from Nova Scotia, there can be no doubt whatever that it will be found here and I do not hesitate to insert it hypothetically in our list. It should be looked for among low bushes in sandy districts. Bayard Long obtained five specimens of the short-winged form at Dundee and West River, Bothwell, Prince Edward Island, late in August, 1912 (E. M. Walker, Can. Ent., 47, p. 341, 1915), and it has been reported from Bay St. George in Newfoundland (M. Hebard, 1915) and Labrador, while it is common throughout New England. The Prince Edward Island and Newfoundland specimens were all of the short-winged form, sometimes called *M. fasciatus curtus* Scudder (1879), which is the form which should occur here. The very rare long-winged form sometimes known as *M. fasciatus volaticus* Scudder, in which the wing-covers are broad and far surpass the hind femora (length 17 mm.), has hitherto only been known from Michigan, although Dr. E. M. Walker has lately reported it from Alright Island in the Magdalen Islands (Can. Ent., 47, p. 342, 1915).

17. **Melanoplus femur-rubrum** (De Geer). RED-LEGGED LOCUST.

*Caloptenus femur-rubrum.* F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 678 (1870); Nova Scotia, etc.—Do., Can. Ent., iv, 30 (1872); Nova Scotia, etc.

*Melanoplus femur-rubrum.* Piers, Trans. N. S. Inst. Sc., ix, 215 (1896); Halifax and Windsor, N. S.—Gooderham, Proc. Ent. Soc. N. S. for 1916, 24, 27 (1917); Col., Cum., Kings, Hants, Ann., Digby, Yar., Queens, Pict., Vict., and Inver. Cos.

*Description*.—Prosternal spine nearly cylindrical, the tip bluntly rounded; wing-covers somewhat longer than abdomen, slightly surpassing tip of hind femora; apex of subgenital plate entire (not notched); male cerci at least three times as long as its middle breadth, the apical half less than half as broad as its extreme base (i. e., cerci broad at base and markedly tapering at end).

*Colour*.—Nova Scotian specimens. Variable; usually brownish above; tea-green (greenish olive-gray) or olivaceous on front and sides of head and thorax; sides and under surface of abdomen mostly dirty cream-white or grayish; a yellowish line on side of thorax from insertion of wing-cover to insertion of hind leg; a broad black bar extends from eye backward onto lateral front part of pronotum, often inconspicuous in female. Wing-covers hair-brown to broccoli-brown, usually very obscurely spotted with fuscous along basal half of median area. Hind femora raw-umber brown, clouded with dark fuscous which usually forms two oblique bars on upper edge; lower edge yellowish with pale poppy-red on outer part of edge; knee black. Hind tibiæ almost always poppy-red; spines black. Occasionally a specimen is found whose general colour is yellowish olive-buff, and the markings much paler than in normal specimens.

*Measurements*.—Male: body, 16-23 mm.; antennæ, 7-10 mm.; pronotum, 4.5 mm.; wing-covers, 13-20 mm.; hind femora, 11-13 mm. Nova Scotian males, 21-28 Oct., 1917: body, 20-21 mm.; antennæ, 8-9 mm.; pronotum, 4.3 mm.; wing-covers, 16-16.5 mm.; hind femora, 11 mm.; hind tibiæ, 9-9.5 mm. Female: body, 18-28 mm.; antennæ, 7-9 mm.; pronotum, 5 mm.; wing-covers, 16-23 mm.; hind femora, 11-15 mm.

*Range*.—This very common species ranges over most of Canada and the United States into central Mexico: from P. E. Island, Nova Scotia, New Bruns., Que., Ont., Man., and Br. Columbia, south to N. Car., Tenn., Miss., Texas, central Mexico, Ariz., Nev., and southern Calif. It thus occurs from the Canadian to the upper part of the Lower Austral Zone—a very extensive range which is also about that of *M. atlantis*. It is exceedingly abundant everywhere in New Eng. It has not been found in Newfoundland.

*Occurrence in Nova Scotia*.—The Red-legged Locust was first reported from Nova Scotia by F. Walker in 1870, from specimens collected no doubt by Lieut. Redman, probably about 1821. Although at that time *M. atlantis* had not been differentiated from it, yet the greater abundance of *M. femur-rubrum* about Halifax makes it fairly clear that the latter species was referred to.

This species is excessively abundant about Halifax, where it is probably our most common orthopteran exclusive of the Crickets; and it is more or less common elsewhere throughout the province. It has been observed by C. B. Gooderham, myself and others in Inverness, Victoria, Pictou, Cumberland, Colchester, Hants, Halifax, Kings, Annapolis, Digby, Yarmouth and Queens Counties, and I think I have

also taken it in Lunenburg County. About Truro, Col. Co., Gooderham reports it as common, whereas he says *M. atlantis* is there more abundant, the conditions being the reverse of those about Halifax. It is found in large numbers in pastures and meadows, where it scatters in all directions from the feet of a passer-by; and also along roadsides. It avoids dense herbaceous thickets and woodland, and favours open grasslands and clover fields, and very often such as are quite dry. Large numbers seen about short sparsely-bladed grass, suggest that they have destroyed the herbage in such cases. About Windsor, Hants Co. and Kentville, Kings Co., I have observed it on the diked meadows. When disturbed it either hops away or else flies swiftly and noselessly ahead for some distance and then drops to the grass again.

It occurs in the perfect state from the first to the latter part of July, according to locality (7 July, 1915, and 9 July, 1914, Truro; 31 July, 1917, Hubbards), until about 24 October (20 Oct., 1895, 24 Oct., 1897, and several 28 Oct., 1917 Halifax), although in October, particularly in the latter part, it is much less frequently seen. Its last appearance is a month after the first hoar-frost which usually occurs throughout the province about 20 September, and a little after the first hard frost which generally occurs about 16 October. Thus hard frosts soon terminate its existence. It, *M. atlantis*, *M. extremus*, and *Chorthippus curtipennis*, are the earliest of our species to be met with in the adult state, exclusive of the hibernating Grouse Locusts (*Acrydiinæ*).

This species, like the closely related *M. atlantis*, is one of the most destructive locusts in Nova Scotia. About Halifax, because of its predominate numbers, it is probably the one which does the most damage in our fields; whereas in the western part of the province, the sub-migratory *atlantis*, owing to its reported prevalence there, would be entitled to that unenviable reputation. The capabilities of *atlantis* to do injury are probably the greater. The onslaught on

*scandens*); hind femora, 10 mm. Female: body, 19-28 mm.; pronotum, 5 mm.; wing-covers, about 11 mm. (*M. e. junius*) to about 17 mm. (*M. e. scandens*); hind femora, about 11mm. (Short-winged specimens of extremely large size, males with bodies up to 24 mm., and females up to 28 mm., with corresponding increase in size of wing-covers, hind femora, etc., have been lately recorded by Dr. E. M. Walker from the Magdalen Islands. Northern specimens of this species are distinctly larger than more southern ones.)

*Range.*—*M. extremus* in either its short or long-winged form or both ranges over the larger part of Canada and northernmost United States: from P. E. Island (both short- and long-winged forms), Nova Scotia (short-winged form), New Bruns. (short-winged form), Magdalen Islds. (short-winged form,) Bic (Quebec, both forms), Alb. Gt. Bear Lake (about lat. 65°), and Alaska (lat. 66° 30'), south to Mass., Ind., Ill., Iowa, Neb., and Wyom. It is confined more or less to the Hudsonian, Canadian, and Transition Zones, ranging further north in the west than in the east. In the northern half of New England it is common, and reaches the summits of the highest mountains.

*Occurrence in Nova Scotia.*—Only the short-winged form (sometimes called *M. extremus junius* Dodge) has so far been detected in Nova Scotia, although the long-winged one should also occur and no doubt will yet be met with. The species has not before been reported from this province, and the credit of adding it to our list belongs to C. B. Gooderham who collected three short-winged females at Truro, Col. Co., on 28 July, 1913, and 5 July, 1914, their determination being verified by Dr. E. M. Walker of Toronto. He also reports a female taken by G. F. Collingwood in Kings County, N. S., but when received it had no precise data as to exact place where captured or date. He likewise has a short-winged female collected at Hillsboro, in the neighbouring province of New Brunswick, on 8 Aug., 1913, by Miss V. L. Tarris, from which province it has also not previously been reported. He considers it rare about Truro, and I have never noted it about Halifax. From its known range, this boreal species was to have been expected to occur here, as B. Long had taken three specimens in Prince Edward Island in the summer of 1912, namely a short- (*junius*) and a long-winged (*scandens*) male at Souris, and a short-winged female at Southport (E. M. Walker, Can. Ent., 47, p. 342, 1915). The long-winged form is probably more frequently met with at high elevations as well as high latitudes.

Sable Island is an illustration of what havoc the latter species is capable of doing. Were it possible to calculate the damage done by these two locusts, we would be somewhat astounded. I do not believe, however, that any of our species do quite as much injury as in more southern regions, possibly owing to the comparative severity of some of our winters which is apt to destroy many eggs. Even under favourable conditions for their increase, they are so subject to the attack of parasites and other enemies, as well as the influence of various climatic changes, that their natural increase is restricted. Were it otherwise we would have to regard some of the locusts as a very much more serious pest than they are in Nova Scotia. In the case of *femur-rubrum* it is also fortunate that the species is not a migratory one, whereas *M. atlantis* is sub-migratory. M. P. Somes, however, has observed in Minnesota (Acridiidae of Minn., Bulletin 141, Agric. Exp. Station, Minn., p. 85, 1914) that during dry summers the majority of specimens of *M. femur-rubrum* had longer wing-covers than normal, and in many cases fully as long, relatively, as in *M. atlantis*, accompanied with an instinctive inclination for more extended flights late in the summer; which led him to wonder if a prolonged series of dry seasons might not produce a more nearly migratory form in these two species, especially in the case of *M. atlantis* which would then become almost identical in this respect with the very destructive Rocky Mountain Locust, *M. spretus*, which in the past has done millions of dollars worth of damage in the western United States.

As to remedial measures, ploughing to a depth of at least six inches in late autumn or very early spring, will more deeply bury many of the egg-pods and so prevent the young escaping to the surface in the spring. The following poisoned bait has been successfully employed in eastern Canada, but should be used with caution on pastures where cattle feed or where fowls are apt to roam: Poisoned Bran,—bran, 20

lbs.; Paris green or white arsenic, 1 lb.; molasses, 2 quarts; the juice and finely cut-up pulp and peel of 3 oranges or lemons; water, 3½ gals. The bran and arsenic are thoroughly mixed while dry, while the orange juice, molasses and water are mixed separately and then added to the bran and poison mixture so as to dampen it thoroughly. It is then sown broadcast and very thinly over the infested area early in the morning. The amount given above will cover five acres. It should be applied co-operatively, at the same time, by the farmers of a district in order to be really effective. The cost is about 20 cents an acre at the price of ingredients in 1914, but just now would be considerably more.

This species, like *M. bivittatus*, is attacked by a coral-red parasite, which is doubtless the Red Locust-mite, *Trombidium locustarum* Riley, which attaches itself to the insect beneath the base of the wings. A specimen taken at Hubbards, Hx. Co., 31 July, 1917, had six or seven of these parasites upon it.

18. **Melanoplus extremus** (F. Walker). (Short-winged form.)

*Melanoplus extremus*. Gooderham, Proc. Ent. Soc. N. S. for 1916, 24, 27 (1917); Col. and Kings Cos.

*Description*.—Wing-covers either (a) not reaching tips of hind femora, being about 11 mm. long, and reaching about end of abdomen in male and covering usually from half to three-quarters of abdomen in female, bluntly subacuminate at apex (short-winged form sometimes called *M. extremus junius* Dodge), or (b) wing-covers surpassing tips of hind femora, generally considerably, being about 17 mm. long, and rather broadly rounded at apex (long-winged form, sometimes called *M. extremus scandens* Scudder). In the former the wings are considerably shorter than the wing-covers, and in the latter form they are very little shorter than those members. Apex of subgenital plate in male without a median notch; cerci of male short and broad, the apical half distinctly more than half as broad as the extreme base, gently curved, well rounded at tip; furcula a pair of parallel, tapering, cylindrical spines, about half as long as supra-anal plate.

*Colour*.—Dark greenish-yellow, more or less fuscous. A black bar from behind eye and along anterior part (prozona) of sides of pronotum; pronotum olive-brown above, greenish-yellow on sides. Wing-covers olive-brown, sometimes with a few dark spots on median area. Hind femora yellowish tinged with red-brown, lower face usually light orange, knees darkish; hind tibiae reddish or yellowish, with black spines.

*Measurements*.—Male: body, 16-24 mm.; antennæ, 8-9 mm.; pronotum, 4 mm.; wing-covers, about 11 mm. (*M. e. junius*) to about 16 mm. (*M. e.*

19. *Melanoplus bivittatus* (Say). YELLOW-STRIPED LOCUST.  
(Red-legged phase, sometimes called *M. bivittatus femoratus* (Burmeister)).

*Caloptenus bivittatus*. F. Walker, Cat. Derm. Salt. Brit. Mus., iv, 678 (1870); Nova Scotia, etc.—Do., Can. Ent., iv, 30 (1872); Nova Scotia, etc.

*Melanoplus femoratus*. Piers, Trans. N. S. Inst. Sc., ix, 218 (1896); Halifax Co.

*Melanoplus bivittatus* Gooderham, Proc. Ent. Soc. N. S. for 1916, 24, 27 (1917); Col., Kings, Hants. Ann., Yar., Queens. Vict., and Inver. Cos.

*Description*.—Our largest species of *Melanoplus*. Wing-covers reaching or a little surpassing the hind femora, sometimes a little shorter in female. *Cerci* of male large, wide, with the apical half much expanded, but not forked, somewhat boot-shaped with wide "toe" and a distinct, but somewhat small, protuberant "heel"; furcula short, swollen, triangular.

*Colour*.—Nova Scotian specimens (red-legged phase). The very distinctive colouring of this familiar locust makes it impossible to confuse it with any other species found here. General colour above bright apple-green (but occasionally grayish olive-green); under parts yellowish. Antennæ reddish-brown; mouth straw-yellow (occasionally pale clay-colour); eyes brown. A very distinct sulphur-yellow (occasionally paler Naples-yellow) line extends on each side from upper part of eye along lateral angle of pronotum and thence, as a less pure yellow (maize-yellow or buff) line, along the anal vein of the wing-cover to near the latter's extremity; this stripe bordered below by a wider, almost black band on head behind eye and on upper side of pronotum, being widest on front part of latter. A diagonal sulphur-yellow stripe on side of metathorax from insertion of wing-cover to insertion of hind leg. Wing-covers hair-brown, sometimes blacker; hind-wings transparent with veins mostly brownish. Hind femora greenish-black on upper half of outer face, extending to knee where it is darkest; outer face margined with yellow (occasionally pale buff); upper inner margin with three black-spots or short bars; a black ring near knee. Hind tibiæ poppy-red or nopal-red (intermediate between vermilion and carmine), dusky at base; spines black; hind feet red. (In the extralimital colour variant, *M. b. bivittatus* of Say, the hind tibiæ are purplish or green basally, and yellow, very rarely reddish, apically).—Colour from 3 males and 3 females, just captured among meadow-sweet (*Spiræa latifolia*) and grass, near Willow Park, Halifax, N. S., 17 Aug., 1895. Only one of these, a female, taken with the others, showed the more olivaceous and less striking colours noted above as occasionally occurring. All had bright red hind tibiæ.

*Measurements*.—Three males and three females, Halifax, 17 Aug., 1895. Male: body, 26.5-28 (average 27) mm.; antennæ, 13 mm.; wing-covers, 18.5-21.2 (average 19.4) mm.; wing-covers extend beyond body, 0-2.5 (average 1.2) mm.; hind femora, 14-15.2 (average 14.5) mm.; hind tibiæ, 11.5 mm. Female: body, 31-35 (average 33) mm.; antennæ, 11.5 mm.; wing-covers, 19.7-21.5 (average 20.7) mm.; wing-covers short of end of body, .7-5.5 (average 3) mm.; hind femora, 15.2-18.7 (average 17) mm.; hind tibiæ, 13-15 (average

14.2) mm. I have taken females which have measured 40 mm. in total length, and probably still longer ones can be met with.

*Range.*—*Melanoplus bivittatus* ranges generally from near Hudson Bay to N. Car. and Calif., and from the Atlantic to the Pacific.—The red-legged phase (*M. b. femoratus*) which is said to be a seaboard and northern colour-phase, occurs from Newfoundland (Port aux Basques, Hebard), P. E. Isld., Nova Scotia, Quebec, Ont., Man., and Br. Columbia, south through New Eng. to N. Car., Ind., Ill., Colo., and Calif., it being the only variant found along the Atlantic seaboard and the Pacific slope south of Washington. This phase therefore ranges from the Canadian (or a little beyond) to probably the upper Austral Zone.—The typical phase (*M. b. bivittatus*) is of interior distribution, ranging probably from southern-central and western Canada to the Gulf of Mexico, being unknown on the Atlantic seaboard and the Pacific coast south of Washington. The ranges of the two forms therefore overlap in the central region of the continent.

*Remarks.*—The late Dr. Scudder always held that *femoratus* was specifically distinct from *bivittatus*, contending that the former is a seaboard and northern species, while the latter is an interior one, the ranges of the two overlapping in the central areas, and he so treated them as distinct in his exhaustive "Revision of the Melanopli" (Proc. U. S. Nat. Mus., 20, 1898) for reasons there stated. He continued to maintain this, I think, until the last, *M. femoratus* appearing as a separate species in his "Catalogue of Described Orthoptera" (1901). Blatchley of Indiana (1903), Walden of Connecticut (1911), Somes of Minnesota (1914), and many others, particularly those of the central portions where the two ranges overlap, consider them to be but trivial colour-phases of the same species, the differences being of little diagnostic value. While going with recent opinion in this, we may for the present retain the name *femoratus* as a mere varietal appellation conveniently indicating the colour variant which is found here.

*Occurrence in Nova Scotia.*—The very well known Red-legged Yellow-striped Locust, one of our largest orthopterans, was first reported from Nova Scotia, as *Caloptenus bivittatus*, by F. Walker of the British Museum in 1870, no doubt from specimens collected about 1821 by Lieut. Redman (Cat. Derm. Salt., 4, p. 678).

Only the colour-phase *femoratus*, with bright red tibiae, is found here. All specimens in the collection of the Agricultural College, Truro, have bright coral-red tibiae except one in which they are black passing into bright red less than half-way down, and this may be owing to discoloration after being placed in the cabinet. Mr. Gooderham says his examples from Colchester, Annapolis and Yarmouth Counties all have red or purplish tibiae. All the specimens I have observed about Halifax, also have these members red, as well as others I have seen from Hants, Kings, and Yarmouth



Counties. So likewise had those taken in Prince Edward Island and at Moncton, N. B., by B. Long in 1912.

This form is very common throughout the entire province, but varies somewhat in abundance according to the climatic condition of the seasons, being some years less abundant than in others. It has been taken by Gooderham, myself and others in the following counties: Inverness, Victoria, Colchester, Hants, Halifax, Kings, Annapolis, Yarmouth, and Queens, and I think I have also observed it in Pictou and Lunenburg Counties. As it is common in the vicinity of dwellings, it is well known by sight to residents in rural districts, although strange to say I have never heard a distinctive common-name applied to it here, except the indefinite general term "grasshopper" which it shares with all other related species. It may, however, be considered "the grasshopper" of most country children's vocabulary; and is usually the one referred to when the descriptive designation "molasses bug" is once in a while used by the little generation, for a reason which we will refer to later.

It occurs in long grass in meadows, being frequently seen among the swaths at haying time, but leaves the open meadow after the grass is cut, and then frequents the uncultivated borders. It is very fond of the rank succulent vegetation which flourishes on the margins of fields, and frequents the vicinity of the Wrinkle-leaved Goldenrod (*Solidago rugosa*), and at times seems partial to Meadowsweet (*Spiræa latifolia*). Very many have been observed early in September on the Low Blackberry or Dewberry (*Rubus canadensis*). I have also frequently observed it in marshy grass. Large numbers were seen in the middle of October about a variety of herbage on the borders of Stanford's Pond, Halifax, then dried up. When abundant it occasionally enters gardens and attacks their contents. On being disturbed it tries to escape by hopping, seldom taking to flight, and is generally a very clumsy and rather slothful species. Its

appearance and movements have a lack of elegance which makes it less attractive than many of our locusts, although it is decisively and somewhat handsomely bedecked with colours.

It hatches in the latter part of June, as I have collected the green-coloured nymphs, about 9 mm. long, in the second stage, before the appearance of the wing-pads, on 1st July, 1917, in grass at the head of the North West Arm, Halifax, and others 14 mm. long, in about the fourth stage with wing-pads 2 mm. long, at the same place on 8th July. Adults are noted from about the latter part of July (22 July, Truro; 1 Aug. '17, Hubbards, Hx. Co.) until toward the end of October (20 Oct. '95; 26 Oct. '97, 27 Oct. '17, Halifax). The first hard frosts which begin to occur about the 16 Oct. soon put an end to any but lingering stragglers, although an occasional individual may possibly considerably prolong its existence by getting into some warm crevice about a barn to reappear under the influence of a warm day. It seems to be a silent species.

No doubt this locust does very considerable damage in the aggregate in Nova Scotia, more particularly to hay-crops; but so far it does not seem to have called loudly for repression. Next, however, to *M. femur-rubrum* and *M. atlantis*, and the Crickets, it is one of the most destructive species of Orthoptera we have as far as grass, grain, and other cultivated crops are concerned; and with them it deserves watching. After a series of favourable dry seasons, which have permitted it, as well as other species, to increase rapidly, it becomes most numerous and occasions much loss; but then there usually follows a period when it dwindles much in numbers from natural causes; so that it is only occasionally the farmer views it with much concern. It is said to be subject to the attack of a fungi in wet seasons, as well as other parasites, besides various vertebrate enemies. In the middle of August, 1895, and on other occasions, I have collected

specimens with from two to a dozen minute, egg-shaped, coral-red parasites about half of a millimeter in length, beneath the base of the hind wings. These were doubtless the Red Locust-mite, *Trombidium locustarum* of Riley.

Near the mouth opening of insects are salivary glands which in the *Acrididæ* usually secrete a brown-coloured fluid, which is also probably defensive in character as many species when captured very readily exude it from the mouth. This is particularly noticeable in the present species, and country children have everywhere given the dark-coloured secretion the name of "grasshopper molasses" and to the insect itself they occasionally apply the name "molasses bug". This species is often captured by Nova Scotian children for the sole purpose of seeing it exude the fluid, their invariable saying on such an occasion being, "Grasshopper, grasshopper, give me some molasses and I'll let you go." It is also known to many children as a doughty fighter, boys often amusing themselves by bringing two large specimens together so that they wrestle vigorously with their front legs and endeavour to bite each other. These gay-coloured locusts bring back childish memories of half-forgotten summer days when we dallied waist-deep in the lush timothy, the air filled with what might be termed the "green" scent of trampled grass; or of afternoons in early autumn when we loafed about the rank vegetation of fence-rows with its odour of dank decay.\*

\*The following *Melanoplæ* are more or less abundant in northern New England, and one or two of them may be taken here:—

*Melanoplus manicus* (Smith) occurs locally in elevated (2,000 to 3,500 ft.) localities in Maine, New Hamp., and Conn., etc.; but has not been taken in Canada. Wing-covers shorter than pronotum, and subovate. Male cerci slender, clasp-like, about four times as long as middle breadth, the middle breadth less than half of extreme basal breadth. General colour fuscous. Length, male 14-17 mm.; female, 18-25 mm.

*Melanoplus minor* (Scudder) is common in New England north to Maine, and has been taken in Ont. and Sask., and we should expect it here. Wing-covers reach the knee. Male cerci with apex expanded and somewhat forked, the lower branch of fork merely an angle or median projection on the lower edge. General colour brownish, yellowish below; black bar behind eye; hind femora brownish-yellow with indistinct darker bars, their lower face generally orange. Length, male, 15-18 mm.; female, 19-24 mm.

*Melanoplus luridus* (Dodge) = *M. collinus* Scudder. Blatchley has shown that these names are synonymous, or the later merely varietal. Scudder reported *M. collinus* as common in New England north to Maine, and Walker found it in Ont. Wing-covers reach, or slightly surpass, the knees. Male cerci expanded at apex and very distinctly forked. In colour and appearance it resembles *M. femur-rubrum*, but wing-covers are much shorter, and the forked cerci distinguish it immediately. Length, male, 17-20 mm.; female, 20-27 mm.

Family TETTIGONIDÆ (Long-horned Grasshoppers,  
Katydids, Camel Crickets, etc.)

(*Locustidæ* of former writers.)

This family is easily separated from the *Acrididæ* by the long bristle-shaped antennæ, which are much longer than the body, and the long ovipositor of the female; while from the *Gryllidæ* it is distinguished by the four-jointed tarsi and the sloping sides of the wing-cover which meet in an acute ridge above. The ovipositor forms a strongly compressed, elongated, generally sword-shaped blade, the tip not expanded. The stridulating or calling organs of the male, when present in the winged species\*, are situated just behind the pronotum, at the base of the sub-triangular overlapping dorsal area of the wing-covers, and usually consist of a transparent resonant membrane of somewhat rounded form, crossed by a prominent curved vein which on its under side bears a row of minute file-like teeth. In stridulating, the wing-covers are parted and then brought together again, thus rasping these teeth over a vein on the upper surface of the under wing-cover, and so producing the loud strident call which is such a typical nocturnal sound in the country. These notes differ in different species, and somewhat resemble the word "katydid" in the true Katydid, *Cyrtophyllus perspicillatus*, which does not occur in this province. In our own species, however, the note has no resemblance whatever to that sound. The mandibles are well developed, which enables the insect to dig into plant tissue and eat grass seeds as many of them do; and being greedy feeders they produce considerable damage to vegetation, but fortunately mostly of the uncultivated kinds. The manner of oviposition differs in the various subfamilies: in the *Phaneropterinæ*, which are arboreal, the eggs are usually attached in double rows to the exterior of small twigs, or are inserted in the edges of leaves, and the ovipositor is

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\*The Stone Crickets (*Stenopelmatus*) are wingless and therefore silent.

broad, curved and blunt; in the *Conocephalinæ*, which are mostly terrestrial, the eggs are deposited by a piercer-like ovipositor between the stems and root-leaves of grass or in the pith of twigs, etc.; while in the terrestrial *Stenopelmatinæ* they are doubtless placed in the ground. The eggs usually, and in Nova Scotia doubtless always, remain in the place of oviposition over winter and hatch the next season, the young at first being wingless and arriving at maturity after the usual five months.

KEY TO NOVA SCOTIAN SUBFAMILIES OF TETTIGONIIDÆ.

- a. Wing-covers and wings present.
  - b. *Prosternum* (under surface of thorax) without spines; vertex of head rounded or deflected; wing-covers rather broad, leaf-shaped, and of a bright green colour, always shorter than the wings. (Mostly found on shrubs.).....PHANEROPTERINÆ, p. 309.
  - bb. *Prosternum* with spines (very short and weak in our genus *Xiphidium*, but longer and more slender in genus *Orchelimum* which may occur here); wing-covers narrow, expanded little if any in middle, often shorter than wings; vertex terminating in a rounded tubercle in our species, (and in a long cone in extralimital ones); pronotum without or with only one transverse sulcus; ovipositor slender and nearly straight in our genus *Xiphidium*, (but stout and upcurved in *Orchelimum*). (Mostly terrestrial)..CONOCEPHALINÆ, p. 323.
- aa. Wing covers and wings wholly absent; pronotum short, not covering whole top of thorax; prosternal spines absent; ovipositor nearly straight. (Occurring under stones, etc.).....STENOPELMATINÆ, p. 325.

Subfamily **Phaneropterinæ** (Katydids, in part).

Vertex of head rounded, without cone or spine; *prosternum* without spines, *wing-covers* and *wings* present, the former rather broad, of a bright green and closely resembling a leaf in form and colour, the wings large and extending beyond the covers. The species live chiefly on bushes and small trees, with the foliage of which they remarkably harmonize; they are solitary in habit and slow in movement, and while some kinds are quite numerous yet they so completely blend with their surroundings that they are very rarely seen except by the naturalist. They differ in manner of oviposition from other *Tettigoniidæ*. The eggs instead of being deposited in the earth or in twigs, are usually glued in double rows to the outer surface of slender twigs, or are

inserted in the edges of leaves; and for such use the ovipositor is broad, curved and obtuse at the apex.—Only one genus, *Scudderia*, is represented in Nova Scotia, it being distinguished by having the wing-covers of nearly equal breadth throughout, and by the fastigium of the vertex being no broader than the first antennal joint.

### Group Scudderiæ.\*

#### KEY TO NOVA SCOTIAN SPECIES OF SCUDDERIA (MALES).

Note.—The upper anal appendage of the male must be carefully examined with a lens in order to identify the species, the female being extremely difficult to separate, but, fortunately for the beginner, the latter is much less often met with. The chief member used for identification, is what is called the supra-anal spine of the male, a produced pistillate process on the upper part of the last abdominal segment. There is also a long sub-anal spine which curves upward past the end of the supra-anal process, but it is not used for diagnostic purposes.

Last abdominal segment with a median produced pistillate process on its dorsal side (supra-anal spine), this process forked at its apex, with no median projection in the concavity of the fork.

a. Forked branches of supra-anal spine lobate; these lobes or lateral processes bearing small vertical longitudinal *flanges* or *keels* along their lower surface; *notch of supra-anal spine shallow and acute* (V-shaped).

b. Lobes (or lateral processes) of forked part of supra-anal spine distinctly *tapering toward their ends* when viewed from above; wing-covers relatively *broad* and short, their length about 3 times their greatest width.....20. *pistillata*, p. 312.

bb. Lobes of forked part of supra-anal spine *sub-equal in width* when viewed from above; wing-covers proportionately *narrower*, their length about  $4\frac{1}{4}$  times their greatest width in male, and about  $4\frac{1}{2}$  times in female.....21. *curvicauda borealis*, p. 317.

aa. Forked branches of supra-anal spine lobate; these lobes or lateral processes *not bearing longitudinal flanges* along their lower surface, and not much longer than broad; they are decidedly *swollen* and broadest at the basal part (that is the portion opposite to the extreme depth of the U) when viewed from above; *notch of supra-anal spine deep and rounded* (U-shaped); wing-covers about  $4\frac{1}{2}$  times their greatest width in male, and about  $4\frac{5}{8}$  times in female. ....22. *furcata furcata*, p. 320.

Note.—Typical *S. Curvicauda curvicauda* differs from the race *borealis* in being larger in size, the wing-covers being decidedly longer (33-37 mm.) as well as the hind femora (25-29.5 mm.). It occurs from Maine southward but has not yet been found in Nova Scotia.

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\*See Scudder (S. H.), "The Orthopteran Group Scudderiæ," Proc. Amer. Acad. Arts and Sc., vol. 33, Bost., 1898, pp. 271-290 and 1 plate, which fully describes all species then known: and also the more recent revision by Rehn (F. A. G.) and Hebard (M.), "Studies in American Tettigoniidæ: Synopsis of Species of Genus Scudderia," Trans. Am. Ent. Soc., vol. 40, 1914, pp. 271-314, with 3 plates of anal appendages, etc. Students should be very cautious in accepting names used for species of *Scudderia* previous to the appearance of Scudder's paper of 1898, as the nomenclature had formerly been most lamentably mixed up.

FIELD KEY TO NOVA SCOTIAN SPECIES OF SCUDDERIA.

*Males.*

The following condensed key may be used as a more ready but cruder means of separating our male *Scudderia*:—

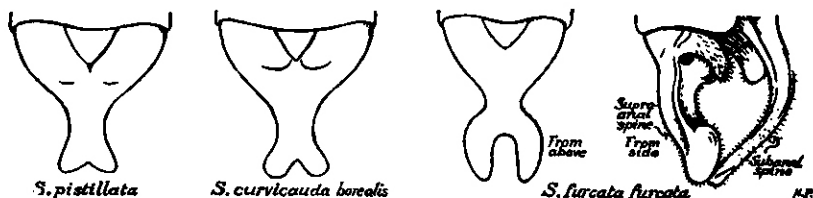
- a. Notch in end of spine on upper side of extremity of body (supra-anal spine) rather shallow and acute or *V-shaped*, the two branches of the fork not swollen.
  - b. Greatest width of wing-cover over 8 mm. (ends of branches of fork gently tapering).....20. *pistillata*, p. 312.
  - bb. Greatest width of wing-cover under 8 mm. (ends of branches of fork of about equal width).....21. *curvicauda borealis*, p. 317.
- aa. Notch in end of spine on upper side of extremity of body very deep and well rounded or *U-shaped*, each branch of the fork very much swollen.
  - 22. *furcata furcata*, p. 320.

*Females.*

The following key may serve to distinguish our female *Scudderia*:—

- a. Disk of pronotum with sides distinctly widening posteriorly.
  - b. Wing-covers relatively broader, over 8 mm. in greatest width, their proportions being about 1 to 3; eyes smaller..20. *pistillata*, p. 312.
  - b. Wing-covers relatively narrower, under 8 mm. in greatest width, their proportions being about 1 to 4½; eyes larger.....21. *curvicauda borealis*, p. 317.
- aa. Disk of pronotum with sides nearly parallel; wing-covers narrow, their proportions being about 1 to 4½.....22. *furcata furcata*, p. 320.

The ovipositors of the three forms closely resemble each other, although that of *furcata* is relatively narrower than that of the other two. Identification by ovipositor is very difficult with these insects and must be done with the greatest caution by a beginner.



Distinguishing Forms of Supra-anal Spines of Males of Species of *Scudderia*.  
(Enlarged about 5 times.)

The first three figures show the spine as viewed from above, the fourth is a lateral view. The figure of *S. pistillata* is from a specimen collected at Halifax, that of *S. curvicauda borealis* is from one collected at Wilmot, N. S., on 6 Sept. 1915, and that of *S. furcata furcata* from one taken at Chocolate Lake, Halifax, on 30 Sept. 1917.

20. *Scudderia pistillata* Brunner. NORTHERN KATYDID.

?*Phaneroptera curvicauda* (not of DeGeer). F. Walker, Cat. Derm. Salt. Brit. Mus., ii, 335 (1869); United States.—Do., Can. Ent., iv, 30 (1872); Nova Scotia.\*

*Scudderia pistillata*. Piers, Trans. N. S. Inst. Sc., ix, 211 (1896); Halifax and Ann. Cos.

(Note.—The synonymy of this and other species of *Scudderia* was very badly confused until Scudder in 1898 finally fixed the standing of the then-known species; and students should be very cautious in accepting specific names of the genus used by writers before that date.)

*Description*.—Like other representatives of the genus, this species has a very odd appearance with its long antennæ, leaf-like wing-covers and wings, and long and very slender hind-legs.—Disk of pronotum distinctly broadening from the front backward; wing-covers leaf-like, fairly broad (the length about 3 times the greatest breadth). Supra-anal spine of male forked, the apical notch acute and shallow, without a median tooth, and narrower than the upturned sub-anal spine; the lateral processes (on the sides of notch) sub-triangular and distinctly tapering toward their ends when viewed from above, the underside of these processes bearing a small vertical longitudinal flange or keel. Greatest width of ovipositor about  $\frac{1}{2}$  of its upper chord. Hind femora about 21 (male) or 20 mm. (female). Disk of pronotum wider posteriorly than anteriorly, the posterior width 1.5 times the anterior. Females may be distinguished from those of *furcata* by the shape of the pronotum disk, and from *curvicauda borealis* by the relatively broader wing-covers.

*Colour*.—From five males, just taken, Halifax, N. S., 26 Aug., 1895. General colour above, including wing-covers, pale oil-green or apple-green; under parts whitish green. Antennæ brownish, greenish basally; upper part of eyes brown; vertex of head white, middle of face greenish-white, mouth and between legs white. Dorso-lateral angle of pronotum with a cream-buff stripe. Abdomen terre-verte green, malachite-green on sides; posterior margin of abdominal segments brighter green (appearing as annular stripes of brighter green on darker green); two longitudinal, slightly raised, white lines on ventral surface of abdomen. Soles of feet brownish.

*Measurements*.—The following are comparative measurements of the five males (a-e) taken at Halifax, 26 Aug., 1895, whose colour has just been

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\*Walker listed two species of Katydid as having been taken in Nova Scotia by Lieut. Redman, to which he applied the names "*Phaneroptera curvicauda* De Geer" and "*Phylloptera m. rufifolia* Serv." Until the specimens in the British Museum are carefully examined by someone perfectly familiar with the North American forms as at present recognized, the best we can possibly say is that these two names as used by Walker to designate Nova Scotian specimens, represent two of the three forms *Scudderia pistillata*, *S. curvicauda borealis*, and *S. furcata furcata*.



monly, at least from Tatamagouche, on Northumberland Strait, south-westward throughout the Annapolis Valley to Yarmouth. No data is available regarding its occurrence in Cape Breton Island.

It is found upon the foliage of clusters of shrubs and low bushes, chiefly Speckled Alders (*A. incana*), in or near somewhat swampy or damp ground in the vicinity of land which is more or less cleared. Usually there is only one male on each bush. On the juices of these shrubs it feeds with the aid of its sharp mandibles; and its eggs, instead of being deposited in the earth or in twigs or grass-stems, etc., as is usual with most of the Orthoptera, are glued in double rows like flattened hemp-seeds, to the outer surface of slender twigs or are inserted in the edges of leaves. All the members of the *Phaneropterinae* agree in this manner of oviposition. *S. pistillata* is usually extremely slothful, although the male occasionally flies some distance from bush to bush, but if in doing so he comes to the ground, he generally falls most awkwardly on his side. If detected while on a bush he can usually be easily taken with the fingers, although occasionally when approached he will suddenly drop to a branch beneath. Females are excessively secretive and are very rarely observed, one reason being that the male only proclaims his location by loud calls. Considering the great difficulty of determining the species to which females belong, most students perhaps are quite thankful for this.

The Katydid, because of their green colour, leaf-like form, and very slow movements, are extremely difficult to distinguish from the leaves among which they are. The best way to ascertain their exact location is by taking rough cross-bearings. First listen for their call-note and so get the bearing, and then go around until approximately at a right-angle with the former position, listen again for the call, and thus obtain another bearing which intersects the first one. Then on going cautiously to the spot indicated by these cross-bearings and listening once more for the guiding note,

described; and a sixth male (f) taken at Chocolate Lake, near Halifax, 10 Sept., 1916:

	a	b	c	d	e	f	Ave.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Body to end of anal appendages...	23.0	23.0	23.7	23.7	25.0	20.0	23.0
Body exclusive of anal appendages.....	20.5	20.7	21.5	21.5	22.0	17.0	20.5
Pronotum, length.....						5.2	
Pronotum, anterior width.....						2.8	
Pronotum, posterior width.....						4.25	
Wing-covers, length.....	30.0	30.5	29.0	30.5	30.0	29.5	29.9
Wing-covers, greatest width.....	9.7	10.2	9.7	10.0	10.2	10.2	10.0
Hing wings, length.....	32.0	32.5	31.7	32.7	31.0	32.0	32.0
Hind wings, greatest width.....	14.5	15.2	14.5	14.5	14.5		14.6
Hind wings extend beyond wing-covers.....	5.2	4.0		5.2	4.0	4.5	4.6
Hind femora.....	20.5	20.5	20.5	22.0	20.5	21.0	20.8
Hind tibiae.....	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Antennæ.....	30.5	32.0	31.7	31.0	31.7	29.0	31.0
Eye, verticle diameter.....						1.3	
Width of wing-cover contained in its length; times.....	3.09	2.99	2.99	3.05	2.94	2.89	2.99

Measurements given by writers in the United States are: Male: body, 19-22 mm.; pronotum, 5.5 mm.; wing-covers, 30-32 mm.; width of wing-covers, 10 mm.; hind femora, 21-22 mm. Female: body, 19-22 mm.; pronotum 5.5 mm.; wing-covers, 26-27 mm.; width of wing-covers, 8-8.5 mm.; hind femora, 20-21 mm.; ovipositor, 6.5 mm. (Width of wing-cover contained in its length, from 3 to 3 $\frac{1}{4}$  times.)

*Range*.—Northern United States and southern Canada east of the Great Plains (or about long. 110°): from Nova Scotia, Maine, Toronto (Ont.), Mich., Minn., Winnipeg (Man.), and Regina (Sask.), south to northern New Jers., Penn., Ind., Ill., Nebr., So. Dak., and Wyom. It thus ranges from the southern part of the Canadian Zone to the northernmost part of the Upper Austral, north of about lat. 40°. Occurs in greatest numbers in the southern portion of Canadian Zone; and common everywhere in northern New England.

*Occurrence in Nova Scotia*.—I have not much doubt that this is the species which F. Walker reported as *Phaneroptera curvicauda*, from Nova Scotia in 1872 (Can. Ent., iv, 30), as even Scudder himself did not distinguish between these two species in 1862, and it was not until 1878 that Brunner separated them. In reply to my enquiry whether Walker's Nova Scotian *curvicauda* was *pistillata*, B. M. A. Cummings of the British Museum informs me (14 Jan., 1916): "We have not in the British Museum collection a specimen of *S. pistillata*, and under *S. curvicauda* a general locality-label is given for Nova Scotia, but no particular specimen labelled. There

are three specimens of *S. curvicauda*." That is, Walker's Nova Scotian specimen cannot now be referred to, and probably is lost. Of course the specimen may quite possibly have been what has lately been named *S. curvicauda borealis*, a form which occurs in the western part of the province; but as the specimens which Walker examined were collected most likely about Halifax, doubtless by Lieut. Redman, and I have not yet found that form here, whereas *pistillata* is very common, it seems best to consider Walker's record as referring to the latter species.

I first collected *S. pistillata* at Halifax on 26 Aug., 1895, and the determination was verified by Dr. Scudder himself who revised the genus in 1898 and placed it on its present sound basis. It was reported from Nova Scotia in 1896, that being the first Canadian record for Canada under its proper name. Elsewhere in that region it has only been recorded from Toronto, Winnipeg and Regina in the west. Strange to say B. Long did not happen to meet with it, or indeed any species of *Scudderia*, in Prince Edward Island, where it should occur and may yet be found.

This species is very common about Halifax, and no doubt more or less so throughout all or the greater part of the province, although in the western section *S. curvicauda borealis* is rather common and to some extent replaces it. The latter I have not yet found near Halifax. C. B. Gooderham speaks of *S. pistillata* as rather common about Truro; and he has in his collection several specimens taken at Truro, Col. Co., Hantsport, Hants Co., Wilmot, Ann. Co., Weymouth, Digby Co., and Deerfield, Yar. Co.; and there are also six specimens in the collection of the Agricultural College, Truro; while I have seen specimens taken at Tatamagouche, Col. Co., at Middleton, Ann. Co. (Irene Cox), at Brooklyn, Yar. Co. (Dorothy Marrell), and at Yarmouth, Yar. Co. (E. C. Allen, who had also collected the Deerfield specimens beforementioned). It therefore clearly occurs, fairly com-

the eye after some searching will usually be able to detect the leaf-like insect and, slowly approaching, it may be taken by the fingers—if it does not suddenly drop among the leaves below! At night a lantern has to be used to see the insect, what is known as a “dark” one being no doubt best for the purpose.

Although so difficult to detect owing to its similitude to a leaf and its sluggish movements, yet the loud stridulation of the males after nightfall makes known its approximate location. During the day they are usually silent, or rarely produce a short, sharp note, *zip*. After nightfall, however, their ear-piercing notes are as notable a rural chorus in late summer and autumn as those of the Tree Toads in spring. It is by far the loudest sound produced by any of our Orthoptera exclusive of other members of its own genus. The calling organ consists of a transparent membrane at the base of the overlapping dorsal area of one of the wing-covers, the membrane being crossed by a prominent curved vein bearing a row of minute file-like teeth on the under side, which are rasped over a vein on the upper surface of the under wing-cover, in which way a strident note is produced. On watching the male, he will be seen occasionally to suddenly lift, part and then again close the wing-covers, producing a sharp *zip* or *crick*, not very loud, which is the same as the day note. After making this sound at irregular intervals for sometime, he opens and closes the wing-covers to a greater extent, and so produces a long-drawn, exceedingly loud, fierce-sounding *cr-r-r-r-r-r-ick!* or *tschr-r-r-r-ip!*, which is repeated in couplets several times. This vehement challenge is then answered successively by every other male in his vicinity, until numbers are rasping out their chorus of ear-piercing notes, which are borne far on the still night air. After a while the notes become few, but later are started again by another bold male; and so the tumult is kept up intermittently throughout the night. I

have often stood near the dark alder thickets, in the calm close nights of August and September, listening to them and the wide-spread continuous undertone from thousands of tiny Crickets among the short grass of the adjacent pasture land, and I could not but have some admiration for the bold, fierce nature which the former's passionate challenge seemed to indicate in those lurking green-clad bushmen, though one could never grow to love them like the little Cricket whose softer serenade lulls rather than arouses.

Its notes are first heard near Halifax about 9th August (8 Aug. '97, 28 July '04, 8 Aug. '09, 12 Aug. '10, 1 Aug. '11, 17 Aug. '16, 19 Aug. '17), a week after the first cricket is heard, and are common throughout that month and September. They are last heard about 20th October (17 Oct. '95, 21 Oct. '15), about the time of the first hard frost which usually occurs in this province near 16th October.

Strange to say, while the species is so very common and its notes must be so very audible to all, yet it has received no vernacular name here; and in fact I have not found anyone but a naturalist who has ever seen the insect, and great surprise is expressed at its appearance when a captured specimen is shown.

## 21. *Scudderia curvicauda borealis* Rehn and Hebard.

### BROAD-WINGED CURVED-TAILED KATYDID.

*Description.*—This geographic race closely resembles *S. pistillata* in general appearance, and the form of the supra-anal spine of the male is also generally similar, except a slight difference in the shape of the branches of the spine.—Supra-anal spine forked, the apical notch acute and shallow, without a median tooth; the lateral processes (on sides of notch) *subequal in width* (not tapering) and somewhat rounded at end when viewed from above, the underside of these processes bearing a small vertical *longitudinal flange or keel*. Wing-covers proportionately *rather narrow* (the length about  $4\frac{1}{4}$  times the greatest breadth in male and about  $4\frac{1}{2}$  in female). Greatest width of ovipositor about one-half of its upper chord. Hind femora about 20.2 to 22.6 mm. Disk of pronotum wider posteriorly than anteriorly, the former being 1.4 of the latter.

From *pistillata* it may be separated by the larger eyes, much narrower wing-covers (6.5 to 7 mm. in male *borealis*, as compared with 9 to 11 mm. in male *pistillata*), somewhat longer hind femora, much smaller tympanal area of the male wing-covers, and the sub-equal width of the branches of the supra-

anal spine (they not being tapering as in *pistillata*). From typical *S. curvicauda* it differs in its smaller size, more compact form, and the broader and shorter wing-covers. From *S. furcata* it is very readily separated by the form of the supra-anal spine. Females are distinguished from those of *furcata* by the shape of the pronotum disk, which widens posteriorly; and from those of *pistillata* by the relatively narrower wing-covers.

*Colour*.—General colour green, the lateral angles of the pronotum in most cases weakly outlined with brownish white. Two Nova Scotian specimens in the Provincial Museum are green with reddish-brown tibiae; one has a pale buffy line on edges of disk, along the lateral angles of the pronotum, the other is suffused with pale reddish-brown on most of head, pronotum, and humeral angles of wing-covers.

*Measurements*.—Male: body, 18.2-22.3 mm.; posterior width of pronotum, 3.3-3.6 mm.; pronotum, 5-5.4 mm.; wing-covers, 27.8-29 mm.; greatest width of wing-covers, 6.5-7 mm.; posterior femora, 21.8-22.7. Female: body, 18-20.4; pronotum, 5.1-5.4 mm.; posterior width of pronotum, 3.6-3.8 mm.; wing-covers, 25.2-29.7 mm.; posterior femora, 20.8-22.6 mm.; ovipositor, 7-7.4 mm. Width of wing-cover contained in its length very slightly more than four times on an average. (*Vide* Rehn and Hebard.)

Two of the Nova Scotian males from Mr. Gooderham's collection have been presented to the Provincial Museum, viz. one taken at Wilmot, Ann. Co., 6 Sept., 1915, by W. E. Whitehead, and the other without data, and these furnish the following measurements:—

	Male, Wilmot 6-9-15	Male
Body, to end of subgenital plate.....	19.4mm.	20.3mm.
Body, exclusive of anal appendages.....	16.0	.....
Pronotum, length.....	5.0	4.7
Pronotum, anterior width.....	2.5	2.5
Pronotum, posterior width.....	3.4	3.5
Wing-covers, length.....	27.5	26.5
Wing-covers, greatest width.....	6.5	6.5
Hind wings, length.....	30.0	.....
Hind wings extend beyond wing-covers.....	4.0	.....
Hind femora.....	20.2	21.0
Hind tibiae.....	22.0	22.5
Subgenital plate, length.....	6.5	6.2
Eye, vertical diameter.....	1.5	1.5
Width of wing-cover to length of same.....	$\frac{1}{4}$ th	$\frac{1}{4}$ th

*Range*.—This is the race occurring in the extreme northern portion of the range of *S. curvicauda*. It has a limited distribution which borders that of *curvicauda curvicauda* in the north and northwest. Hitherto it has only been reported from Maine (in bogs), Ontario (Severn River, Tobermory, and Toronto), and Manitoba (Aweme), being found typical only in the Canadian Zone. Dr. E. M. Walker's Toronto specimens show some tendency toward *curvicauda curvicauda*.

*Occurrence in Nova Scotia*.—This geographical race was first described in 1914 by Rehn and Hebert (*Trans Amer. Ent. Soc.*, 40, p. 281) from specimens taken in Maine, Ontario, and Manitoba. I have not so far detected it about

Halifax although it may very easily have been mistaken for a narrower-winged variety of *S. pistillata*, which at first I took it to be.\* The typical *S. curvicauda curvicauda* has not so far been found in our province and is without doubt replaced in this region by the race *borealis*. The record of *Phaneroptera curvicauda* from Nova Scotia by F. Walker in 1872 (Can. Ent., iv, 30), appears to me to have been *S. pistillata*, as mentioned under that species, but one cannot be at all certain as his specimen seems to be lost.

C. B. Gooderham of the Agricultural College, Truro, who first drew my attention to this insect, has in his collection certain specimens of this new subspecies; viz.: two males and two females taken at Wilmot, Ann. Co., 6 Sept., 1915, by W. E. Whitehead; three males taken at Truro, Col. Co., 8 Oct., 1916, by himself, and one specimen from Deerfield, Yar. Co., by E. C. Allen. In the collection of the Agricultural College, Truro, is one male taken at Kentville, Kings Co., on 12 Aug., 1914, by C. A. Good. It doubtless occurs from early in August until about the middle of October. Specimens sent to J. A. G. Rehn by Mr. Gooderham in Feb. 1917 were verified by the former as his and Mr. Hebard's *S. curvicauda borealis*, so that the determination is authoritative.

While I have not, as before said, detected it about Halifax, it very likely may occur here and should be searched for. In the western part of the province from Truro to Yarmouth, Mr. Gooderham tells me it appears to be rather common, as he has taken it at two or three different places and has received it from two others, and he thinks that in that region it must be as abundant as *S. pistillata*. E. Chesley Allen informs him that there is a narrow-winged *Scudderia* which is very common about Deerfield, Yar. Co., which is probably *borealis*, as Mr. Gooderham has one specimen of

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\*Prof. W. S. Blatchley in 1916 referred some of Mr. Gooderham's specimens to *S. pistillata*, and Dr. E. M. Walker referred them at first to *S. curvicauda* but he now agrees that they are the form *borealis*.

the latter from that place collected by Mr. Allen. One would expect to find it occurring on bushes in bogs, as is the case in Maine.

22. *Scudderia furcata furcata* Brunner. NORTHERN FORK-TAILED KATYDID.

?? *Phylloptera myrtifolia* (not of Serville). F. Walker, Cat. Derm. Salt. Brit. Mus., ii, 376 (1869); Canada. —Do., Can. Ent., iv, 30 (1872); Canada, Nova Scotia.

*Description*.—While generally resembling our other species of *Scudderia*, this one may be very readily separated from them by the form of the supra-anal spine of the male. Females may probably be best distinguished by the nearly parallel sides of the disk of pronotum.—Wing-covers proportionately somewhat narrow (the length about  $4\frac{1}{2}$  times the greatest breadth in the male, and about  $4\frac{5}{8}$  in the female). Supra-anal spine of male deeply forked, the apical notch deep and rounded (distinctly U-shaped), without a median tooth; the lateral processes (on sides of notch) not much longer than broad, decidedly swollen and broadest at the basal part (that is, about opposite the extreme depth of the U) when viewed from above, and these processes not longitudinally flanged or keeled along their lower surface. Disk of pronotum with nearly parallel sides (in male and female of *pistillata* and *curvicauda borealis* it distinctly broadens backward). Greatest width of ovipositor about  $\frac{2}{3}$  of its upper chord. Hind femora about 17.2 to 22 mm.

*Colour*.—General colour dark leaf-green, occasionally more or less suffused with brown; the head and pronotum paler; the lateral angles of the pronotum usually not outlied with yellowish.

*Measurements*.—Male: body, 14-18 mm.; pronotum, 5 mm.; wing-covers, 26-31 mm.; greatest width of wing-covers, 6-6.5 mm.; hind femora, 19-22 mm. Female: body, 18-22 mm.; pronotum, 5 mm.; wing-covers, 26-30 mm.; width of wing-covers, 6 mm.; hind femora, 20-22 mm.; ovipositor, 5 mm. Width of wing-cover contained in its length about  $4\frac{1}{2}$  times in male and about  $4\frac{5}{8}$  in female. (*Vide* Rehn and Hebard.)

The following are comparative measurements of two males of *S. furcata furcata* taken at Chocolate Lake, North West Arm, near Halifax, N. S., 30 Sept., 1897:

	A.	B.
	mm.	mm.
Body to end of anal process . . . . .	17.5	18.5
Body exclusive of anal process . . . . .	15.2	16.0
Pronotum, length . . . . .	4.7	4.1
Pronotum, anterior width . . . . .	2.7	3.0
Pronotum, posterior width . . . . .	3.0	3.2
Wing-covers, length . . . . .	28.0	27.2
Wing-covers, greatest width . . . . .	6.0	6.0
Hing-wings extend beyond wing-covers . . . . .	4.0	3.5
Hind femora . . . . .	18.0	17.2
Hind tibiae . . . . .	19.0	18.2
Antennae . . . . .	.....	34.0
Eye, vertical diameter . . . . .	1.5	1.5
Width of wing-cover contained in its length; times . . . . .	4.66	4.52



*Range*.—This form ranges over the United States and southeastern Canada east of the Great Plains: from Nova Scotia, Brunswick (Maine), Montreal (Que.), Lake Nipissing (Ont.), and Wisc., south to Fla., around the Gulf Coast to Texas, Nebr. and So. Dak. Specimens showing atypical tendencies are found in Idaho, Wash., Oregon, and Calif. Southwestward it intergrades with *S. furcata furcifera* Scudder, which occurs typically in Mexico and New Mexico. It is common everywhere in New England.

*Occurrence in Nova Scotia*.—It is very far from certain that this was the species referred to by F. Walker (1872), under the name *Phylloptera myrtifolia*, as having been taken in Nova Scotia. B. M. A. Cummings of the British Museum in reply to my query whether Walker's Nova Scotian specimen of "*P. myrtifolia*" is *S. furcata*, writes me (14 Jan. '16) that there is in that Museum "one specimen with label 'Redman' [that is, Lieut. Redman, the collector who supplied Walker's Nova Scotian specimens]; also one *S. furcata* with which the former does not agree. In the collection the Nova Scotian specimen is labelled *P. myrtifolia* as synonymous with *S. laticauda*. In W. F. Kirby's Systematic Catalogue of Orthoptera (ii, 445-446, 1906) it is given as synonymous with *S. furcata*." Mr. Cummings adds, "I do not think the Nova Scotian specimen will prove to be either *S. furcata* or *S. laticauda*." *S. laticauda*, of course, it cannot be. All we can say is, that Walker's *Phaneroptera curvicauda* and *Phylloptera myrtifolia* from Nova Scotia, must represent two of the three forms *Scudderia pistillata*, *furcata furcata*, and *curvicauda borealis*, but which of them it is difficult at this distance to say. His *curvicauda* I think must have been *pistillata*.

*Scudderia furcata furcata* had not been detected by me when I published my paper on Nova Scotian Orthoptera in 1896. In the dusk of the evening, on 30 September, 1897, I captured two males of this form at Chocolate Lake, near the head of the North West Arm, near Halifax, N. S.\* One of these was on a balsam fir (*Abies balsamea*), the other on a witherod bush (*Viburnum cassinoides*), and a third, which

\* The spot where these specimens were taken was a few rods from the shore on the south side of Chocolate Lake near its east end. The ground was dry there, but adjoining it southward was a small bog. At the spot were low bushes, small balsam firs and large white pines with a few red spruces. The pine was the characteristic tree of the locality.

I did not succeed in capturing, was seen on a fir tree. In the vicinity were large white pines and spruces. At the time I heard about a dozen others, presumably of the same species. Their note was chiefly a very short *zip*, but unlike that of *S. pistillata*. These two specimens agree fully with Scudder's description and plates in his paper on The Orthopteran Group Scudderiæ (Proc. Am. Acad. Arts and Sc., Bost., p. 33, 1898), the form of the supra-anal spine leaving no doubt whatever as to the determination.\* Their measurements have been given on page 320. I did not determine the specimens until the spring of 1916, and in going to the same locality in the following summer, I only happened to find *S. pistillata*, but further search will without doubt show it is still there.

This form is no doubt rare or quite uncommon about Halifax, and C. B. Gooderham informs me that he has never seen it near Truro, Col. Co., or in the western counties of Nova Scotia, and there is no specimen in the collection of the Agricultural College, Truro. Still we would expect it to be more related to the fauna of our Transition region than to that of the Canadian region of eastern Nova Scotia. In New England it is everywhere common. It probably appears later than *S. pistillata*, and should be met with from August to October. In New Jersey it occurs usually in pine barrens, and in Indiana is mostly seen on low bushes and trees about the margins of thickets and along fence-rows, while in the prairie country to the north it frequents coarse grass and weeds in company with *S. pistillata*.

The characteristic keelless, deeply and widely forked and much swollen end of the supra-anal spine of the male will very readily distinguish it, on careful examination with a lens, from *S. pistillata* and *S. curvicauda borealis*. Females may be separated from those of *S. pistillata* by the proportionately narrower wing-covers of *furcata*; and the proportionately narrower ovipositor of the latter may help in

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\* See figure of supra-anal spine of one of the Chocolate Lake specimens, on page 311.

distinguishing them from *curvicauda borealis*. Comparison of the shape of the disk of the pronotum, whether it expands somewhat behind, or is nearly parallel, will also assist; but positive determination should be made on examination of the male alone.\*

**Subfamily Conocephalinæ** (Cone-headed Grasshoppers and Meadow Grasshoppers).

Vertex of head terminating in a tubercle or spine, sometimes blunt; antennæ long; pronsternum toothed or with two slender spines (these very short and weak in our species of *Conocephalus*); wing-covers narrow; ovipositor usually long and straight, but sometimes upcurved (in *Orchelimum*). To this subfamily belong certain slender-bodied green grasshoppers, with long antennæ and sword-shaped ovipositors, which are common in damp meadows and along the margins of brooks, etc. Their song is produced in the same manner as that of the Katydid, by a stridulating organ at the base of the wing-covers; but the notes are quite soft and low and are heard throughout the day. The eggs are deposited between the stems and root-leaves of grass, in the pith of twigs, etc.; and the ovipositor, being used as a piercer, is slender and sharp-pointed. Only one genus, *Conocephalus* (= *Xiphidium*), has so far been reported from Nova Scotia, but *Orchelimum* may possibly yet be found although it is not at all likely to be. These genera may be separated thus:—

KEY TO GENERA OF CONOCEPHALINÆ.

- Fore and middle femora without spines beneath, vertex terminating in a rounded tubercle hollowed on sides, stridulating organ light brown;
- a. Prosternal spines very short; ovipositor slender and straight or nearly so; insect small, body less than 17 mm. . . . . CONOCEPHALUS, p. 324.
- aa. Prosternal spines longer and more slender; ovipositor stout and usually upcurved; insect of medium size, body more than 17 mm. (Not yet reported from Nova Scotia.) . . . . . [ORCHELIMUM, footnote p. 325.

\**Scudderia septentrionalis* (Serville), readily distinguished by the truncated apex of the male supra-anal plate, although it occurs north to Brunswick, Maine, is very rare and not at all likely to occur here; and *S. texensis* Sauss.-Pict., with a median tooth in the notch of the supra-anal spine, although it has been taken at Norway, Maine, and in southwestern Ontario, is just as unlikely to be found this far north.

## Group Xiphidiini.

23. **Conocephalus fasciatus fasciatus** (DeGeer). EASTERN SLENDER MEADOW GRASSHOPPER.

*Xiphidium fasciatum*. F. Walker, Cat. Derm. Salt. Brit. Mus., ii, 270 (1869); Nova Scotia, etc.—Do., Can. Ent., iv, 30 (1872); Nova Scotia.—Piers, Trans. N. S. Inst. Sc., ix, 213 (1896); Halifax and Windsor, N. S.

*Description*.—Very slender-bodied and delicately formed. Vertex of head extends forward and slightly upward as a rounded tubercle; antennæ long; face oblique; prosternal spines very short and weak; wing-covers narrow, straight and *extending much beyond abdomen*; wings a little longer than wing-covers; ovipositor slender, *straight*, and about two-thirds length of hind femur; hind legs long and slender; femur and tibia about equal in length.

*Colour*.—Nova Scotian specimen, just come to maturity. General colour a beautiful translucent, light apple-green, very finely sprinkled with liver-brown, mostly on face and sides of head, pronotum, and legs; the spots on the hind femora being mostly arranged in a few longitudinal lines. Antennæ drab; eyes clove-brown. A dark brown dorsal stripe from vertex to extremity of abdomen, this stripe narrow on head and expanding into a rather broad band on pronotum and abdomen. Sides of abdomen dark brown. Wing-covers from greenish white to yellowish white, with brownish red dash on lateral basal part, this colour extending onto the veins. Hind femora apple-green, their apical third fawn-colour; hind tibiæ light fawn-colour, the spines tipped with black. Ovipositor green, its dorsal surface and tip fawn-coloured.

*Measurements*.—Male: body, 12-13.5 mm.; pronotum, 3-3.5 mm. wing-covers, 14-18 mm.; hind femora, 11.5 mm. Female: body, 12-14.5 mm.; pronotum, 3 mm.; wing-covers, 15-19 mm.; hind femora, 11.5-13 mm.; ovipositor, 7-9 mm.

*Range*.—United States and southeastern Canada, from Rocky Mtns. to Atlantic and south to South America: from Nova Scotia, P. E. Island, New Brunswick, Montreal (Que.), Ont., and Man., south to Fla. and Mexico, and west to Col. and Mont. The range of this geographic race is therefore extensive, its present known northern limit being apparently in the Canadian Zone. It is generally a very common form.

*Occurrence in Nova Scotia*.—This pretty, very fragile little insect, the smallest of our *Tettigonidæ*, was first reported from Nova Scotia by F. Walker in 1869. It is very common throughout the province, at least in those parts which have come under the eye of the collector, as about Halifax, Truro, Windsor, Kentville, Church Street (Kings Co.), near Yarmouth and Deerfield (Yar. Co.), etc. It frequents damp situations, such as wet meadows and marshes, and is found among moist thick patches of succulent and rank-growing

grass. It is very active and makes extensive leaps. The very tiny but easily recognizable nymphs, in about the second stage, were not noted at Hubbards, Hx. Co., until 19 July, 1917. Adults are met with from about the middle of July (18 July, '97; 29 July, '16, Halifax) until the middle of September (10 Sept., '95, and 12 Sept., '97, Halifax; and 13 Sept., Truro). They no doubt succumb to the first hoar-frosts which occur about then or soon after, being probably the first species to do so. Females are seen much more frequently than males. The stridulation of the male is rather weak-sounding, as might be expected from such a frail little species, and to me sounds like the syllables, *plee-e-e-e-e*, *tzit*, *tzit*, *tzit*, *tzit*, the first part of the call being a rapid vibratory note.\*

Subfamily **Stenopelmatinæ** (Stone and Camel Crickets).

Pronotum short, not covering whole top of thorax; prosternal spine absent; *wings wholly absent*; hind femora stout; ovipositor nearly straight.—These are ungainly insects, stout, with long antennæ, an arched back, and a large head which is bent downward in an obsequious manner between the front legs. They are nocturnal in habit, concealing themselves by day beneath stones, logs, etc., in damp woods or along woodland brooks, and are therefore rarely observed except by the collector. Being wingless they make no sound by which they may be located. They are omnivorous feeders but do not injure cultivated crops. The eggs are supposed to be laid in the earth; and in the United States the young occasionally hibernate, but no doubt do not do so here. The females are very difficult to specifically

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\**Orchelimum vulgare* Harris, the Common Meadow Grasshopper, length 18-19 mm., with spines on prosternum cylindrical and slender, has been taken in southern Maine and elsewhere throughout New England, where it is common, as well as in southern Quebec and Ont., but it is not likely to be found as far north as Nova Scotia; as also *Conocephalus brevipennis* (Scudder), the Short-winged Meadow Grasshopper, length 11-13 mm., somewhat like *fasciatus* in general form, but with wings usually shorter than the wing-covers, and the latter usually not reaching the end of the abdomen, which is common everywhere in New England and north to Eastport, Me., Ont., and Montreal (Quebec).

identify. Only one genus, *Ceuthophilus*, is represented in Nova Scotia.\*

### Group Ceuthophili.

#### KEY TO NOVA SCOTIAN SPECIES OF CEUTHOPHILUS (MALES).

- a. Hind margin of terminal dorsal segment of abdomen distinctly obtusely *notched*; hind tibiæ arcuate or bowed in their basal third. . . . . 24. *maculatus*, p. 326.
- aa. Hind margin of terminal dorsal segment of abdomen *entire*, rounded; hind tibiæ straight; lower outer carina of hind femora with 25 to 30 minute teeth, crowded together over two-thirds or more of apical part; hind femora distinctly shorter (about one-tenth less) than hind tibiæ, and  $3\frac{1}{2}$  times as long as broad; fore femora at least a third longer than pronotum. . . . . 25. *terrestris*, p. 327.

### 24. *Ceuthophilus maculatus* (Harris). SPOTTED CAMEL CRICKET.

*Ceuthophilus maculatus*. F. Walker, Cat. Derm. Salt. Brit. Mus., i, 201 (1869); Nova Scotia.—Do., Can. Ent., iv, 30 (1872); Nova Scotia. (Generic name given as "*Onthophilus*" by typographical error).

*Description*.—(Male). Body stout, back arched, antennæ long. Hind margin of terminal dorsal segment of abdomen obtusely but distinctly *emarginate or notched*; fore femora frequently more than a third longer than pronotum; hind femora about four times as long as broad and about as long as hind tibiæ, the outer lower carina with 12 to 15 small spines; hind tibiæ of male) arcuate or bowed in basal third. (The emarginate hind margin of last dorsal abdominal segment of the male clearly separates it from our other species.)

*Colour*.—Above blackish-brown, often with lighter stripe on dorsal part of thorax; below yellowish-brown; a number of small yellow dots, sometimes somewhat confluent, on dorsal part of abdomen; legs pale reddish-brown, the hind femora with brown bars.

*Measurements*.—Male: body, 14 mm.; pronotum, 4.6 mm.; fore femora, 6-6.5 mm.; hind femora, 15 mm.; hind tibiæ, 16-17 mm. Female: body, 16 mm.; pronotum, 5 mm.; fore femora, 6 mm.; hind femora, 15 mm.; hind tibiæ, 15.5 mm.; ovipositor, 9.5-10 mm.

*Range*.—Northern United States and southeastern Canada, east of the Great Plains: from Nova Scotia, Grand Manan (N. B.), Anticosti Isld., Montreal, Niagara Glen (Ont.), and Minn., south to Maryland, and west to Colo. and Nebr. Its range thus extends from the southernmost portion of the Canadian to the northern half of the Upper Austral Zone. Common throughout New England.

*Occurrence in Nova Scotia*.—This ungainly insect, with its cringing attitude, has hitherto only been reported from

\*Students should certainly consult Dr. E. M. Walker's excellent paper and plates on his puzzling genus in the Can. Entomologist (vol. 37, pp. 114-119, 1905: "Notes on the Locustidæ of Ontario"). The above key is founded on points of difference pointed out by him.

## Family GRYLLIDÆ (Crickets).

Antennæ much longer than body, bristle-shaped; *wing-covers flat above* and abruptly turned downward at sides; hind femora stout; *tarsi (feet) three-jointed*; ovipositor usually protruding, straight or upturned, needle-shaped, the tip often enlarged; calling organ of male, when present as in our species, is near base of wing-covers as in the *Tettigoniidæ*, but is larger and extends across proximal portion of both anal and median areas of wing-covers. The hind-wings are usually short and of little use for flight, although sometimes extending much beyond the ends of wing-covers.

The familiar chirp of the male cricket is not vocal as many suppose, but is produced by rubbing the veins of the stridulatory area at the base of one wing-cover over those of the other, somewhat as in the *Tettigoniidæ*. The eggs of most species are deposited singly in the ground, and a few of the burrowing species lay theirs in masses in their burrows, while the arboreal tree-crickets (*Ecanthinæ*), which have not yet been found in this province, place theirs in a row in the pith of plants. Oviposition takes place in late summer or early autumn, and the eggs in Nova Scotia doubtless do not hatch till the next season. Many of the species do very considerable damage to pasture-land.

Only the subfamily *Gryllinæ* is so far known to be represented in Nova Scotia. *Gryllotalpa borealis* Burmeister, the Northern Mole-cricket, of the subfamily *Gryllotalpinæ*, with fore tibiæ enlarged and fitted for digging, occurs in the northern half of New England, Anticosti Island, and Ontario, and might possibly be found here, but it is not very likely to be.

Subfamily **Gryllinæ** (Ground and Field Crickets).

Tarsi compressed, second joint minute; fore tibiæ not enlarged; hind tibiæ rather stout, with two rows of stout spines without teeth between them.

Nova Scotia by F. Walker in 1869 from a specimen collected many years before by Lieut. Redman. This Nova Scotian specimen is still in the British Museum collection, and B. M. A. Cummings, who has re-examined it for me, states that it is correctly determined.

I have not so far met with the species about Halifax, although possibly it will yet be obtained in suitable places in that locality. Being silent and secretive, it is a difficult insect to find and careful search has to be made for it. C. B. Gooderham has five specimens taken in Colchester and Annapolis Counties from 6 to 25 August, which have been determined by Dr. E. M. Walker of Toronto and verified by Prof. W. S. Blatchley of Indianapolis. They consist of three males taken at Truro, Col. Co., one on an unknown date by Miss L. C. Eaton, and the other two on 10 Aug. 1913; one female from the same place, 6 Aug. 1913; and a second female collected at Granville Ferry, Ann. Co., by H. G. Payne, without date. There are also in the collection of the Agricultural College, Truro, two males from Black Rock, Col. Co., 25 Aug., 1913. Of these seven specimens, the five with dates attached were collected by Mr. Gooderham. This gentleman considers it to be very rare about Truro, and apparently it is also rare in other sections of the western portion of the province, although possibly somewhat less so than its number in collections would indicate. It is usually found under flat stones in dry open woods, as well as beneath logs and in hollow trees. Like other species of its subfamily, it is wholly silent, as being wingless it has no stridulating organs. Adults probably should occur from about the middle of July, but we have no data to confirm this.

## 25. *Ceuthophilus terrestris* Scudder.

*Description*.—(Male). Body stout, back arched, antennæ long. Hind margin of terminal dorsal abdominal segment *not notched*, but obtusely rounded; fore femora at least a *third longer than pronotum*; hind femora  $3\frac{1}{2}$  times as long as broad and distinctly shorter (about one-tenth less) than hind tibiæ, the outer lower carina with about 25 crowded minute teeth; hind tibiæ straight in male as well as in female.



*Colour*.—Reddish-brown, the abdomen mottled with pale spots; often a light stripe on median dorsal area of pronotum, bordered by darker blotches; legs lighter, the hind femora with obscure dark bars.

*Measurements*.—Male: body, 13-14 mm.; pronotum, 4.5-5 mm.; fore femora, 6.3 mm.; hind femora, 14.3 mm.; hind tibiæ, 15.5 mm. Female: body, 14-15 mm.; pronotum, 4.3 mm.; fore femora, 6 mm.; hind femora, 13-14 mm.; hind tibiæ, 14 mm.; ovipositor, 7.5 mm. Newfoundland specimens are reported to be very large for the species.

*Range*.—Northern United States and Canada in eastern parts: north to Newfoundland (Bay of Islands, etc., Hebard), Nova Scotia, Maine, New Hamp., Mass. (?), Anticosti Isld., Isle d'Orleans (Que.), Ont. (north to Muskoka), Keweenaw Bay (Lake Michigan), and Man. Blatchley has reported it from Ind., and Walden very doubtfully from Conn. It seems to be confined to the eastern part of the Canadian and Transition Zones. Scudder says it is not uncommon in northern New England.

*Occurrence in Nova Scotia*.—This northern species has not previously been reported from Nova Scotia. C. B. Gooderham informs me that he has three specimens of *C. terrestris*, all taken at Truro, Col. Co., which were determined by Dr. E. M. Walker of Toronto, who has specially studied this genus. Prof. Blatchley of Indianapolis, has also verified the determination, so there is no doubt as to the specific identity. Of Mr. Gooderham's specimens, a male and a female were taken at Truro, Col. Co., on 6 Aug., 1913, and a male at the same place on 18 July, 1915. There are no specimens in the Agricultural College collection, and I have not noted it about Halifax. Gooderham refers to it as very rare about Truro. It probably occurs in the adult form from early in July, and should be searched for under flat stones in the open woods, where it may possibly be found in company with the related *C. maculatus*. Like the latter it is a wingless and therefore a silent species, and being secretive it requires considerable searching in likely spots in order to find it.\*

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\*Another species, *Ceuthophilus brevipes* Scudder, is generally a rare one, and has only been taken at Grand Manan Island where it is not uncommon, at St. John, N. B., and in Indiana. We would not expect to find such a rare species in Nova Scotia. Its length is 15 mm.; hind femora shorter than hind tibiæ, the lower carinæ with 7-15 small saw-like teeth; hind tibiæ straight; fore femora about one-third or more longer than pronotum.

## KEY TO NOVA SCOTIAN GENERA OF GRYLLEINÆ.

- a. Species small (length of body less than 12 mm.); last joint of maxillary palpi double the length of preceding one; hind tibiæ with long, movable, pilose spines; first joint of hind tarsi without teeth above, or with one row of small teeth.....NEMOBIUS, p. 330.
- aa. Species large (length of body more than 12 mm.); last joint of maxillary palpi but little, if any, longer than preceding one; hind tibiæ with strong immovable spines; first joint of hind tarsi grooved above, with two rows of teeth.....GRYLLUS, p. 337.

Genus *Nemobius* (Ground Crickets).

## KEY TO NOVA SCOTIAN SPECIES OF NEMOBIUS.

- a. Ovipositor distinctly *longer than hind femora*, very nearly straight; colour blackish or fuscous, with dark lengthwise stripes on occiput. 26. *fasciatus*, p. 330.
- aa. Ovipositor distinctly *shorter than hind femora*, usually more or less curved; wing-covers reaching tip of abdomen in male, shorter in female, their ground-colour yellowish-brown; dorsal area of pronotum and the legs yellowish-brown more or less mottled with black... 27. *carolinus*, p. 335.

26. ***Nemobius fasciatus*** (De Geer). STRIPED GROUND CRICKET. (Short-winged form, sometimes called *N. fasciatus vittatus* (Harris)).

*Nemobius vittatus*. F. Walker, Cat. Derm. Salt. Brit. Mus., i, 57, 114 (1869); Nova Scotia, etc.—Do., Can. Ent., iv, 30 (1872); Nova Scotia.

*Acheta vittata*. Piers, Trans. N. S. Inst. Sc., viii, 410 (1894); Windsor, N. S.

*Nemobius fasciatus vittatus*. Piers, Trans. N. S. Inst. Sc., ix, 210 (1896); Halifax and Windsor, N. S.

*Description*.—Size small; head and pronotum hairy; *ovipositor straight or very nearly so and about one-eighth or more longer than hind femora*; wing-covers of male cover about two-thirds of abdomen, while those of female cover about half of abdomen and have prominent cross-veinlets; hind wings wanting in both sexes in short-winged form which has sometimes been called *vittatus* (but are more than twice length of wing-covers and extend, like two tails, to about apex of ovipositor in typical long-winged form *fasciatus*, which latter has not yet been taken here).

*Colour*.—Nova Scotian specimens. The general colour of the short-winged form, varies from black to brown-black, the wing-covers and legs somewhat paler, particularly the basal part of inside of hind femora; top of head, between eyes, with three black longitudinal stripes, which are very obscure, or not noticeable, in darker specimens. Walden (Connecticut) and Beutenmüller (New York) say there are four black stripes on the head; but such Nova Scotian specimens as are before me, have only three stripes, when noticeable. Ovipositor blackish.

*Measurements.*—Nova Scotian specimens. Male: body, 10 mm.; pronotum, 1.9 mm.; wing-covers, 4.5 mm.; hind femora, 5.5-6 mm.; hind tibiæ, 4-5 mm. Female: body, 10-12 mm.; pronotum, length 1.9 mm., width 2.6 mm.; wing-covers, 3.5-4.5 mm.; hind femora, 6.0-6.2 mm.; hind tibiæ, 4.6-5 mm.; ovipositor, 7.4-8 mm. (1.07-1.29 times length of hind femora). Blatchley (Indiana) and Walden (Conn.) give the length of pronotum as 3 mm. in both sexes, whereas the Nova Scotian specimens before me are 1.9 or about 2 mm. in that measurement, which agrees closely with Walker's (Ontario) 1.5 mm. for male and 2 mm. for female. (In the extralimital long-winged form the inner wings are about 13 mm. long).

*Range.*—United States and Canada east of the Great Plains; from Nova Scotia, Quebec, Montreal, Ont. and Minn., south to Maryland, Ind., and Kans. The range therefore extends from the southern part of the Canadian to the northern part of the Upper Austral zone in the east. The long-winged form seems to be generally more or less rare. Very strange to say, this species was not reported from Prince Edward Island by B. Long (*vide* E. M. Walker) in 1912, and it must be truly remarkable if this very common insect does not extend its range there, and one could hardly expect it to be overlooked by any collector. It has not been taken in Newfoundland.

*Occurrence in Nova Scotia.*—The very common and familiar short-winged Striped Ground Cricket was first reported from Nova Scotia by F. Walker in 1869, as *N. vittatus*, no doubt from specimens collected by Lieut. Redman about 1821.

It is a social species which is excessively abundant in pastures and damp grassy places, as well as along grass-grown roadsides in Nova Scotia; it being one of, if not the most numerous of all the species of Orthoptera of this region. I have seen specimens from Tatamagouche, Col. Co., and have noted it at Westville, Pict. Co. (10 Sept., 1901), and in the counties from thence southward and southwestward, and suppose it must also occur commonly in Cape Breton Island. Neither C. B. Gooderham nor I have ever seen the typical long-winged form (*N. fasciatus fasciatus* as it has been occasionally termed) in this province, although I have often looked for it in the field and in such collections as have come before me. It, however, occurs northward to Maine, and I think also to Ontario.

A few newly-hatched nymphs of a cricket, species undetermined, but which were either *N. fasciatus vittatus* or *Gryllus pennsylvanicus neglectus*, were observed by Mr. Gooderham at Truro on 5 June, 1915. They were very

active, moving and leaping rapidly, and until closely examined might have been easily mistaken for a flea-like insect. Probably both these species hatch at about the same period. Individuals of the Striped Ground Cricket have been first noted by me at Halifax about the middle of July (17 July, '97, six seen, probably nymphs in the later stages). They were then silent and were no doubt immature. I have also observed nymphs of this species, in damp grass, at Halifax, at least as late as 26 August, 1917, when adults were very common.

In this locality they do not begin to shrill or stridulate until towards the end of the haymaking season, the average date for their first notes being about 3rd August, and the earliest date 24 July\*; the particular dates being 19 Aug. (1890), 6 Aug. ('91), 29 July ('92, at Windsor, Hants Co.), 2 Aug. ('93), 29 July ('95), 11 Aug. ('96), 2 Aug. ('97), 26 July (1904), 29 July ('08), 5 Aug. ('10), 24 July ('11), 6 Aug. ('16), and 7 Aug. ('17). At first a few are heard and only at night, and so very faintly as to be all but inaudible except to a trained ear. In a few days they may be heard in daytime as well as at night, and the notes become more noticeable; and the shrilling or chirping is fairly common in about a week's time (10 Aug., 1910; 1 Aug. '11; 18 Aug. '16).

All through the latter part of August and September, after the songs of birds have ceased, and when the asters and golden-rods are in bloom, their pulsating multitude of notes is heard from everywhere about the fields. By October they very seldom shrill at night; but on sunny, warm, calm days, with a temperature of over 50° F., their notes are temporarily rather common, but not so incessant or loud as in September, while on some cloudy, cold days they cannot be heard at all. As October proceeds, and the cold increases and frosts occur, the number heard by day becomes fewer and fewer, even when the weather is fine and bright, and the notes are more subdued, and they cease completely at

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\*The date "17 July" given for first appearance of adults in table on page 232, should be 24 July. The silent specimens seen on 17 July, 1897, were doubtless immature.

21°, and on the night of 16-17th the thermometer went down to 11° Far. Again in 1917, on 14th Oct., a sunny warm day with a temperature of 56° Far., many crickets were heard, but faintly. After various hard frosts, only a few were noted on 29th Oct., although the sun was bright and the thermometer at 47°. On the morning of 10th Nov. about an inch and a half of snow was on the ground, but rapidly disappeared. At noon on 11th Nov. I heard four crickets very faintly shrilling, in different warm spots, during a three-mile walk in the vicinity of Dutch Village, Halifax, and they proved to be the last of the season. The day was a bright sunny one, with a noontime temperature of only 31°, and the ground muddy. On the 13th the thermometer was 24° at 9 a. m., but sunny; and on the 15th the North West Arm was extensively frozen about its head for the first time in the season. This seems to show that the first hard frosts silence some of them, but that a few survive as many as four ice-forming frosts and frozen ground, and even evanescent snowfalls, and that a still lower temperature or a fairly heavy fall of snow which lasts for some time, finally causes the last most favourably situated survivors to perish.

The stridulation or shrilling note of the male is produced by the insect lifting the wing-covers about 45° above the body, and then shuffling them very rapidly together so as to vibrate the resonant organ at their base; thus producing a trilling sound or tremolo, of a prolonged character, resembling the syllable *ple-e-e-e*, *ple-e-e-e*, *ple-e-e-e*, repeated at rather short intervals or sometimes continued for several seconds or even much longer. The sound has a peculiar silvery timbre, and when myriads are shrilling all over the fields at night, or on fine days in late autumn, when other sounds are hushed and the air filled with the mystic charm of the hour or season, it produces a peculiarly drowsy, ceaseless tremor, pulsation, or "shimmer" of sound which is very familiar and loved by all dwellers in the country.\* It

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\*The continuous shrilling of this cricket reminds one somewhat of the much louder eternal trill of the American Toad when the latter is heard at a distance.

night. By the end of October or the first of November, even on fine days, only four or five individuals may be heard, rather faintly, and the sound abbreviated to a short chirp, not the prolonged trill of early autumn, and now only in daytime. They are last heard at Halifax from about the 7th to the 12th November, according to the character of the particular season and the temperature, the final one being heard about noon on a bright, warm, Indian-summer day when practically all the leaves are off the trees, and after the insect has survived two or three fairly hard night frosts which have formed thin ice and frozen the bare ground. In 1916, as will be more fully described below, a few sleighs were in use only two days after I heard the last cricket.

To illustrate somewhat the effect of weather conditions upon crickets, we may take the autumn of 1916, which was generally a very mild and fine one. On the 11th Oct. the first light frost occurred about some parts of Halifax, and thin ice formed during the mornings of 12th and 18th Oct. and 6th and 12th Nov. About 15th Oct. hardly any crickets were heard; but on the 22nd, a mild, damp day, the prolonged shrilling of many was heard in the daytime, while on the 31st, which was very mild but cloudy, only a couple were faintly heard. On 3rd Nov., a lovely sunny morning after a hoar-frost of the previous night, about a dozen were heard chirring faintly and briefly. On the 6th, another fine sunny day after a night when thin ice had formed and the ground had been slightly frozen, about six were noted, their trill being short and faint. Again on the 12th, after a night of ice and frozen ground, four were faintly heard, in the middle of the day when the temperature was 35° Far., fine and sunny but cold, in short grass on the sunny side of a slope in a pasture at the head of the North West Arm. They were the last noted. Very light snow was on the ground next morning, on the 14th about four inches of snow fell and a few sleighs were out, on the 15th the day temperature was

is, however, ineffably associated with a sad feeling that summer is on the wane or past, for it is our most characteristic autumnal sound in grassy places, and is linked with the sight of golden-rods and purple asters and the odour of falling leaves. If one may compare audible things with those seen, there always has seemed to me something about the tremulous shrilling of the little cricket which reminds me of the shimmering effect produced over rising ground on a still summer's morning when the hot sun causes invisible vapour to ascend and so sets the distant landscape pulsating and dancing as if by Terpsichorean bewitchment.

Mingled with the call of this species, particularly about the more stony edges of fields and the sloping sides of country roads, may be heard the louder and more staccato trill of the larger and less social *Gryllus pennsylvanicus neglectus*, but in fewer numbers. When the crickets begin to shrill, and when the chorus is faintly ending in late fall, I sometimes find it difficult to differentiate the notes of these two species, although it is easy to do so in the intervening period of full song. Crickets are one of the few orthopteran families which are known by sight and sound to almost everyone, although they are merely called "crickets" without attempting to specially distinguish the species.

The Striped Ground Cricket is an omnivorous feeder, subsisting upon grasses, carrion and cow-dung, and because of its excessive numbers it must do very considerable damage to pasture land, and is to be considered as a bad enemy of the agriculturist and grazier.

#### 27. *Nemobius carolinus* Scudder. CAROLINIAN GROUND CRICKET.

*Description.*—In general appearance it bears considerable resemblance to *N. fasciatus* but is smaller and differs in certain other particulars. Wing-covers of male reach about tip of abdomen, those of female cover half abdomen; hind wings wanting; *ovipositor distinctly shorter than hind femora* and a little up-curved. Its small size and short ovipositor readily distinguish it from *N. fasciatus*.

*Colour*.—Nova Scotian specimen (male, Truro, Col. Co., 12 Aug. 1915). Head dark brown with yellowish markings on vertex; front slightly darker than vertex or cheeks; eyes dark, lighter on upper edge; antennæ dark brown on three basal joints and distal third, middle portion light brown. Pronotum disk mottled with spots of light and dark brown; lateral lobes dark brown, and sparsely clothed with dark coarse hairs. Wing-covers uniform yellowish brown. Femur light brown, the outer face with darker transverse markings; tibia light brown, thickly clothed with minute dark hairs; base of spines dark brown.—The coloration usually given is, head and pronotum varying from dull yellow to dusky brown, the pronotum usually more or less mottled with dark; wing-covers brownish yellow with a blackish bar on the upper third of the lateral field; legs dull brownish-yellow, often mottled with blackish.

*Measurements*.—Nova Scotian male (Truro, 12 Aug., 1915): body, 8.3 mm.; pronotum, length, 1.6 mm.; wing-covers, 5.6 mm.; hind femora, 5.3 mm.; hind tibiae, 4.0 mm.; wing-covers 0.2 mm. shorter than abdomen; hind wings absent.—The measurements of the species usually given are: male: body, 7 mm.; wing-covers, 4.2 mm.; hind femora, 5.3 mm. Female: body, 8.5 mm.; wing-covers, 3.5 mm.; hind femora, 6.2 mm.; ovipositor, 3.8 mm. (Blatchley).

*Range*.—Nova Scotia, Maine and other parts of New England, south to Florida and Texas, and westward to Neb. It is not common in the northern part of New England (Scudder). Dr. E. M. Walker (1904) does not report it from Ontario, although his common *N. angusticollis* seems to be a somewhat related form.

*Occurrence in Nova Scotia*.—This small, light-coloured species has not hitherto been reported from Nova Scotia; although it occurs, but not commonly, in Maine. C. B. Gooderham has in his collection a single male specimen collected by himself at Truro, Col. Co., on 12th August, 1915, which was identified by Dr. E. M. Walker of Toronto. Prof. W. S. Blatchley of Indianapolis has also examined the specimen and states it is the "male of what I described as *Nemobius exiguus*, but which according to Rehn is *Nemobius carolinus* Scudder." Mr. Gooderham is convinced that the specimen is correctly determined as *N. carolinus*. It is a pity that Mr. Gooderham's specimen is not a female, as the specific characters are most decisive in that sex. The species is apparently very rare in this province, although it is possible that closer search may show it to be less so than the capture of a single specimen would lead one to suppose. It should be looked for in grass in somewhat similar situations to those frequented by the common *N. fasciatus*, and on sunny grass-covered banks of streams and about fences. Its note is said to be a long, continuous, soft, rolling *whirrrrr*.



Genus *Gryllus* (Field and House Crickets).

The separation of the native species or supposed species or variants of this genus is a matter which presents great perplexities to specialists, and the subject has been far from on a satisfactory basis. We therefore find considerable difficulty in assigning a precise name to the form which occurs in Nova Scotia, and can only hope that further study may enlighten us so that the matter may be satisfactorily settled. The name herein used, will at least serve tentatively to indicate the variant with which it agrees or is most closely related. This is as near as we can now go. Otherwise we should probably have to adopt the opposite and more generalizing course which will soon be referred to. If the course here selected is open to criticism, it is probably because it is unjustly taken to indicate a disposition to draw fine distinctions in forms which intergrade or which have a strong tendency to do so.

Some fifty-five years ago the forms of *Gryllus* of the New England region bore several names. In 1862 Scudder considered there were five native species there, namely *G. luctuosus* Serv., *abbreviatus* Serv., *angustus* Scudd., *neglectus* Scudd., and *niger* Harr. In 1900 he reduced these to four, namely *G. abbreviatus* (also including his narrow-bodied *angustus*), *luctuosus*, *pennsylvanicus* Burm. (including *niger*), and *neglectus*. In 1902, in his monograph on the genus (*Psyche*, vol. 9, p. 291), he brought the number still further down to two, namely *G. abbreviatus* (including also *luctuosus* and *angustus*), and *pennsylvanicus* (including also *nigra* and *neglectus*). Prof. Blatchley in 1903, Dr. E. M. Walker (of Toronto) in 1904, and B. H. Walden in 1911, in the main concurred with this. In 1907 Lutz in his paper on "The Variation and Correlations of Certain Taxonomic Characters of *Gryllus*," surprised us by concluding that species in an anyway natural sense do not exist at all in the genus. In 1915 J. A. G. Rehn and M. Hebard followed this with an article on "The Genus *Gryllus* as found in America" (*Proc.*

Acad. Nat. Sc., Phila, 67, pp. 293-322), in which after carefully studying 1,540 specimens from North and South America, they finally unite all native American forms of *Gryllus* under one specific name, *Gryllus assimilis* (Fabricius, 1775), the type-locality of which species is Jamaica, and with a range extending from Canada to Patagonia. Simple as this solution of the Gorgon knot may appear, it is doubtful if it will meet with immediate approval, at least from many field orthopterists who are familiar with the habits as well as other points of difference of the various forms in moderately large areas. Their contrary arguments must be heard before a decision is reached. In the meantime until this matter becomes clearer, we will endeavour to fit in with the hitherto prevailing nomenclature. Further remarks on the nomenclature of our Nova Scotian form will be given on page 348.

Considering the very great difficulty of clearly defining between various so-called species, forms, or variants, whichever they may be, the best we can do regarding analytical keys is to give that of Dr. E. M. Walker (1904), founded on metric distinctions, for the determination of Ontario forms, which agrees very closely with the keys of Scudder (1902), Blatchley (1903), and Walden (1911), and which is as good as any that are available along such lines. We must bear in mind, however, that the value of metric diagnostic characters is very much doubted by some recent specialists. Lutz in his paper before referred to, shows the liability to error in using lengths of wing-cover, wing and ovipositor as characters of specific importance in the genus *Gryllus*; and Rehn and Hebard (1915) believe that the mass of evidence on these features in Lutz's paper is absolutely convincing. With this caution, we may say that this key should at least embrace such forms as may occur here, subject to the variation which is met with from region to region. Should subsequent writers sustain Rehn and Hebard's contention that there

is only one native species, *G. assimilis*, in the whole of America, then such keys as this, or better ones to replace them, may be of service as indicative of prevailing phases or variants.

KEY TO NATIVE FORMS OF *GRYLLUS* IN NORTHEASTERN AMERICA.\*

(After Dr. E. M. Walker.)

Black, wing-covers and parts of body sometimes dull reddish-brown; first joint of antennæ not projecting beyond front of head.

- a. Ovipositor nearly or fully half as long again as hind femora, usually exceeding 16 mm. [Blatchley and Weldon say exceeding 18 mm.] in length; male stout, with large and broad head. [Not yet reported from Nova Scotia] ..... *abbreviatus*.
- aa. Ovipositor rarely more than one-fourth as long again as hind femora, seldom if ever more than 14 mm. or less than 12 mm. [Blatchley says 13-14 mm.] in length; male more slender, with narrower and less swollen head.....28. *pennsylvanicus*, p. 341.

Both of these forms are dimorphic as regards length of wing, being termed *short-winged* or *long-winged*, the former being the usual variety.

We should now consider the views of still later writers on these vexed points of difference. Rehn and Hebard (1915) in writing of the variants of their all-embrasive *G. assimilis*, caution us that the characters intermingle in every way and are in no case fixed, so that in their opinion the use of special names to designate the variants is not at all warranted. These writers, however, present the leading characteristics of the variants most frequently encountered and which have hitherto been designated by names. Colour, length of wing-covers and wings, and general size are the only peculiarities considered, other metric comparisons being discarded. The unstable characters of variants occurring in the northeastern and northern regions are compiled as follows from symbolic formulæ given on page 302 of their paper. These characters will hardly bear drafting into a formal key. Their remarks on distribution and intergradation are also given. It may be noted that females, as a rule, have the tegminal and

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\*The European House Cricket, *Gryllus domesticus* Linnæus, an introduced species, is said to occur in the United States and Canada east of the Great Plains. It has been reported from Toronto (E. M. Walker) and Montreal, and is said to occur sparingly on the southern borders of New England, but has not been found in Nova Scotia. It is distinguished from native species by being straw-coloured, marked with brownish on head and thorax, and by the first joint of the antenna projecting slightly beyond the front of head. It may possibly occur about old stone fireplaces in rural districts.

femoral markings more decided than males; thus frequently in the same series the males will show the ventro-proximal portion of the hind femora varying between being briefly and widely marked with reddish, and the wing-covers entirely black, while the females will on an average show a wide reddish patch on that part of the femora, the wing-covers being dark with the intermediate channel pale. By "small" the authors appear to mean body-lengths from about 17 to 20 mm., and by "medium" those from about 20 to 23 mm.

CHARACTERS OF SOME OF THE MORE PROMINENT VARIANTS OF *GRYLLUS*.\*

(Compiled from Rehn and Hebard.)

*neglectus* Scudder.—Head and pronotum black; caudal femora black; tegmina normally unicolorous and dark; tegmina slightly reduced, wings very much reduced; size small.—This is the darkest variant of the present species (*assimilis*), the maximum development of the condition seen also in the two following variants. Found in the northeastern portion of the insect's distribution, ranging southward in the high Appalachians to northern Georgia, and is known from the Piedmont Plateau only in Pennsylvania. Much variability exists and every intergradation with the next two variants is often to be found in the same series.

*pennsylvanicus* Burmeister (other names: *nigra* Harris, *angustus* Scudder).—Head and pronotum black; caudal femora black, with ventro-proximal portion briefly reddish; tegmina normally unicolorous and dark, or else dark with intermediate channel pale, but also ranging through unicolorous and slightly pale, to slightly pale with base and intermediate channel very pale; tegmina slightly reduced, and wings very much reduced, but tegmina often large and wings fully-developed organs of flight; size medium.—This is the dominant variant of the species in well-watered regions of temperate North America and is found southward to the Gulf coast of eastern Texas. Great variability is exhibited and every intergradation exists with the variants termed *neglectus* and *luctuosus*.

*luctuosus* Serville (other name: *abbreviatus* Serville).—Head and pronotum black; caudal femora black, with ventro-proximal portion widely reddish; tegmina normally unicolorous and slightly pale, but ranging from unicolorous and dark, through various gradations, to slightly pale with base and intermediate channel very pale; tegmina slightly reduced and wings much reduced and concealed by tegmina, but tegmina often large and wings fully-developed organs of flight; size medium.—This variant shows an intensification of the features of the last. It is found throughout the lowlands of the southeastern United States and in the Middle West from Manitoba southward to the arid regions. It also exhibits great variability. The maximum of this condition is found in material from the pine woods of the southeastern United States.

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\*It must be remembered that Rehn and Hebard discourage altogether the use of names to designate these so-called variants, in forms which they say so completely intergrade.

28. **Gryllus pennsylvanicus** Burmeister. PENNSYLVANIAN FIELD CRICKET. (Shortest-winged form, sometimes called *G. pennsylvanicus neglectus* Scudder.)

*Acheta abbreviata* (not of Serville). Piers, Trans. N. S. Inst. Sc., viii, 410 (1894); Windsor, N. S.

*Gryllus pennsylvanicus* form *neglectus*. Piers, Trans. N. S. Inst. Sc., ix, 210 (1896); Halifax, Bedford, and Windsor, N. S.

*Gryllus assimilis* (Fabricius), in part. Rehn and Hebard, Proc. Acad. Nat. Sc., Phila., 67, 293 (1915).

Note.—Should Rehn and Hebard be sustained in their contention that there is only one species of native cricket in America, then our Nova Scotian form may be termed *Gryllus assimilis* form *neglectus* of Scudder.

In order to clearer understand what relates to this form, I have thought it better to divide what is here presented into two sections; the first describing generally, for comparative purposes, what has been termed *G. pennsylvanicus* in its various forms as found in North America, according to late writers, and the second dealing in detail with the variant which occurs in Nova Scotia.

#### 1. *General Description of G. pennsylvanicus as found in North America.*

*Description of G. pennsylvanicus.*—Medium-sized and rather broad; male more slender and head more narrow and less swollen (a little wider than pronotum) than in *G. abbreviatus*; pronotum proportionately a little wider and shorter than in *abbreviatus*, length contained in breadth nearly 1.6 times, the width being about 6.3 mm. and length 3.9 mm. in male and about 4.2 mm. in female, the hind margin sinuate.\* Wing-covers of male of both short- and long-winged forms, reach to or nearly to tip of abdomen. In female of short-winged variant the wing-covers vary from (a) covering only about two-thirds of abdomen (in what I consider to be *G. pennsylvanicus neglectus* Scudder, which is the form represented in Nova Scotia), to (b) reaching nearly to tip of abdomen, they being about 10 mm. long (in what I consider to be

\*In Blatchley's *G. americanus* (= *neglectus*?) the head is no wider than the pronotum, and the length of the latter is contained in its width 1.3 times, the width being 5 mm. in male and 5.6 mm. in female, and the length 3.5 mm. in male and 4.2 mm. in female.

winged form, with the hind-wings considerably shorter than wing-covers, has been met with in this province; and it is generally the variety with decidedly shorter wing-covers, covering on an average only about  $2/3$  of the female abdomen, which I take to be the variant termed *neglectus* by Scudder. I have noted only two females (*a* and *f*) with wing-covers very slightly exceeding  $3/4$  of abdomen, and these may show a tendency towards a passage to the ordinary short-winged *pennsylvanicus* in which the wing-covers of the female reach nearly to the tip of abdomen. Hind femur stout, averaging 10.3 mm. in length, and 3.3 mm. in greatest width; its length contained in length of ovipositor from 1.17 to 1.47 times, averaging 1.32 times. The hind tibia usually has 6 pairs of stout spines and a few additional spines at the extremity. The ovipositor ranges from .57 to .95 times length of body, and averages .72; in no specimens does it exceed the body length. The actual length of ovipositor varies from 12.2 mm. to 15.2 mm., the average being 13.69 mm.

*Colour of Nova Scotian specimens.*—From my notes I transcribe the following colour descriptions of seven females and one male which are fairly typical of our form. The measurements of each specimen will be found in the general table of measurements on pages 345 and 346—*Two females* (*e* and *f*) taken on roadside at Halifax, 5th and 7th Sept., 1897. General colour black, with fine grayish pubescence on pronotum, femora and some other parts; head shining black; antennæ black; wing-covers shining black with a light-coloured line on lateral ridge where they bend downward onto sides; light-coloured veins on lateral part (costal area or portion bent down) of wing-covers; ovipositor brownish. This description was noted immediately after the specimens were taken. My notes make no mention of any reddish tint on the femora, and therefore most likely they were unicolorous. (Size small; body, 18.5 and 18.2 mm.)—*Four females* (*a*, *b*, *c*, and *d*), taken on King's Meadow, Windsor, Hants Co., Sept., 1892, and determined in 1895 as *G. pennsylvanicus neglectus* by W. Beutenmüller, furnish the following colour-description on re-examination after being in alcohol for many years: Upper parts black, under parts with a brownish tinge; a slight grayish pubescence on some of upper parts, but not at all general; dorsal and median areas of wing-covers rather pale sepia-colour or dark broccoli-brown, with dark sepia veins or nerves (darker than the ground-colour); costal area of wing-covers, or portion turned downward, dark sepia with broccoli-brown veins (lighter than ground-colour); a paler, buffy, narrow line on humeral angle or lateral ridge of wing-covers; femora black or dark brownish-black, sometimes slightly paler on proximal fifth of inner face; tibiæ brownish-black; ovipositor brown-black; antennæ black near head, becoming brown anteriorly. These four specimens have no doubt faded somewhat in the preservative fluid. (Size very small to small, 14.75 to 17.30 mm.)—*One female* (*g*), taken on road at Kentville, Kings Co., 13th Oct., 1915. Shining black, no pubescence anywhere; wing-covers pale clay-colour with liver-brown veins, the light colour being most noticeable as a very obscure stripe on lateral ridge and extending backward until lost; femora with a chestnut or hazel-coloured area on both outer and inner faces, on basal lower two-fifths, and gradually passing into the adjacent blackish colour of remainder of limb. (Size small, 19.0 mm.)—*One male* (*s*) taken beneath a stone on roadside, Halifax, 7th Sept., 1897, in company with one of the before-mentioned females (*f*), was coloured just as was that female, except that there was apparently no light-coloured line on the lateral ridge of wing-covers and no light-coloured veins on their costal area. Structurally, of course, it showed the differences which are seen in the sexes of field crickets, the male being proportionately much narrower in the body, and the raised veins on wing-covers being differently disposed. (Size very small; body, 15 mm.)

the typical *G. pennsylvanicus pennsylvanicus* Burmeister); while in female of rarer long-winged form they slightly surpass tip of abdomen, being about 12.4 mm. long. Hind-wings in short-winged form are narrower and shorter than wing-covers, and in long-winged form extend considerably beyond as tail-like projections. All these variants are said to intergrade when specimens from various regions or even the same area are compared, and the distinction is probably of little value except for convenience. Hind femora short and stout; hind tibiae grooved above, with 5 or 6 teeth on each side. Ovipositor seldom if ever less than 12 mm. (Walker) or more than 14 mm. in length, the length being about 1.1 times length of hind femora and rarely more than 1.25 times length of latter.

*Colour*.—Head shining black; wing-covers varying from deep black to smoky or grayish brown, rarely dull reddish-brown, often with a yellowish-brown line along humeral angle; pronotum, underside of body and legs in freshly-matured specimens, often with minute grayish pubescence which becomes abraded through age, leaving a shining black; hind femora often with basal half of underside reddish-brown; tibiae and ovipositor black. (The student should also consult the variable colour features, compiled from Rehn and Hebard's paper, on page 340.)

*Measurements*.—*G. pennsylvanicus* (Blatchley, Indiana). Male: body, 17.5 mm.; pronotum, 3.9 mm.; width of pronotum, 6.3 mm.; wing-covers, 11.5 mm.; hind femora, 12.2 mm. Female: body, 17.1 mm.; pronotum, 4.2 mm.; width of pronotum, 6.3 mm.; wing-covers, 10 mm. (in the short-winged form which I take to be *G. pennsylvanicus pennsylvanicus*) to 12.4 mm. (in long-winged form); hind femora, 12.4 mm.; ovipositor, 13.5 mm.; ovipositor about 1.1 times as long as hind femora.—*G. pennsylvanicus* (Walker, Ontario). Male: body, 17.5 mm.; pronotum, 3 mm.; hind femora, 10 mm. Female: body, 17.5 mm.; pronotum, 3.3 mm.; hind femora, 10.5 mm.; ovipositor, 13.5 mm.; ovipositor about 1.30 times as long as hind femora.—*G. americanus* = *G. neglectus* (?) (Blatchley, Indiana). Male: body, 14 mm. pronotum, 3.5 mm.; width of pronotum, 5 mm.; wing-covers, 7.5 mm.; hind femora, 10 mm. Female: body, 16.5 mm.; pronotum, 4.2 mm.; width of pronotum, 5.6 mm.; wing-covers, 8 mm. (covering 2/3rds of abdomen); hind femora, 11 mm.; ovipositor, 11 mm. (10-12 mm.); ovipositor short, just equalling or rarely exceeding by 1 mm. the length of hind femora.—In the variant which I consider to be the so-called *G. pennsylvanicus neglectus*, and which seems to represent our Nova Scotian insect, the wing-covers reach about or nearly to end of abdomen in male, and only cover about 2/3rds of abdomen in female.

*Range*.—Scudder in 1902 gave the range of *G. pennsylvanicus* (with which he included *neglectus* and *nigra*), from specimens before him, as from Maine, New Hamp., Mich., Iowa, Nebr., Montana and Br. Columbia, south to Md., Ill., Missouri, Texas, New Mex., Utah and Calif.; but its actual range is slightly more embracing. Rehn and Hebard (1915) give in effect the range of the variant *neglectus* as the northeastern portion of United States and Canada as far northward as the Field Cricket extends, and thence southward in the high Appalachians to northern Georgia and on the Piedmont Plateau only in Pennsylvania; whereas they say that the variant *pennsylvanicus* (= *nigra* and *angustus*) is the dominant form in the well-watered regions of temperate North America and southward to the Gulf Coast of eastern Texas. In Canada *G. pennsylvanicus*, as such, has been reported from P. E. Island and Ont. (E. M. Walker), Man. (Criddle), Sask. (Caudell), and Br. Columbia (Scudder); and *G. neglectus*, as such, has been reported from Quebec, Montreal and Toronto (Caulfield), and as *G. pennsylvanicus neglectus* from Nova Scotia (Piers) and Moosejaw, Sask. (Caudell). The range of the complex *pennsylvanicus* may therefore generally be taken as extending from southern Canada

through the United States, in non-arid regions from ocean to ocean, south in the central western region to Texas and New Mexico; thus embracing the Canadian to the humid parts of the Upper or Lower Austral Zones; whereas the form *neglectus* is more nearly restricted to the Canadian and Transition Zones and mostly is found in the northeastern and eastern areas. Long-winged forms are usually uncommon, and in Canada have only been taken once (Ontario). None of the forms have been found in Newfoundland. Scudder in 1900 reported *neglectus* as common in the southern half of New England at least, and *pennsylvanicus* as common in the same half; while he states that *abbreviatus* and *luctuosus* are common everywhere in that region.

## 2. *The Variant occurring in Nova Scotia.*

*Name of Nova Scotian variant.*—From such Nova Scotian specimens as are at hand as I write, and measurements of others sent me by C. B. Gooderham of Truro, I find that they generally agree most closely with the very short-winged form sometimes known as *neglectus* of Scudder, with probably a slight tendency in a very few specimens towards the ordinary short-winged form termed *pennsylvanicus* of Burmeister with which it is closely affiliated and with which it probably intergrades in other regions. We may tentatively, therefore, and as a mere matter of present convenience, refer to our form as *Gryllus pennsylvanicus neglectus* Scudder. Further remarks on this point will be made on page 348.

*Description of Nova Scotian specimens.*—The size varies from very small to medium for *Gryllus*, but averages small (length 18.5 mm. in males, 19.2 mm. in females); the greater extremes in length being found in females. Breadth of female abdomens usually about one-third length of body. Apparently all before me have greatest width of the head slightly less than greatest width of pronotum by from .17 to .75 mm. Pronotum but little if any narrower in front than behind, its average "length" contained in its "width" 1.50 times; the front margin slightly concave and sometimes ciliate, hind margin slightly convex, lateral margins of disk nearly straight but tending to convexity; an impressed line very close to and parallel to front and hind margins, and a longitudinal median impressed line distinct on a little more than half of its anterior part. The wing-covers of female cover from a little less than 6/10ths to a little less than 8/10ths of abdomen as measured from hind margin of pronotum to tip of abdomen, and average only 65/100ths or 2/3rds. Those of male usually cover more of abdomen than those of the other sex, ranging from 6/10ths to 1 1/10th, and averaging 82/100ths. It is rarely they slightly exceed the abdomen in male and never in female. The inner edges of wing-covers overlap for their entire length in males; but in some females, perhaps late in the season, they are more or less separated at their ends so as to form a  $\Delta$ -shaped notch, but all gradations are found from unnotched to notched state, and it is possible the latter may be caused to some extent by the degree of distension of abdomen.\* Only the short-

\*Blatchley has made this notch one of the characters of his *G. americanus*, which apparently is the same as Scudder's *neglectus*.



It may be added that many females and most of those from about Truro show a chestnut or hazel-coloured area on about one-third or two-fifths of the lower basal portion of the outer and inner faces of the hind femur, that on the outer face being considerably narrower and slightly longer than that on the inner one; this reddish tint graduating into the adjacent blackish colour. Some of the females exhibit this colour only on the inner face and lower edge of femur. Males do not seem to have this reddish mark on the outer face of the femur; but it is often seen, but very much less extensively than in the other sex, on the lower basal portion of the inner face and sometimes slightly on the lower edge. It may be noted that females of *Gryllus* as a rule have the tegminal and femoral markings more decided than in males.

*Detailed measurements of Nova Scotian Specimens.*—The following is a comparative table of measurements in millimetres of specimens of the Short-winged Pennsylvanian Field Cricket collected in this province:—

MALES

Designation.....	r	s	t	u	v	w	x	y	Males, Average, 8 Specimens	
Locality.....	Bedford	Hali-fax	Truro							
Date.....	2 Sep. '96	7 Sep. '97	7 Sep. '14	1 Sep. '15	31 Aug. '14	9 Oct. '13	18 Oct. '16	18 Oct. '16		
Collection*.....	P	P	AC	AC	AC	G	G	G		
Millimeters.										
Body, length.....	17.0	15.0	13.9	18.5	16.7	17.2	20.0	21.1	18.5	
Pronotum, length.....	3.2	—	3.3	3.5	3.0	3.4	3.2	3.4	3.2	
Pronotum, width.....	5.0	—	5.0	5.6	5.1	5.0	5.0	5.0	5.1	
Abdomen, from hind margin of pronotum.....	10.0	11.2	11.6	12.6	11.8	11.8	14.6	15.7	12.4	
Wing-cover**.....	11.0	9.0	10.0	10.8	10.0	8.8	9.0	10.9	9.9	
Wing-cover shorter (—) or longer (+) than end of body.....	+1.0	—2.2	—1.6	—1.8	—1.8	—3.0	—5.6	—4.8	—2.8	
Hind femur.....	10.5	10.0	—	10.7	9.4	10.0	9.7	10.0	10.04	
Hind tibia (exclusive of spines).....	7.0	—	—	8.3	7.3	7.3	7.2	8.0	7.5	
Percentage of abdomen covered by wing-covers.....	110	84	86	86	85	75	62	69	32 or 13/16	
Absence or presence of A-shaped notch between ends of wing-covers.....	No	No	No	No	No	No	No	No		

\*Collection: P=Piers; A C=Agricultural College, Truro; G=Gooderham, Truro.  
 \*\*All hind wings are shorter than wing-covers.

FEMALES

Designation.....	FEMALES														Females, Average 17 Specimen								
	Windsor				Halifax				Kentville				Truro										
	a	b	c	d	e	f	g	h	i	j	k	l	m	n		o	p	q					
Locality.....																							
Date.....	Sept., 1892.																						
Collector*.....	P	P	P	P	P	P	P	P	AC	AC	AC	AC	G	G	G	G	G	G	G	G	G	G	
Body, length.....	14.7	17.3	16.5	16.7	18.5	18.2	19.0	18.4	21.3	17.1	20.9	16.7	21.2	23.7	22.6	22.9	21.9	19.27					
Pronotum, length.....	3.0	3.6	3.0	3.4	—	—	3.3	3.5	4.0	3.3	4.0	3.4	3.7	4.0	4.0	3.8	3.3	3.55					
Pronotum, width.....	4.9	5.5	4.6	5.5	—	—	5.2	5.0	6.0	4.8	5.8	5.2	5.3	5.9	5.1	5.5	5.5	5.32					
Abdomen, from hind margin of pronotum.....	9.6	12.5	11.5	13.5	14.7	13.0	12.4	13.1	15.0	11.8	14.1	10.3	15.2	16.8	16.5	17.0	16.3	13.72					
Wing-cover**.....	7.5	8.5	6.9	8.0	10.0	10.0	7.2	8.1	10.5	7.8	10.5	7.2	8.9	10.5	10.0	9.8	9.3	8.86					
Wing-cover shorter (-) or longer (+) than end of body.....	-2.1	-4.0	-4.5	-5.5	-4.7	-3.0	-5.2	-5.0	-4.5	-4.0	-3.6	-3.1	-6.3	-6.3	-6.5	-7.2	-7.0	-4.86					
Hind femur.....	9.5	10.6	9.4	—	—	11.5	10.5	—	—	9.8	11.0	9.2	—	11.0	10.5	10.4	10.1	10.30					
Hind tibia (exclusive of spines).....	7.0	7.5	7.5	—	—	—	8.0	—	—	7.0	7.9	7.3	—	9.0	—	8.1	8.0	7.73					
Ovipositor.....	14.0	14.0	12.9	14.1	15.2	15.2	12.3	13.0	13.9	12.2	14.2	13.4	13.6	15.0	13.5	13.0	13.3	13.69					
Hind femur contained in ovipositor; times.....	1.47	1.32	1.37	—	—	1.32	1.17	—	—	1.25	1.29	1.47	—	1.36	1.29	1.25	1.32	1.32					
Percentage of abdomen covered by wing-covers.....	77	68	60	59	68	77	58	62	70	66	74	70	59	63	60	58	57	65 or 74					
Absence or presence of A-shaped notch between ends of wing-covers.....	No	No	Yes	No	No	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Gradate					

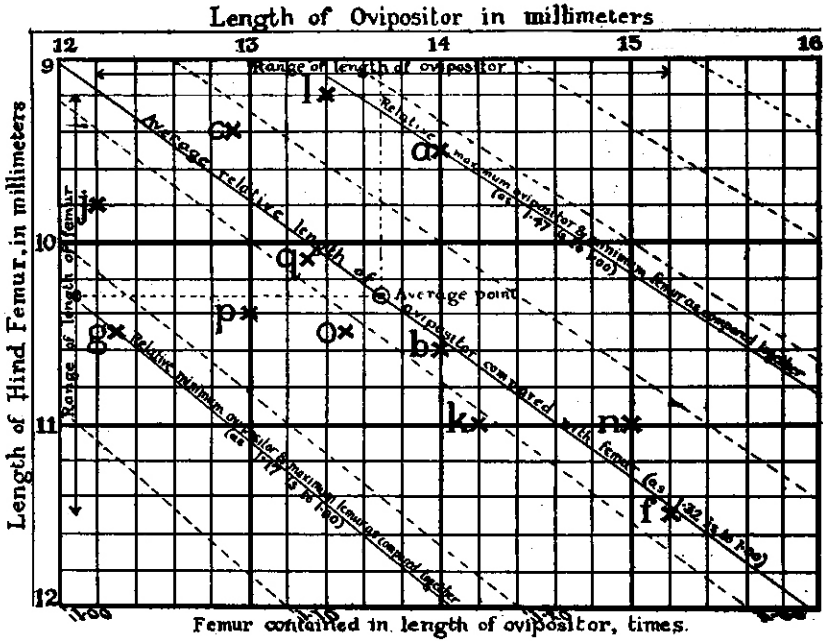
\*Collection: P = Piers; AC = Agricultural College, Truro; G = C. B. Gooderham, Truro. \*\*All hind wings are shorter than wing-covers.

Females *a* to *d* were taken on King's Meadow, Windsor, Hants Co., Sept., 1892 (see colour-description previously given; these four specimens determined in 1895 as *G. pennsylvanicus neglectus* by Wm. Beutenmüller of the Am. Museum of Nat. Hist., N. Y., author of Descriptive Catalogue of Orthoptera of New York, 1894); female *e*, Dutch Village Road, Halifax, 5 Sept. 1897 (see colour-description); female *f*, Quinpool Road, Halifax, 7 Sept. 1897 (see colour-description; taken in company with male *s*); female *g*, Kentville, Kings Co., 13 Oct. 1915 (see colour-description); females *h* to *q*, Truro, Col. Co., various dates Sept. and Oct. (some of them and of the preceding with notch between ends of wing-covers as in Blatchley's *G. americanus*); *n* to *q* were full of eggs and were measured from specimens preserved in formaline; male *r*, Rifle Range, near Bedford, Hx. Co., 2 Sept. 1896 (determined as *G. pennsylvanicus neglectus* by Beutenmüller); male *s*, Quinpool Road, Halifax, 7 Sept. 1897 (see colour-description; taken in company with female *f*); males *t* to *y*, Truro, Col. Co., various dates, Aug. to Oct., *x* and *y* being measured from specimens preserved in formalin. The measurements of the Truro specimens have been supplied by Mr. Gooderham.

*Extreme and average measurements of Nova Scotian specimens.*—As compared with various forms of American *Gryllus*, the males and females of our Nova Scotian variant vary in size from very small to medium, and average small in both sexes. The variation in size is considerably greater, however, in females than in males.—*Males* (8 specimens): length, 15.0-21.1 mm. (average 18.5 mm.); pronotum, length, 3.0-3.5 (average, 3.29); pronotum, width, 5.0-5.6 (average, 5.1); abdomen from hind margin of pronotum, 10.0-15.7 (average, 12.4); wing-covers, 8.8-11.0 (average, 9.94); wing-covers from 5.6 mm. shorter than end of abdomen, to 1.0 mm. longer than end of abdomen (average, 2.8 shorter); wing-covers cover from 6/10ths to 1 1/10th of the abdomen (average, 8/10ths); hind femora, 9.4-10.7 (average, 10.04); hind tibiæ, 7.0-8.3 (average, 7.5); anal bristles, 5.5-7.0 (in *r* and *s*).—*Females* (17 specimens): length, 14.75-23.7 mm. (average, 19.27 mm.); head, length, 2.7-3.0 (average, 2.87); head, width, 4.1-5.0 (average, 4.71, in *a-d*); pronotum, length, 3.0-4.0 (average, 3.55); pronotum, width, 4.6-6.0 (average, 5.32); abdomen from hind-margin of pronotum, 9.6-17.0 (average, 13.72); wing-covers, 6.95-10.5 (average, 8.86); wing-covers from 2.15 mm. to 7.2 mm. shorter than end of abdomen (average, 4.86 mm.); wing-covers cover from 57/100ths to 77/100ths of abdomen (average, 65/100ths or 2/3rds); hind femora, length, 9.2-11.5 (average, 10.3); hind femora, greatest width, about 3.3; hind tibiæ, 7.0-9.0 (average, 7.73); ovipositor, 12.2-15.2 (average, 13.69); hind femora contained in length of ovipositor, 1.17-1.47 times (average, 1.32 times); antennæ, 33 mm. (in female *e*) and 28.5 (in female *f*). In all specimens, male and female, the hind-wings are shorter than the wing-covers; the hind-wings being 8.0 mm. long in one female (*e*) which was measured, in which the wing-covers were 10.0 mm. None of the males have a  $\Lambda$ -shaped notch between the ends of the wing-covers; but in the females, 9 have such a notch more or less developed, while 8 are more or less without the notch, although in this feature complete intergradation is seen.

The following diagram illustrates graphically the relative length of the ovipositor as compared with that of the hind femur in twelve Nova Scotian females, about which such data are available, and makes clearer the range of departure from the normal proportions of those members as found in specimens in this province. It will be seen that specimens *b*, *q* and *f* approach nearest to the normal or average line, while the maximum departures are found in specimen *a* which exhibits the relative longest ovipositor, and in *g* which exhibits the relative shortest ovipositor as compared with the femur. The longest ovipositor, apart from comparisons with the femur, is actually found in specimen *f*, and the shortest one in *j*; while the longest femur is in

specimen *f*, and the shortest in *l*. Detailed measurements of each of the specimens are given in the full table of measurements on page 346.



*Gryllus pennsylvanicus neglectus*: Nova Scotian females.

Diagram illustrating the Relative Length of Ovipositor to that of Hind Femur. The letters are those designating the particular specimens in the preceding table of measurements.

Longest ovipositor actually, specimen *f*; shortest ovipositor actually, specimen *l*. Longest hind femur actually, specimen *f*; shortest hind femur actually, specimen *l*. Longest ovipositor compared proportionately with length of hind femur, specimen *a*; shortest ovipositor compared with hind femur, specimen *g*. Specimens nearest normal, *f*, *b*, *g*.

*Nomenclatural remarks on the Nova Scotian form.*—To sum up the question of nomenclature, I have no doubt that our common Nova Scotian Field Cricket is a shorter-winged variant of the form which has hitherto been known as *Gryllus pennsylvanicus*. Furthermore, without at all desiring to hold to an older nomenclature or to what may be an untenable hair-splitting of names in a genus the members of which, as we have seen, are being gradually bulked

together by specialists, I have decided, tentatively at least and as a matter of convenience, to place our form under the old name *Gryllus pennsylvanicus neglectus* of Scudder, for with that variant or subvariant it seems mostly to agree. No doubt the variants intergrade in various parts of America, and therefore their characters are of slight real classificatory value. My belief that our form is nearest Scudder's *neglectus*, is perhaps a matter of very unnecessary detail, and quite open to criticism at the present time when *neglectus*, once held to be a separate species, has become to most students a mere transitory phase of *pennsylvanicus*, and when, as we have noted on page 338, even all the American native forms of *Gryllus* have been by the two well-known authorities, Rehn and Hebard, very recently thrown together under one specific name, *assimilis* of Fabricius, those writers maintaining that all forms and colour-phases intergrade over wide areas. Still in a purely local paper like this, it is perhaps better for the present to endeavour to draw minor or closer distinctions, and so risk the charge of being over-exact; leaving to systematists with a much wider vision and material from extensive geographic areas, the task of finally assigning the form where it properly belongs, an undertaking which will probably be the easier for them because of such initial detailed treatment.

I may say that by *neglectus* I understand a rather small-sized, distinctly short-winged variety of the complex *pennsylvanicus*, in which the wing-covers of the female cover on an average only about two-thirds, or a trifle less or more, of the abdomen, and in which the ovipositor averages about 14 mm. or a little less in length and also averages less than half as long again as the hind femur. In the other short-winged or typical *pennsylvanicus* the wing-covers are considerably longer, reaching nearly to the end of the abdomen in the female.

Scudder's original description of *G. neglectus* (Boston

Journ. Nat. Hist., vol. 7, p. 428, 1862) may here be reproduced for comparison, as it is not accessible in most libraries:

"This is our most common species. . . . The head, thorax, and body, as well as the hind femora, are pitchy black, the elytra of both male and female are dark, sometimes jet black, but frequently of quite a light ochraceous brown; indeed, the elytra of almost all our species vary to this extent in coloration; the elytra of the females generally cover about two-thirds of the abdomen, although sometimes they entirely conceal it; those of the males extend to the extremity of the abdomen; the ovipositor in this species is proportionately shorter than in either of the preceding species [that is, *G. luctuosus*, *abbreviatus* and *angustus*], and is also a smaller species than any of the preceding. Length averaging a little more than half an inch; length of ovipositor in nine individuals .23 [i. e. .46 in. = 11.5 mm.] to .32 in. [i. e. .64 in. = 16.0 mm.], average .28 in. [i. e. .56 in. = 14.2 mm.]; length of hind femora, .16 [i. e. .32 in. = 8.0 mm.] to .21 in. [i. e. .42 in. = 10.5 mm.], average, .20 in. [i. e. .40 in. = 10.00 mm.]"\* [It will be observed that the length of the ovipositor averages 1.4 times the length of the femur; while in *niger* he gives it as only 1.11, in *angustus* and *abbreviatus* as 1.68, and in *luctuosus* as 1.55 times.]

Our form generally seems to agree most nearly with *neglectus* of Scudder, although a few specimens may show a tendency towards intergradation with the ordinary short-winged *pennsylvanicus* with somewhat longer wing-covers. Scudder in his paper just quoted, seemed mostly to rely on metric differences. Rehn and Hebard, along with other features, draw some attention to the all-black hind femora and normally dark unicolorous wing-covers of the *neglectus* variant; and to the brief reddish patch on the ventro-proximal portion of the femur and the dark or paler wing-covers of the *pennsylvanicus* variant. (See page 340). As we have seen, many of our specimens have a reddish patch on the femora.

As to the claim of *neglectus* to any recognition whatever, it may be mentioned that A. N. Caudell of the U. S. Department of Agriculture, in 1904-05 held that the smaller size and shorter wing-covers of Scudder's *neglectus* certainly entitle it to varietal distinction, and he refers to it trinomially as *G. pennsylvanicus* var. *neglectus*, even though Scudder himself, in 1902 had subordinated it as a synonym of Burmeister's *pennsylvanicus* (Can. Ent., vol. 36, p. 248, 1904;

\*I have doubled the lengths of ovipositor and femur as given by Scudder, for the reason that it is now known that he inadvertently used a half-size scale when measuring his forms of *Gryllus* in the paper of 1862. This has been pointed out by Caudell and other writers.

and Proc. U. S. Nat. Mus., vol. 28, p. 477, 1905). As late as 1910, Rehn and Hebard themselves, writing of *G. neglectus*, said that this form appears worthy of some designation whether specific or varietal (Proc. Acad. Nat. Sc. Phila., vol. 62, p. 647, 1910); and in 1915 they speak of *neglectus* and *pennsylvanicus* as two of the nine most frequently encountered, but unfixed, variants of *G. assimilis*, under which latter name they finally place all the variants (Proc. Acad. Nat. Sc. Phila., vol. 67, p. 302, 1915). They however advise against the use of special names to designate such variants. We may for the present conclude that *neglectus* is at least a convenient tentative name, although of very minor rank, and as such I have used it here.

I do not feel inclined to say that the form which has been known as the typical *G. pennsylvanicus* (such as described by Blatchley for instance) has yet been found in Nova Scotia, although a very few of our specimens show a slight tendency towards intergradation with that variant. Scudder in 1900 reported *pennsylvanicus* (= *niger* of his older list) as common in the southern half of New England. The so-called *abbreviatus* of authors, one would rather expect to find here, as Scudder in 1900 said it is common everywhere in New England; but it has not yet been reported from the Maritime Provinces, and I have met with nothing to cause me to include its name among our Orthoptera.

*Occurrence in Nova Scotia.*—The Short-winged Pennsylvanian Field Cricket, which I consider to be the variant previously known as *Gryllus pennsylvanicus neglectus* of Scudder, varies in abundance from rather common to very common in Nova Scotia, although it is not so excessively abundant as its lesser relative the Short-winged Ground Cricket (*Nemobius fasciatus*). It was not, however, definitely recorded from this province until 1896.\* I have never

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\*In 1894 I had reported it from Windsor, N. S., under the erroneous name of *Acheta abbreviata* (Trans. N. S. Inst. Sc., 8, 410). Strange to say F. Walker did not report it from Nova Scotia in his list of the Orthoptera of Canada (Can. Ent., iv, 1872). Walter Bromley's mere reference, in 1825, to "crickets" as occurring in Nova Scotia is altogether indefinite.

found the long-winged form here, although I have examined very many specimens, nor has C. B. Gooderham of Truro, and there are none of that form in the collection of the Agricultural College.

While rather common about Halifax, this cricket is not nearly so abundant here as in the western parts of the province, where in some districts at least it is excessively common. Although not often seen unless looked for, it is, however, moderately plentiful about this town, and not at all so rare as I supposed it to be when I prepared my previous paper. I have noted it at Westville, Pict. Co., in the middle of Sept., 1901, and no doubt it extends into Cape Breton Island, as it occurs also in Prince Edward Island, where it has been recorded as *G. pennsylvanicus*.

In the vicinity of Halifax it is usually found on dry, sloping banks, with scant vegetation and therefore somewhat earthy and having some flattish stones scattered about, on country roadsides, the borders of fields, and similar places. It does not seem to congregate in numbers much about here; but is usually met with in pairs, a male and a female, under small stones, and when the stone is lifted it runs rapidly about, this way and that, in a bewildered manner, looking for a hiding place or its little burrow. Its leaping power is plainly not so great as that of *Nemobius*, and it makes but short jumps, and prefers if possible to find a place of concealment by running away. Its timidity and secretive nature causes it to be seldom seen about Halifax; but its notes draw attention to its hiding-place beneath a stone or piece of rubbish, where it can easily be captured.

In the western part of the province it is much more numerous, more in evidence and less secretive, and is probably more social, being oftener seen with others of its kind about pastures as well as roadsides and banks. I observed it in immense numbers everywhere in the rather short grass



of the expansive King's Meadow, near King's College, Windsor, Hants Co., early in Sept., 1892, when it had laid aside almost all timidity, only moving from an approaching foot when the latter threatened to crush it;\* and in large numbers on the sparsely-grassed banks on the margin of dyked pasture-land at Kentville, Kings Co., in the middle of October, 1915; as well as at other places in the western districts. Its abundance at those places far exceeded that found anywhere about Halifax. It is possible that it may be more liable to congregate in the latter part of the autumn in some localities.

The eggs are deposited in loose soil in the latter part of the autumn; and as females taken at Truro, Col. Co., on 18th Oct., 1916, were full of eggs, that date no doubt indicates approximately the time of oviposition. The eggs hatch the following year, possibly early in June or thereabout, as on 5th June, 1915, Mr. Gooderham says he observed at Truro a few newly-hatched nymphs of an undetermined cricket but which was either this form or *Nemobius fasciatus*, both of which no doubt hatch about the same time. They moved and leaped rapidly, and until examined closely might have been mistaken for a flea-like insect. I have never noted adults in the spring or early summer, as in Ontario and other places to the south where nymphs hibernate to some extent.

If this cricket does hatch early in June, adults should be about during the lattermost part of July; but if so they must be silent at that time, as I have not noted them then. Its notes or shrilling, which are produced in a similar manner to those of *Nemobius*, are apparently first heard near Halifax about the 2nd August,† and approximately at the same time as those of the smaller cricket, although at first I find it difficult to distinguish the notes of the larger species, as both call very faintly at that time. They are frequently heard during both day and night in suitable places; but by October

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\*With it was *N. fasciatus*, but the larger species far outnumbered the smaller one.

†2 Aug., 1897, 8 Aug. 1916. The doubtful date "17 (?) July" given for first appearance of adult *G. pennsylvanicus* in table on page 232, should read about 2nd Aug.

the number heard has much lessened in daytime and few or none shrill at night; and often none are noted during some days in the latter part of that month, although the little *Nemobius* is then chirring. The last one heard in 1897 was on 5th Nov., about noon, it being a fine sunny day although a hoar-frost had occurred the previous night. The period of their stridulation, therefore, is about coincident with that of *Nemobius*; and like the latter, this insect is rather silent during dull days.

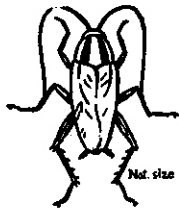
A close observer can readily learn to distinguish the shrilling of the larger cricket, when in full song, from that of *Nemobius*, although they have many tonal characteristics in common. The note of our *Gryllus* is considerably louder, and is a shorter, slower-timed, and more distinct and noticeable trill than that of its smaller relative. It sounds like the trilled syllable *plee-e-e*. After each such trill it is silent for a moment and then calls again, thus: *plee-e-e; plee-e-e;* and so on. These notes sound out distinctly louder and more staccata from the omnipresent undertone and lower-toned tremolo resultant from the intermingled shrilling of countless numbers of *Nemobius* on all sides. When both species call more faintly at the beginning of the season, it is much more difficult to differentiate between the two.

No doubt this species does considerable damage to pasture land in the western parts of the province, but about Halifax its abundance is not sufficient to make it a pest to the agriculturist, the Striped Ground Cricket being the one which creates most injury in the latter district.

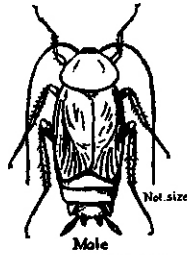
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#### ADDENDA

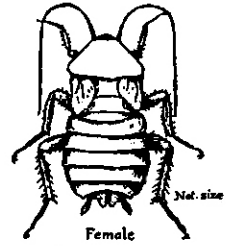
Page 268. A nymph of *Chorthippus curtipennis* (green phase) in about 4th stage was taken at the head of the North West Arm, Halifax, 23 June, 1918. —Page 306 and 232. Nymphs of *Melanoplus bivittatus* in about 1st, 2nd and 3rd stages, and from 5½ to 14 mm. long, were taken at the head of the North West Arm, 22-23 June, 1918. Hoar frost and ice ¼ inch thick formed there on morning of 21 June.



1. *Blattella germanica*



Male



Female

2. *Blatta orientalis*

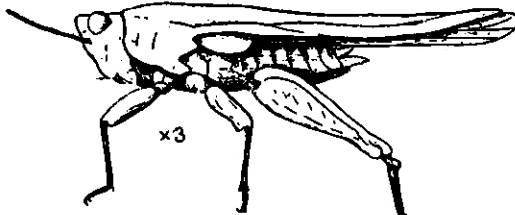


Dorsal view



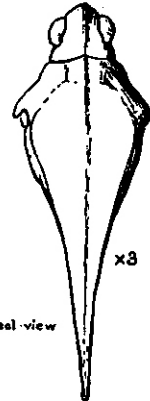
x3

3 *Nomotettix cristatus*  
Short-pronotum form Female  
(North West Arm, Halifax, N.S.)



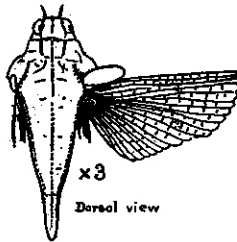
x3

4. *Acrydium granulatum*  
Long-pronotum form, Female.



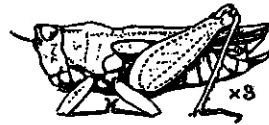
x3

Dorsal view



x3

Dorsal view



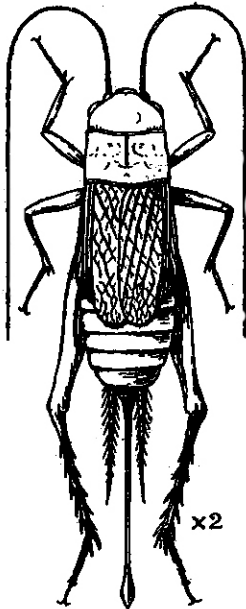
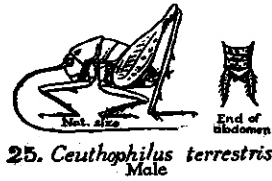
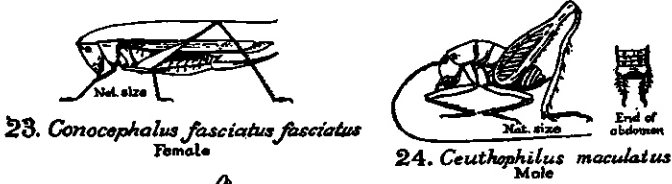
x3

5. *Acrydium arenosum angustum*  
Short-pronotum form Female  
(Truro, N.S.)

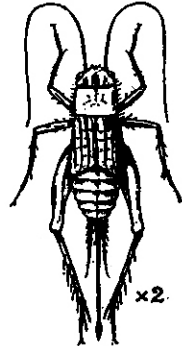
(H. Piers del.)

ORTOPTERA OF NOVA SCOTIA.  
(To illustrate paper by H. Piers)

The numbers are the same as those preceding the name of the species in the text of the paper.



28. *Gryllus pennsylvanicus*  
Short-winged form (*neglectus*) Female  
Average Nova Scotian specimen



26. *Nemobius fasciatus*  
Short-winged form. Female

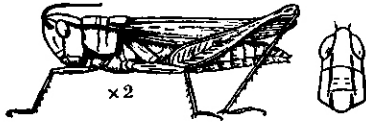


27. *Nemobius carolinus*  
Female

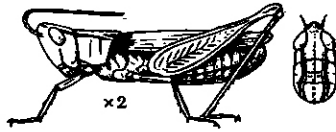
H. Piers det.

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6. *Orphulella speciosa*  
Female



7. *Chorthippus curtippennis*  
Male



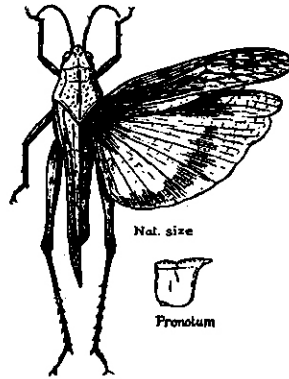
8. *Mecostethus lincatus*  
Female



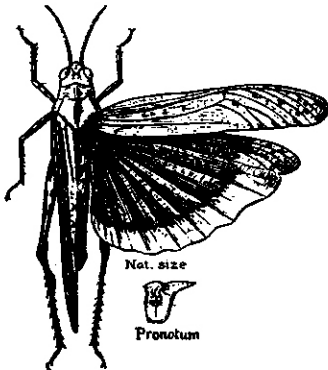
9. *Mecostethus gracilis*  
Male  
(Cow Bay, etc.)



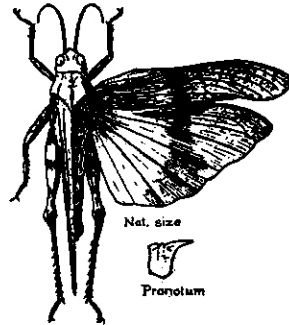
10. *Camnula pallucida*  
Female



11. *Hippiscus apiculatus*  
Male



12. *Dissosteira carolina*  
Male



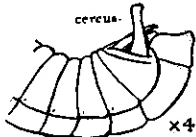
13. *Circotettix verruculatus*  
Female

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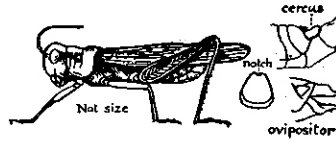
ORTHOPTERA OF NOVA SCOTIA.

(To illustrate paper by H. Piers)

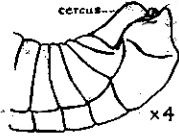
The numbers are the same as those preceding the name of the species in the text of the paper.



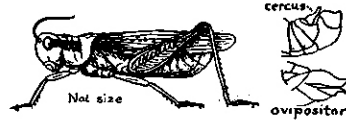
14. *Podisma glacialis*  
Male  
(Side view of end of abdomen)



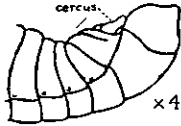
15. *Melanoplus atlantis*  
Male



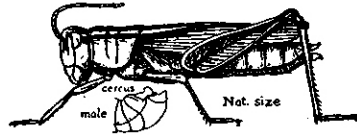
16. *Melanoplus fasciatus*  
Male



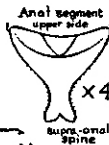
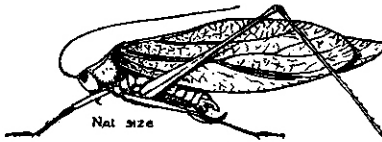
17. *Melanoplus femur-rubrum*  
Male



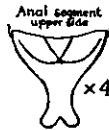
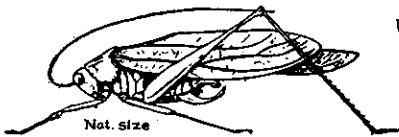
18. *Melanoplus extremus*  
Male



19. *Melanoplus bivittatus*  
Female



20. *Scudderia pistillata*  
Male  
(Chocolate Lake, Halifax, 10 Sep. 1916)



21. *Scudderia curvicauda borealis*  
Male  
(Wilmot, N.S., 6 Sep. 1915)

H. Piers del.

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