STUDIES IN THE BIOLOGY OF NORTH AMERICAN ACRIDIDAE: THE EGG-SAC AND EGG

By Norman Criddle

PREAMBLE TO PUBLICATION OF THE ORIGINAL MANUSCRIPT

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Norman Criddle was appointed as the officer in charge of the Dominion Entomological Laboratory, Treesbank, Manitoba in 1913, and remained in that position until his death in May 1933 (Gibson and Crawford 1933; Holliday 2006). At the time of his death, Criddle was planning three major publications on grasshoppers, one on eggs and egg-sacs, one on nymphs, and one on the natural history of grasshoppers, but none of these had been submitted for publication. According to Criddle's personal friend, J.B. Wallis, who bemoaned the loss of all three papers (Wallis 1954), submission was delayed because Criddle wanted to include all stages of all species in Manitoba, and a few remained to be obtained.

The archives of the Entomological Society of Manitoba have harboured the original handwritten manuscript and a typescript of the papers on natural history and on egg-sacs and eggs; these must be regarded as incomplete in Criddle's view, but nevertheless are major contributions to knowledge of grasshopper biology. A modified form of the natural history paper was posthumously presented at a conference and published as part of the conference proceedings (Criddle 1933). Volume 75 of the Proceedings of the Entomological Society of Manitoba contains a republication of the natural history paper (Criddle 2020), restored to be as close as possible to Criddle's original wording and organization, and with the removal of errors apparently introduced by the editors of Criddle (1933). Criddle (2020) is available online so is much more accessible than Criddle (1933).

No trace has been found of the work on nymphs. Earlier, Criddle had published descriptions of the eggs and nymphs of nine species (Criddle 1924) and descriptions of the nymphs of 31 species of grasshoppers in Manitoba (Criddle 1926). However, neither of these is the paper referred to as the third part of the trilogy in the introductions to Criddle (1933, 2020) and to the egg paper presented here.

Criddle (1918) contains some information about grasshopper eggs and egg-sacs, as does Criddle (1924). However, it was not until 1925 that Criddle began to rear grasshoppers systematically with the aim of describing egg-sacs, eggs, and nymphs. The paper on egg-sacs and eggs of grasshoppers that we present here is a result of those rearing studies, and has not previously been published in any form. It contains descriptions of the eggs and egg-sacs of 72 species of grasshoppers, with keys to allow many genera to be distinguished. As is evident from the acknowledgment in the introduction, the text was to be accompanied by photomicrographs,

probably one representing the egg chorion structure of each species. Unfortunately, there is no trace of these photographs, and so references to them have been removed from the text. Microscope slides of chorions of eggs were prepared by Criddle and his colleagues, some even after Norman Criddle's death. Slide preparations are not available for the eggs of all species included in the manuscript below. Furthermore, the specimens on the slides are not necessarily those used by Criddle in preparing the species descriptions and keys in his paper. These slides became part of the collections of the J.B. Wallis/R.E. Roughley Museum of Entomology at the University of Manitoba, and so are available for study. A list of these holdings, compiled by T.D. Galloway, is provided as an appendix to this publication.

There are two papers subsequent to Criddle's works in which grasshopper eggs were prepared and described in similar ways to those used by Criddle. Bushland (1934) described, and provided photomicrographs of, the chorion of 18 species of grasshoppers in South Dakota; as 14 of these are taxa described in the Criddle's work, Bushland's photomicrographs may be used as a substitute for some of the missing photographs. Tuck and Smith (1939) described the eggs of 48 species of grasshoppers in Kansas; their publication includes photographs of whole eggs at low magnification for 24 taxa described in Criddle's work, and high magnification drawings of chorion sculpture of seven of these taxa. In neither of these papers do the authors indicate awareness of Criddle's studies in Manitoba and, unlike Criddle's work, no species-specific descriptions of egg-sacs are provided.

Criddle was writing at a time before the current practice of citing sources with a corresponding reference list; indeed, most publications in *The Canadian Entomologist* in the early 1930s had no indication of the sources of previously-published information. For the current paper, Criddle provided a list of some relevant information sources but there are no citations in the text.

We have retained Criddle's scientific nomenclature for insects. Criddle's use of parentheses around authorities for scientific names was variable, and we have corrected errors of this type without notation of the correction. Where scientific nomenclature or authority designation now differs from that used by Criddle, we have included the current nomenclature in square brackets in addition to the original rendition. Current nomenclature of Orthoptera is from Cigliano *et al*. (2022), but with some interpretations derived from Vickery and Kevan (1985). Square brackets are also used to signify other insertions by the writers of this preamble. Mainly, these are to provide explanations of the treatment of deviations of current acridid classification from those used by Criddle, to clarify the meaning of Criddle's wording, to provide the current subfamily designation for each species description, or to indicate where Bushland (1934) or Tuck and Smith (1939) contain illustrations relevant to Criddle's species descriptions. With these exceptions, except when there were clearly errors in spelling or typography, we have reproduced Criddle's original wording, and his often idiosyncratic punctuation and key structure.

The authors of the preamble acknowledge the valuable comments of the anonymous reviewers. These comments helped in the presentation of a historic scientific document, the author of which could not be consulted for clarification of intent or meaning. The document has scientific significance in addition to its historical importance: it contains descriptions of eggs and egg sacs

that, for many species, to our knowledge, are not to be found anywhere in the published literature.

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INTRODUCTION

Hitherto the classification of the Orthoptera in North America has been based wholly upon the structures and colour of adults. This, in view of our ignorance concerning the immature stages of development, was necessary. The final arbiter, however in any classification must have a full knowledge of all phases of the insect's life. Such information is usually acquired slowly and it is generally necessary to add a few details at a time. To date, however, the contributions in respect to Orthoptera have been extremely meagre and with the exception of a few life-histories worked out by C.V. Riley and his associates G. Thomas and A.S. Packard, little has been done to enlarge upon our knowledge of this important order of insects.

My own studies of the immature stages of the Orthoptera began, in a fragmentary way, some 30 years' ago but it was not until 1925 that actual rearing of the various species was begun. Unfortunately the acquisition of material has been far from easy. For reasons which it is unnecessary to enter into, most entomologists have an aversion to collecting Orthoptera; moreover there is a certain amount of technique required in rearing, or keeping the insects alive a knowledge of which is seldom possessed. Under these circumstances I have been obliged to rely very largely upon my own efforts to obtain the required material and as a result many desirable species remain unstudied. It is felt, however, that enough is known to warrant the preparation of a preliminary paper, but since it has not been possible to find a medium for publication of the entire study, this has been divided into sections the first of which will deal with the egg-sacs and eggs. This it is hoped will be followed by one on the nymphal instars and another on general habits.

While this study relates chiefly to the Manitoban species a number of others from different parts of Canada and the United States are included and in this connection I am pleased to acknowledge assistance from a number of persons including Mr. E.R. Buckell of the Dominion Entomological Laboratory, Vernon, B.C. to whom I owe all the material from British Columbia. Mr. H.L. Seamans of the Entomological Laboratory, Lethbridge, Alberta, has aided me in securing living specimens from that province and Montana, while Messrs. K.H. King, George Manson, and P.C. Brown, all of the Dominion Entomological Branch, have performed a similar service in Saskatchewan. In Manitoba I have had the aid of Messrs. R.M. White, R.H. Handford and R.H. Painter of the Treesbank Laboratory, Mr Shirley Brooks of Transcona, and Mr. J.B. Wallis of Winnipeg; while my brothers, Evelyn and Stuart, and my sister Miss M. Criddle, have aided me in rearing work. To Messrs. George Stirrett and George Hammond of the Entomological Branch I am indebted for individual species from Ontario and Quebec. Finally my appreciation is extended to Dr. J.R. Parker and Mr. Robert Shotwell of the United States Bureau of Entomology,

Bozeman, Montana, for eggs of *Melanoplus differentialis* and [*Melanoplus*] *bivittatus* from Utah and South Dakota and to Mr. Morgan Hebard of the Academy of Natural Sciences, Philadelphia for the determination of several doubtful species. The micro-photographs were taken by the Branch Artist, Mr. Frank Hennessey.

On making a study of the egg-sac of the Acrididae it has become manifest that there is considerable variation in the size and shape of the sac even in the same species. This is, in part, due to the resistance encountered by the grasshopper in drilling the egg-sac cavity but also to a variation in the number of eggs deposited at one time, or to the age of the insect. These variations from normal are most frequently met with towards the end of the egg-laying period when the capacity of the female for reproduction is almost exhausted. At such time some individuals may deposit very few eggs or occasionally a sac without any. Another feature encountered at such times is a lack of a neck, or upper empty portion of the sac in species which normally provide one. It is important, too, to bear in mind that the sacs assume entirely different proportions with the development of the eggs within them. Thus when first deposited the sac may be quite narrow and the eggs tightly packed, but towards the time of hatching the sacs become so greatly distended that they burst asunder and consequently lose much of their original shape. There are, however, a number of exceptions to this rule mostly encountered in the "Acridinae" [See the section "Guide to 'Acridinae'" for explanation of Criddle's use of this epithet] when the sacs are sometimes very strong. In all such cases the eggs are less closely packed, thus allowing for an expansion of the eggs without breaking the sacs.

Apart from the variations mentioned above the sacs are fairly uniform, the texture is quite constant and arrangement of the eggs only varies within certain limits, such, for example, as the number of rows. In many instances the shape of the sac is quite characteristic and while it does not usually differentiate between species, many genera are easily recognised. In all cases, however, it is wisest to make determinations from a series of egg-sacs, thus escaping the pitfalls to which an abnormal sac might lead.

Those attempting to classify the eggs will also be confronted by a number of obstacles, the most important of which is a stretching of the chorion due to the development of the embryo and the consequent enlargement of the pattern. In some instances, the reticulation, after the development of the embryo, is practically twice the size it was before development. This enlargement of the meshes is chiefly in a transverse direction, the swelling being much greater in width than length. On account of this variation the size of the egg-pattern is a character to be used with reservation and with a knowledge of the variation within the species.

Another fact that should be noted is that in some groups of species the egg-pattern is very easily displaced and in consequence perfectly preserved eggs are rare. This is particularly true of the central tubercle found in the reticulation of certain Oedipodinae. An ideal comparative study would provide all eggs at exactly the same age. It is a lack of much uniformity in the present work which proves one of its most serious defects.

In the notes which follow the arrangement of the genera and species is based on the zonal studies of Morgan Hebard, with such modifications as are suggested by the characters under review. The

idea has been to indicate relationships rather than provide a linear arrangement from high to low or vice versa. Thus several species may be grouped together due to apparent affinities but whether they should be placed before, or after, other groups is a problem which we have not attempted to solve. Also it should be remembered that the study of other species, or genera, and of the nymphal instars may greatly alter the arrangement here presented in which undue weight may have been placed upon the characters of the egg-sac and egg.

The subfamily Acrydiinae [now family Tetrigidae] has been purposely omitted, the immature stages having been reviewed by J.L. Hancock (1902).

We should add that, unless otherwise indicated, all species studied came from Manitoba.

GUIDE TO THE "ACRIDINAE"

[Acridinae remains a valid subfamily; however, with the exception of *Stethophyma* which is now within the subfamily Oedipodinae, all taxa Criddle treated in this section are now in the subfamily Gomphocerinae. To maintain the integrity of his key, we have retained Criddle's use of "Acridinae", but identify it as no longer valid by placing it in quotation marks. The current subfamily of each species is given in the headings of individual species treatments below].

Egg-sac, when present, short rarely more than three times as long as wide and, with the exception of *Stethophyma,* having thick, tough walls and frequently an oblique opening. Or more elongate slender with thin tough walls which, in most cases, are closely wrapped round the eggs. Eggs in the shorter sacs, most frequently smooth without definite markings, those in the slender sacs reticulated or not, dividing lines of reticulation never tuberculate and the meshes without a median tubercle. Of the two genera without sacs *Acrolophitus* has reticulated eggs, *Psoloessa* smooth ones. In several genera the egg-sacs are capped by a detachable stopper and in some the eggs have a button-like projection at the posterior extremity.

"Acridinae" Affinities

A study of the egg-sac and egg indicates that some of these fall into well defined groups while others are more difficult to place. Among the genera to which no definite place can be assigned are *Acrolophitus* and *Stethophyma*. In the arrangement of the eggs and in the egg-pattern they seem to show affinities, in other characters they are totally unlike.

There seems no doubt that *Acrolophitus* is a member of the "Acridinae"; this is suggested in the habits, egg-stage and nymphal instars. Doubtless the rearing of other genera will assist in placing it correctly.

There is little doubt but that *Opeia* and *Amphitornus* form a natural group, this is especially suggested by the egg-sacs with their detachable stoppers and other peculiarities. To this group we suspect *Cordillacris* should be added. The close relationship is indicated by the egg-sac, eggs and nymphal instars.

The placing of the groups which follow is open to greater criticism. If we based our classification on the egg-sacs, and to a lesser extent upon the eggs, then a natural arrangement would seem to be to place all those species with thick sacs together and follow with the thinner more elongate ones. The shape of the sacs and arrangement of the eggs within them also favours this classification.

Adopting these suggestions we would follow the group headed by *Opeia* with the obviously closely related genera *Gomphocerus* [*Aeropedellus*] and *Ageneotettix* and continue with their apparent allies *Bruneria* and *Aulocara*. *Chorthippus* [*Pseudochorthippus*] seems to have a place near here and it shows some affinities to the thin sac groups such as *Orphulella* and *Chloealtis* [refers to *C. conspersa*] which, however, is more evident in the nymphal instars. We are at a loss to place *Phlibostroma*: its elongate, abnormal shaped sacs are so very unlike any others. The eggs and their arrangement suggest those of *Psoloessa* and despite the lack of a sac in the latter species we are tempted to put the two together. The similarity of the nymphs also indicate that this is their correct position. We have by the above classification run gradually into the thin coated, elongate sacs and *Orphulella* seems to follow rather naturally, the sacs resemble those of *Chloealtis* [*conspersa*] and *Chrysochraon* [refers to *Chrysochraon abdominalis*, which is now *Chloealtis abdominalis*] but lack a detachable stopper. The two species under review, namely [*Orphulella*] *speciosa* and [*O.*] *pelidna* are rather dissimilar both in the egg and nymphal stages and may represent different genera.

The genus *Chloealtis* [*C. conspersa*] seems to come next with *Chrysochraon* [*Chloealtis abdominalis*] following. They have a number of features in common, to which might be added the habit of both in depositing their eggs in wood or dung. The egg-pattern of the latter, however, seems to definitely segregate them.

In *Stethophyma* with its short polished egg-sacs and strikingly marked eggs, we encounter a deviation from all others. The eggs recall those of *Acrolophitus*, while the nymphs are not unlike similar stages in *Chloealtis* [*conspersa*] and *Phlibostroma.*

Key to the Genera of "Acridinae"

[**Note:** the generic epithets in this key are those used by Criddle; the reader should consult the species treatments that follow to find the current names of taxa.]

	Sacs absent, the eggs unprotected	1
	Sacs well defined	2
1	Eggs upright, resting on the same level, dark in colour, usually six in number, length 7 mm	*Acrolophitus*
	Eggs in elongate rows, 12 to 16, colour creamy-white; length 5.5 mm.	*Psoloessa*
2	Walls of sac thick	3
	Walls of sac thin	9
3	Entrance to sac with a detachable stopper	4
	Entrance to sac without a detachable stopper	5
4	Top of sack horizontal, number of eggs 10 or 11	*Opeia*

	Top a little at an angle, number of eggs 4	*Amphitornus*
5	Top of sac at a distinct angle	6
	Top of sac horizontal, number of eggs 2 to 5	*Cordillacris*
6	Sacs elongate-cylindrical of about equal width throughout	8
	Sacs pyriform, oval or sub-cylindrical rarely more than twice as long as wide	7
7	Sacs elongate-pyriform, the upper part tapering to an obtuse point, number of eggs 5 to 14	*Chorthippus*
	Sacs oval or more broadly pyriform the upper part not gradually tapering, more definitely angulate, number of eggs usually 6	*Gomphocerus*
	Sacs smaller, eggs 3 to 5	*Ageneotettix*
8	Opening to sac widely angulate, length of sac 10 to 16 mm; eggs 5 to 6	*Bruneria*
	Opening to sac obscurely angulate, opening small; length of sac 12 to 20 mm, eggs 4 to 7	*Aulocara*
9	Sacs elongate-cylindrical	10
	Sacs sub-equal in width and length	13
10	Sacs in the form of loose sacking through which the outline of the eggs is plainly visible	11
	Sacs closely woven in appearance, through which the eggs are not visible; length 24 mm. number of eggs 16	*Phlibostroma*
11	Sacs always in wood or dung, the top with a detachable stopper	12
	Sacs only in soil, without a detachable stopper	*Orphulella*
12	Eggs hispid or tuberculate the pattern well defined	*Chrysochraon*
	Eggs smooth, or nearly so, the reticulation, if present, hidden by a coating of opaque matter	*Chloealtis*
13	Sacs leather-like, shiny without particles of earth attached; chorion closely wrapped round the eggs, the outline of which is everywhere visible. Number of eggs 4 to 24	*Stethophyma*

Acrolophitus hirtipes (Say) [Gomphocerinae]

Egg-sac.– There is no egg-sac, the eggs merely placed side by side in the earth.

Egg.– The eggs rest together in an upright position and may be partly attached to each other by a sticky material exuded by the female grasshopper. The usual number of eggs deposited at one time is six although they may number as high as eight. The eggs are large, the posterior cap constricted and distinctly produced; ring a little concave with a median dark line of close-set, elongate punctures. Chorion thick; reticulation coarse, the meshes round or indefinitely angulate, dividing walls wide, rugose or minutely hispid. Colour clay-yellow becoming reddish-brown with age; length 7 mm.

Opeia obscura (Thom.) [Gomphocerinae]

Egg-sac.– Cylindrical or sub-cylindrical not unlike that of *Cordillacris*, a little wider below and with an egg-free neck of about half the total length. The top is capped by a close-fitting, concave stopper made of chitinous-like material. The walls are moderately thick but brittle. Length 8 to 12 mm, greatest width 5 mm.

Egg.– The eggs rest a little oblique, there being usually five on almost the same level and a few others, less closely packed, lower down. They usually number 11 to a sac. The eggs smooth, opaque, but with age the surface develops innumerable elongate cracks. The posterior cap is produced into an obtuse, button-like, protuberance and the posterior ring is indicated by a row of elongate punctures. Colour creamy-white; length 5 mm.

The specimens were obtained from Estevan, Sask.

***Amphitornus bicolor* (Thom.) [*Amphitornus coloradus coloradus* (Thomas)] [Gomphocerinae]**

Egg-sac.– Sub-cylindrical, usually curved, about twice as long as wide; walls thick and very tough; top closed by a shallow bowl-like stopper which is readily detached. Length 6 to 8 mm, width 3.5 to 4 mm.

Egg.– Four in number arranged in pairs so that the lower ones are about a sixth of their length below those above. Posterior cap with a button-like extremity, the ring indicated by a series of fine, short transverse punctures; surface shiny without marks; colour pale cream, the posterior end darker; length 5 mm.

***Cordillacris occipitalis cineria* (Thom.) [*Cordillacris occipitalis* (Thomas)] [Gomphocerinae]**

Egg-sac.– Short cylindrical, in some instances sub-oval, averaging nearly three times as long as wide, there is a short egg-free neck which is deeply concave on top although no definitely detachable stopper is discernible. The walls are moderately thick and spongy. Length 6 to 14 mm.

Egg.– There are two to five eggs resting perpendicular to the opening, they may be on the same plane or at slightly different elevations. Eggs rather small, smooth, polished without markings other than a narrow posterior ring of elongate punctures and a button-like extremity. Colour pinkish-yellow with a whitish bloom, posterior cap paler; length 4.5 mm.

***Gomphocerus clavatus* Thom. [*Aeropedellus clavatus* (Thomas)] [Gomphocerinae]**

Egg-sac.– Sub-cylindrical, about twice as long as wide, often sub-round or narrowly pyriform, the opening an angle, wide, a little concave. Empty neck very short; walls thick and tough. Length 6 to 8 mm.

Egg.– Number of eggs to a sac usually four rarely five, these are almost perpendicular and form two rows, the lower overlapping the upper one to about half their length. The eggs are smooth or very slightly wrinkled, the posterior cap button-like, ring normal. The surface rarely shows an obscure reticulation which looks as if it had been painted over. Colour creamy-white, the posterior extremity darker; length 6 mm.

***Ageneotettix deorum* (Scud.) [Gomphocerinae]**

Egg-sac.– Sub-pyriform or oval, the upper empty portion moderately, to very short or absent; opening as in *Gomphocerus* [*Aeropedellus clavatus*]: walls very thick and tough. Length 8 to 14 mm, width 7 mm.

Egg.– Three to five in number, arranged at slightly different elevations. Posterior extremity with a button-like knob; surface polished, smooth; colour creamy, the button darker; length 5 mm.

The egg-sacs are so tough that they retain their form for several years.

***Ageneotettix occidentalis* Brun. [now synonymized with *Ageneotettix deorum* (Scudder)] [Gomphocerinae]**

Egg-sac.– There is no appreciable difference between this and that of [*A.*] *deorum.*

Egg.– We can find no distinguishing features to separate this from the above mentioned species.

Specimens were obtained from British Columbia.

***Bruneria brunnea* (Thom.) [Gomphocerinae]**

Egg-sac.– Short, sub-cylindrical, usually more curved on the ventral side and flattened on the upper dorsal margin, the opening being at a distinct angle. Walls thick, tough and rather firmly attached to the eggs. Length 10 to 16 mm, width 4.5 to 5 mm.

Egg.– The eggs are five or six in number arranged in two rows at unequal heights, but overlapping. Since the sac rests obliquely in the soil the eggs are actually almost on the same level and their tips approximate the wide flattened area which constitutes the opening. The eggs are semi-smooth with what appears to be obscure reticulation, mostly hidden by an overcoating of varnish-like material. Cap — sub-button like; ring punctate; colour pale cream; length 5.5 mm.

***Aulocara elliotti* Thom. [Gomphocerinae]**

Egg-sac.– Elongate-cylindrical, of almost equal width throughout; empty neck occupying almost half the total length of sac; walls thick and tough. Length 12–20 mm.

Egg.– The eggs vary in number from two to seven, the average being five, they are in two overlapping rows being practically on a level when the row rests naturally on its side. The posterior extremity is little produced, the usual row of punctures rather obscure. Surface polished without reticulation. Colour creamy-white; length 5.5 mm.

The sacs might be mistaken for those of *Camnula*, the opening however, is nearly always on a slant and the eggs are quite different.

***Chorthippus curtipennis* (Harr.) [*Pseudochorthippus curtipennis curtipennis* (Harris)] [Gomphocerinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-pyriform with a varied length of empty neck comprising from a third to half the length of sac. This neck tapers almost to a point so that the opening is usually small. The walls are rather thick and tough. Length 10 to 14 mm, width 5 to 7 mm.

Egg.– The eggs are practically on a level and they point directly upward, varying from 5 to 14 in number. Posterior cap widely rounded the extremity produced into broad, flat knob or button; ring indicated by the usual row of punctures. Surface faintly reticulated but hidden, as a rule, by an overcoating of varnish-like material. Colour creamy-white; length 5.5 mm.

***Phlibostroma quadrimaculatum* (Thom.) [Gomphocerinae]**

Egg-sac.– Elongate-cylindrical, slightly wider below, a little constricted at middle; the egg-free neck occupying half the total length of sac; walls rather thin but tough, paper-like, usually with roots embedded in them; length 24 mm.

Egg.– The eggs are in three row formation the rows at different elevations; there are an average of 16 eggs to a sac. Posterior cap a little produced, the ring obscure; surface smooth except the cap which is reticulated; cap brownish the rest flesh colour; length 5 mm.

Specimens obtained in Saskatchewan and Alberta.

***Psoloessa delicatula delicatula* (Scud.) [*Psoloessa delicatula* (Scudder)] [Gomphocerinae]**

Egg-sac.– Practically non-existent, it consists of a small amount of frothy matter deposited with the eggs to which a certain amount of earth adheres. This latter is easily removed and the eggs are then nude. Length of egg-mass 12 to 18 mm.

Egg.– The eggs are arranged in rather regular order of two, three, or four rows, usually two; there are from 6 to 16 eggs to a sac. The eggs are without markings other than an obscure posterior ring of elongate punctures. Colour cream, the surface sub-transparent, polished; length 5 to 6 mm.

***Orphulella speciosa* (Scud.) [Gomphocerinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-cylindrical, the walls thin but tough, wrapped closely round the eggs, not unlike coarse sacking through which the eggs bulge, this coating is glued tightly to the eggs. Length 18 to 20 mm., width 3.5 mm.

Egg.– The eggs are irregularly placed without definite arrangement, they vary in number but average 10 to a sac. The chorion is smooth but it is possible that the outer coating may hide an

obscure reticulation of which, however, there is little indication. The posterior cap is not button-like at its extremity and the ring is indefinite. Colour dark cream, length 4–5 mm.

***Orphulella pelidna* (Burm.) [Gomphocerinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Similar to that of [*O.*] *speciosa*. Length 20 mm.

Egg.– Arrangement as in the former species they number from 6 to 14 to a sac. Posterior ring smooth with a row of elongate punctures; surface reticulated, but often obscurely so, or not discernible; the posterior cap, however, is always reticulated. Colour creamy-white; length 4.5 mm.

***Chloealtis conspersa* (Harr.) [Gomphocerinae]**

Egg-sac.– Elongate-cylindrical, rather narrow, about a third free of eggs. The walls are thin and they fit closely round the eggs the outline of which is discernible. Top capped by a saucer-like, shiny, detachable stopper; length 20 mm.

Egg.– The eggs are in two rows of uneven elevation and average 10 to a sac. The posterior cap is a little dilated and the ring indicated by a row of elongate punctures. Surface very obscurely reticulated due to a surface coating and the uniform colour which is cream, the extremities a little darker; length 5 mm.

***Chrysochraon abdominalis* Thom. [*Chloealtis abdominalis* (Thomas)] [Gomphocerinae]**

Egg-sac.– Elongate-cylindrical, the egg-free upper part approximating a tenth of the total length. Walls thin but tough, the opening capped by a concave, detachable stopper. Length 19–22 mm.

Egg.– The eggs are in an irregular two row formation and number 7 to 10, they are quite firmly cemented together with coarse frothy matter. Posterior cap a little produced, the ring with the usual line of elongate punctures. Surface in the form of elongate depressions and curved rows of sharp tubercles. Viewed from certain directions it appears reticulated. Colour pale yellow becoming darker with age. Length 5 mm.

***Stethophyma lineatum* (Scud.) [Oedipodinae]**

Egg-sac.– Very irregular in shape, pyriform or horizontally longer than high, usually pointed, the surface thin leather-like, polished, without adhering particles of earth; walls fitting closely round the eggs so that their outline is plainly showing.

Egg.– The eggs are in regular rows of from two in the smallest sac to four in the larger ones; they rest on a concave plane, and when the sacs lie on their sides, in a natural position, point directly upwards. These number from 4 to 28 eggs to a sac; they are firmly stuck together and difficult to clean. Posterior ring wide, its upper edge with a row of elongate punctures; chorion

thick, opaque; reticulation well defined the meshes round or obscurely angulate, dividing line wide a little rugose; meshes with a small central tubercle. Length 5.5 mm.

***Stethophyma gracile* (Scud.) [Oedopidinae]**

Egg-sac.– Similar to that of [*S.*] *lineatum* from which no constant difference has been discovered.

Egg.– Tightly packed as in [*S.*] *lineatum* averaging 24 to a sac, shape similar. The pattern seems to be distinctive but this may be due to the freshness of the eggs; length 5 mm.

GUIDE TO THE OEDIPODINAE

Egg-sac elongate-cylindrical, three or more times as long as wide; the walls either thick or thin, but never very tough. Eggs always in elongate rows and, with the exception of *Encoptolophus* and *Chortophaga*, always with a definite pattern, the meshes of the reticulation, in many instances, with a median tubercle. In general those eggs without the median tubercle become brown with age, or have pale streaks. This, with a few exceptions, distinguishes them from eggs of the "Acridinae" or "Cyrtacanthacrinae" [See the section "Guide to the 'Cyrtacanthacrinae'" for interpretation of this name]. The eggs of eight genera, namely *Pardalophora*, *Xanthippus*, *Arphia*, *Spharagemon*, *Dissosteira*, *Trimerotropis*, *Circotettix*, and probably *Aerochoreutes* [now synonymized with *Circotettix*] are irregularly tuberculate or hispid along the dividing lines of the reticulation. Five, namely: *Hadrotettix*, *Cratypedes*, *Camnula*, *Metator*, and *Trachyrhachys* are apparently without such tubercles. Somewhat similar tubercles are present in the egg-chorion of *Asemoplus* of the Cyrtacanthacrinae [*Asemoplus* is now placed in Melanoplinae].

Oedipodinae Affinities

In attempting to trace affinities in this subfamily a number of perplexing problems are encountered the solution of which must necessarily be somewhat tentative.

Without doubt the best defined and most segregated group is represented in the genera *Encoptolophus* and *Chortophaga.* The chief peculiarities of this group are a smooth egg, with a posterior ring of elongate punctures, in which characters they are indistinguishable from certain "Acridinae". In addition the egg-sacs are thin and fit closely round the eggs, while the nymphs have strikingly short thick antennae quite unlike those of any species met with in the Oedipodinae and only suggested in *Hypochlora* and *Hesperotettix* of the "Cyrtocanthacrinae" [Melanoplinae]. Since this group cannot be placed between any of those which follow we prefer to put it at the head of the subfamily.

The genus *Hadrotettix*, in its egg of extraordinary wide reticulation, seems to constitute a separate unit. If we are to rely upon the characters of the egg then it certainly does not show affinities with that extensive aggregation represented by those genera with a central tubercle in the reticulation, but, instead, seems to have a possible place in the group represented by *Pardalophora* and its allies. This relationship is also suggested by the early nymphal instars. It is

possible that this genus should come after *Arphia* next to *Trachyrhachys* but for the present we prefer to place it before that group.

In *Pardalophora*, *Xanthippus* and *Arphia* we seem to have another natural segregation to which *Hippiscus* [identity uncertain] may doubtless be assigned. The egg-sac, eggs and nymphal stages all suggest this arrangement.

Whether *Trachyrhachys* and *Metator* should follow is open to more question. This arrangement is indicated, especially in the egg-pattern of the first named species to which there is a resemblance in the fine angulate lines to *Hadrotettix.* The two genera have many characters in common and we believe form a natural group not very closely allied to any other referred to here.

The genus *Cratypedes* shows affinities with both *Xanthippus* and *Arphia*, in other respects, its nearest relation seems to be *Camnula*, this last is suggested by the egg-sac and egg. Both species show an obscure median tubercle in the reticulation of the egg chorion thus suggesting a development towards the genera which follow. *Camnula*, in particular, in its first nymphal instar is quite like *Spharagemon* and its allies. Placing *Camnula* with *Cratypedes* we next come to that perplexing aggregate in which all the remaining genera are involved. *Aerochoreutes* [*Circotettix*] has features which might fit it almost anywhere. In some of these it recalls *Metator* in others *Circotettix* while its habits are very like those of *Dissosteira.* We shall not do more than has been indicated here.

Probably *Dissosteira* as represented by *carolina* comes next, followed by *Spharagemon.* The cristate median carina of the adults suggests a connection with *Arphia*, in all other respects the relationship with *Trimerotropis* and *Circotettix* seems very close. The only feature of separation so far known is the colour of the eggs. Those of *Dissosteira* and *Spharagemon* being pinkish, while in the genera which follow they are light yellow. The nymphs cannot be told one from another.

It is probable that more than one genus is involved in *Trimerotropis*. Among the species which indicate this most clearly are [*T.*] *agrestis* and [*T.*] *pistrinaria*, both are well defined in so far as the immature stages are concerned.

Key to the Genera of Oedipodinae

[**Note:** the generic epithets in this key are those used by Criddle; the reader should consult the species treatments that follow to find the current names of taxa.]

	Egg-sac short in comparison to width with little or no egg-free neck	1
	Egg-sac more elongate, usually with an egg-free upper part occupying at least a quarter of the sac	2
1	Sac not exceeding 16 mm long [but see species description below], eggs in three rows, closely packed. Egg chorion rather thick, yellow or brownish with lighter streaks; meshes of reticulation small with an indefinite tubercle in their centre; dividing lines high; number of eggs 16 to 32.	*Camnula*

	Sacs more than 16 mm long but not exceeding 20 mm; width greater; egg chorion very thick, otherwise as *Camnula*	*Cratypedes*
2	Sac thin and tough, closely fitting round the eggs the outlines of which are visible through it; egg-chorion smooth without markings	3
	Sac walls thicker, often corky, but brittle; outline of eggs rarely visible from without; egg-chorion with well-defined markings	4
3	Sac less than 25 mm long, number of eggs to a sac not exceeding 20.	*Encoptolophus*
	Sac more than 25 mm long, number of eggs to a sac greater ranging from 16 to 45	*Chortophaga*
4	Reticulation of egg-chorion without a central tubercle, walls of sack rather thick, corky	5
	Reticulation of egg-chorion with a central tubercle, sac walls less thick	9
5	Sac elongate-cylindrical; eggs becoming brown with age, in 3, 4 or 5 row formation	6
	Sac sub-cylindrical, distinctly wider below; walls less thick; eggs in 3–4 rows	7
6	Sac 9 mm wide, 40 to 50 mm long; eggs 36 to 73, in 4 or 5 rows; colour yellow becoming brown with age; chorion moderately thick; reticulation sub-angulate or rounded; length of eggs 6.5 mm	*Pardalophora*
	Sac 8 mm wide, 36 to 40 mm long, eggs 30 to 54 in number; chorion a little less thick; reticulation more angulate	*Xanthippus*
	Sac more narrow, 32 to 36 mm long; eggs in 3–4 rows, not exceeding 24 in number; reticulation as in previous genus, rarely with a central tubercle in the meshes	*Arphia*
7	Sac distinctly wider below; 33 mm long, empty portion short; eggs in 3 or 4 rows, reticulation sharply angulate the meshes much larger than in any other species.	*Hadrotettix*
	Sac smaller, eggs abnormally pointed; chorion very thick, colour becoming reddish-brown with paler streaks	8
8	Sac not exceeding 18 mm long; reticulation of chorion fine definitely angulate; length 5 mm	*Trachyrhachys*
	Sac larger, 23 to 31 mm long [but see species descriptions below]; markings of chorion in the form of large, shallow foveolae with thick dividing walls, the former having a series of minute black punctures in the centre; length of egg 6.5 mm	*Metator*
9	Sac moderately short but brittle, 35 to 40 mm long, the empty portion rather short; eggs in 4 rows, 35 to 60 in a sac; colour pinkish	*Dissosteira*
	Sac more thin but tougher, the empty portion long; length of sac 37 mm; eggs in 2 rows, 20 to 30 in a sac, colour clay-yellow, reticulation often obscured by an opaque coating	*Aerochoreutes*
	Sac shorter, the texture like *Dissosteira* but more frail; length not exceeding 30 mm	10
10	Eggs in 3 rows, not exceeding 25, the chorion with a pinkish tint	*Spharagemon*
	Eggs in 2 or 3 rows, colour pale yellow, occasionally becoming blackish, otherwise as the last	*Circotettix-Trimerotropis*

***Encoptolophus sordidus* (Burm.) [Oedipodinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-cylindrical a little wider below; empty upper portion occupying about a third of the sac; walls thin fitting closely round the eggs so that their outline is visible; length 18 to 20 mm.

Eggs.– The eggs are arranged in a three row formation averaging [but see following paragraph] about 26 to a sac. Surface polished without reticulation, colour pale cream. Length 5 mm.

The above description is drawn from a single sac of old eggs taken at Clarenceville, Quebec.

***Encoptolophus costalis* (Scud.) [Oedipodinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-cylindrical, the upper third without eggs, narrower; walls tough but thin, fitting closely around the eggs so that their outline is often visible; length 16 to 20 mm.

Egg.– The eggs are arranged in a rather irregular three row formation and vary in number from 8 to 20, 14 being an average. Posterior ring indicated by a row of elongate punctures; surface smooth without reticulation. Colour pale creamy-white shading to light brown at the extremities; length 5 mm.

***Chortophaga viridifasciata* DeG. [Oedipodinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, the empty portion occupying from a third to half the total length; walls thin but tough; closely wrapped round the eggs; length 25 to 30 mm.

Eggs.– The eggs are arranged in a three, or rarely four, row formation and vary from 6 to 45 in number, the average being 19. Surface smooth, the posterior ring indicated by a rather obscure row of elongate punctures. Colour pale, bright clay-yellow; length 5.5 mm.

***Hadrotettix trifasciatus* (Say) [Oedipodinae]**
[Drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Sub-cylindrical, almost two-thirds wider basally than above; egg-free neck short, not more than a quarter of the entire length of sac; walls moderately thick but breaking easily; length 33 mm, width about 7 mm, 4 mm above.

Egg.– The eggs are in three or four rows, semi-upright and number about 22 to a sac. Posterior ring wide, smooth, a little concave; chorion thick; reticulation sharply angulate the meshes very large, dividing lines fine in proportion. Colour creamy-yellow changing to olive green or brown-pink; length 7 mm.

Specimens were obtained from the Marias Hills in Montana.

***Pardalophora apiculata* (Harr.) [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, large usually curved, a little narrower above; walls fairly thick, corky; top concave; the empty upper portion occupying from a third to half the length of sac; length about 50 mm, width 9 mm.
Egg.– The eggs are in an irregular 4–5 row formation and number from 36 to 73. Reticulation large; colour clay-yellow changing to dark reddish with age; length 7.5 mm.

***Xanthippus corallipes latefasciatus* Scud. [*Xanthippus corallipes* (Haldeman)] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, usually curved, the egg-free neck from a third to half the entire length of sac; walls thick corky; length 40 mm.

Egg.– In an irregular 4–5 row arrangement about 38 to a sac, moderately closely packed; posterior cap round, the ring wide, flat; reticulation large obscurely angulate. Colour, pale clay-yellow changing to reddish-brown; length 6.5 mm.

***Xanthippus montanus* (Thom.) [Oedipodinae]**

Egg-sac.- Very like that of *latefasciatus* [*X. corallipes*] length 30 to 40 mm.

Egg.– The eggs are arranged in irregular 3, 4 or 5 rows and number from 20 to 52 to a sac. Posterior extremity a little produced, the ring wide and flat; reticulation large the meshes definitely angulate, colour clay-yellow, becoming brown with age; length 6.2 mm.

***Arphia pseudonietana* (Thom.) [Oedipodinae]**
[Photomicrograph of chorion in Bushland (1934); drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, generally curved, the lower part a little wider than the upper; egg-free neck occupying half to two-thirds the entire sac; walls thick and corky; length 32 to 36 mm, width 6 mm.

Egg.– Arranged in a three or four row formation, numbering from 8 to 24 to a sac the average being 20. Posterior ring wide, slightly concave; surface widely reticulated with angulate meshes; there is occasionally a small tubercle in the centre of some of the meshes. Colour pale brown-ochre, lighter adjacent to other eggs; length 6 mm.

Occasionally sacs are met with an empty neck in which case they are much shorter than average.

***Arphia conspersa* Scud. [Oedipodinae]**

Egg-sac.– Elongate-cylindrical with a slightly narrower neck which comprises about two-thirds the length of sac; walls rather thin so that the outline of the eggs is occasionally visible; length 28 to 33 mm.

Egg.– Somewhat irregularly placed in three rows or more frequently the lower part with three and the upper with two rows. There are from 12 to 32 eggs in a sac. Posterior ring wide, smooth; general colour creamy changing to brown; length 6 mm.

***Cratypedes neglectus* (Thom.) [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, about three times as long as wide, the empty portion very short; walls moderately thick but brittle; length 13 to 18 mm.

Egg.– Closely packed, usually in three rows, ranging from 8 to 26 to a sac; chorion rather thick, the surface deeply reticulated, usually with an obscure median tubercle in the meshes. Colour clay-yellow, often with a creamy bloom and pale streaks; length 6 mm.

The resemblance to *Camnula* both in the sacs and eggs is apparent.
Specimens obtained in British Columbia and Manitoba.

***Camnula pellucida* (Scud.) [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, rarely curved, empty neck or lacking, the walls thick and moderately tough; length about 17 mm.

Egg.– Closely packed in a three row formation numbering 12 to 28 to a sac with an average of 18. Posterior ring narrow; reticulation deep, rather fine, with an obscure median tubercle in the meshes. Colour pale cream frequently with darker streaks, palest where contact is made with other eggs; length 4 to 6 mm.

***Trachyrhachys kiowa kiowa* (Thom.) [*Trachyrhachys kiowa* (Thomas)] [Oedipodinae]**
[Drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate, sub-cylindrical, usually abnormally wide below, the walls rather thin and fitting closely to the eggs; empty part occupies half the sac; length 17 mm.

Egg.– Closely packed in three rows, more rarely in four, with an odd egg misplaced; average number of eggs 16, range of variation 10 to 25. Eggs rather pointed, posterior ring narrow, concave, chorion very thick; reticulation fine, angulate, the dividing lines thin. Colour pale brown to Indian-red, streaked with lighter shades adjacent to other eggs; length 4.8 mm.

***Metator pardalinus* (Saus.) [Oedipodinae]**

Egg-sac.– Elongate sub-cylindrical, wider below, the upper half without eggs. Walls thin and fragile; length 20 to 30 mm.

Egg.– The eggs are in four irregular rows, the number to a sac varying from 10 to 26. Size large, tapering abruptly at the posterior extremity, cap constricted and produced, ring narrow. Chorion thick, the surface semi-foveolate or obscurely reticulated, the meshes of various shapes but usually sub-angulate or round, containing a series of dark punctures; interspaces almost as wide as the foveolae. Colour at first, pale clay-yellow becoming brown ochre with pale streaks; length 6.5 mm.

Specimens obtained at Estevan, Sask., and Goodlands, Manitoba.

***Metator nevadensis* (Brun.) [Oedipodinae]**

Egg-sac.– Very similar to [*M.*] *pardalinus*, length 30 mm.

Egg.– Indistinguishable from those of the above species, either in shape, pattern, or colour; length 6.5 mm.

Material secured from British Columbia.

***Dissosteira carolina* (L.) [Oedipodinae]**
[Photomicrograph of chorion in Bushland (1934); drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, usually curved, the egg-free portion short not more than a quarter of the sac; walls moderately thick, more so than in *Spharagemon* but easily broken; length 31 to 50 mm.

Egg.– The eggs are in fairly regular four row formation and number from 26 to 69 with an average of 56. Chorion of moderate thickness, reticulation with fine dividing lines and a median tubercle which is easily rubbed off. Posterior ring wide, smooth; colour light brownish-pink, the dividing lines darker. Length 5 to 6 mm.

***Spharagemon aequale* (Say) [Spharagemon equale (Say)] [Oedipodinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, usually curved, eggs occupying about half the sac; walls rather thin, fragile, an outline of the eggs being occasionally visible; length 18 to 22 mm.

Egg.– The eggs are in a fairly regular three row formation, they range from 6 to 22 to a sac, 14 being an average of six sacs. Posterior ring wide with a row of elongate punctures; chorion of moderate thickness, the reticulation fine, well defined, with a median tubercle. Colour pinkish-cream to dull salmon-pink; length 6 mm.

The specimens come from Alberta.

***Spharagemon collare* (Scud.) [Oedipodinae]**

[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Of the same general shape as *aequale* [*S. equale*], walls thin and fragile; length about 20 mm.

Egg.– The eggs are in three rows or rarely in two rows, and average from 10 to 20 in number. Posterior ring as in *aequale* [*S. equale*]; reticulation less well defined and larger. Colour creamy

with a pinkish tinge; length 5.5 to 6 mm. The pink colour seems to be peculiar to this genus and *Dissosteira*.

***Spharagemon bolli* (Scud.) [Oedipodinae]**

Egg-sac.– Like that of [*S.*] *collare*; length 10 to 20 mm, average 19 mm.

Egg.– As [*S.*] *collare*, ranging from 6 to 26 to a sac. The pattern is also similar but the meshes seem to be wider and frequently lack the central tubercle. Colour pale cream with a pinkish flush, later becoming darker; length 6 mm.

***Trimerotropis agrestis* McN. [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, a little stout, the walls moderately thick but fragile; length 20 to 26 mm.

Egg.– Arranged in three or four rows, numbering about 22 to a sac; posterior cap a little produced, the ring wide and smooth. Colour dull clay-yellow, changing to pale brown; length 6 mm.

***Trimerotropis maritima maritima* (Harr.) [*Trimerotropis maritima* (Harris)] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, the egg-free neck rather short not exceeding a quarter of the total length of sac; walls rather thin and fragile; length 14 to 20 mm.

Egg.– The eggs are in three rows and number from 20 to 32 per sac. Posterior cap ill defined with a line of elongate punctures, chorion thin, the reticulation of moderate size, containing the usual central tubercle which is frequently rubbed off. Colour creamy with a slight brownish shade; length 5 mm. The eggs from which this description was made were old and rather dry.

The specimens came from Point Pelee, Ontario.

***Trimerotropis gracilis sordida* E.M.Walk. [*Trimerotropis gracilis* (Thomas)] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, narrow, the walls moderately thick but fragile; the egg-free portion comprises about a third of the sac; length about 20 mm.

Egg.– The eggs are in two or three rows and average 16 to a sac. Posterior cap produced into an obtuse sub-button shaped knob, the ring obscure; pattern normal. Colour pale cream; length 5 mm.

Specimens collected at Hatton, Saskatchewan.

***Trimerotropis sparsa* (Thom.) [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, usually curved at lower third, the empty portion short; walls thin and fragile, the outline of the eggs being frequently visible; length 20 to 26 mm.

Egg.– The eggs are in three rows and number about 30. Posterior extremity a little produced, ring rather wide, concave; pattern similar to other species; length 5.2 mm.

The specimens came from the Marias Hills, Montana.

***Trimerotropis pallidipennis salina* McN. [*Trimerotropis salina* McNeill] [Oedipodinae]**

Egg-sac.– Of the usual shape but large, about half the total length being free of eggs; walls moderately thick but easily broken; length 30 mm.

Egg.–The eggs are in a three or four row formation and average 35 to a sac. Posterior ring wide, smooth; reticulation normal; colour creamy, to pale clay-yellow; length 4.5 mm.

***Trimerotropis laticincta* Saus. [*Trimerotropis latifasciata* Scudder] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, in all respects closely resembling the sac of [*T.*] *salina*; length 30 to 37 mm.

Egg.– The eggs are in three rows and average 30 to a sac. Posterior ring obscure with a row of elongate punctures. Pattern normal but apt to be obscured by a film of varnish-like matter. Colour pale clay-yellow, becoming more brown with age; length 5 to 5.5 mm.

The specimens were obtained from southern Saskatchewan.

***Trimerotropis campestris* McN. [*Spharagemon campestris* (McNeill)] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, usually curved, the empty portion occupying a third of the sac; walls rather thin and frail; length 15 to 20 mm.

Egg.– The eggs are in three rows and average 20 to a sac. Posterior extremity obscurely button-shaped, the ring indefinite or well defined, wide; reticulation fine, easily displaced. Colour at first pale creamy-yellow, later turning to dull brown or almost black; length 5 mm.

***Trimerotropis pistrinaria* Saus. [Oedipodinae]**

Egg-sac.– Of the usual shape, rather closely resembling that of [*Spharagemon*] *campestris*; the walls thin and frail; length 11 to 18 mm.

Egg.– Usually in two rows, averaging from 10 to 18 to a sac. Posterior ring narrow or moderately wide; reticulation fine often obscure. Colour pale cologne-earth, darkening with age; length 5.6 mm.

The specimens came from southern Alberta and Saskatchewan.

***Circotettix verruculatus* Kby. [*Trimerotropis verruculata verruculata* (Kirby)] [Oedipodinae]**

Egg-sac.– Elongate-cylindrical, usually curved, the portion containing the eggs a little wider than the upper empty half; walls rather thin and brittle; length 23 mm, width 4 mm.

Egg.– The eggs are in three rows and average 26 to a sac. Of 28 sacs examined the eggs ranged from 16 to 28. Posterior extremity rounded, the ring rather narrow, smooth, concave; surface finely reticulated, the meshes containing a median tubercle. Colour gamboge-yellow; length 4.5 to 5 mm.

***Circotettix rabula rabula* R. and H. [*Circotettix rabula* Rehn and Hebard] [Oedipodinae]**

Egg-sac.– Very similar to that of *verruculatus* [*Trimerotropis verruculata verruculata*], possibly averaging a little smaller.

Egg.– As *verruculatus* [*T. verruculata verruculata*],the eggs average 24 to a sac.

***Aerochoreutes carlinianus* (Thom.) [*Circotettix carlinianus* (Thomas)] [Oedipodinae]**

Egg-sac.– Very elongate, cylindrical, the egg cavity a little wider than the empty neck which comprises rather more than half the total length of sac; walls moderately thick and rather tough; length 37 mm.

Egg.– The eggs are in two rows, numbering from 20 to 30 to a sac. Posterior cap a little produced, the ring narrow, obscure; surface semi-smooth due to a thick coating of varnish-like matter which hides a well defined reticulation, this latter showing at the juncture of other eggs or where the coating has been removed. Colour clay-yellow, darker at the extremities. Length 5.6 mm. The above description is made from but three sacs of eggs, obtained from Saskatchewan.

GUIDE TO THE "CYRTACANTHACRINAE"

[The subfamily Cyrtacanthacrinae is now considered a synonym of Cyrtacanthacridinae, which continues to be a valid subfamily. However, with one exception, all the species Criddle included within the section "Cyrtacanthacrinae" are now in the subfamily Melanoplinae; the exception is *Schistocerca lineata*, which is in the Cyrtacanthacrinidae. To maintain the integrity of his key, we have retained Criddle's use of "Cyrtacanthacrinae", but identify it as inconsistent with current interpretation by placing it in quotation marks. The current subfamily of each species is given in the headings of the individual species treatments below.]

Egg-sac either short and wide or elongate-cylindrical; in the short sacs the walls are nearly always thick and tough; in the elongate ones they are usually corky and easily broken. The eggs, without exception are definitely reticulated and in no case is there a median tubercle in the meshes. A great majority of the eggs are pale in colour, rarely either brown or pink but there is

considerable variation in the thickness of the chorion. In the genus *Asemoplus* the eggs are hispid or tuberculate. It seems possible that *Bradynotus* [probably refers to *Bradynotes obesa* (Thomas)] may also have this characteristic.

"Cyrtacanthacrinae" Affinities

There are a number of interesting segregations suggested in the study of this subfamily. The first of these is in *Hypochlora* and *Hesperotettix* the close affinities of which are indicated in all stages of development. *Aeolopus* [*Aeoloplides turnbulli*] probably has a place here but we cannot be sure until the nymphal instars have been studied. It is possible too, that *Asemoplus* should be placed near the above mentioned species instead of after *Melanoplus*; this is suggested by the form of the egg-sac; but not so strikingly so by the nymph.

The species *Schistocerca lineata*, in the large egg-sac, suggests relationship with the *bivittatus* group of *Melanoplus* but not very close. It seems to fit as well here as anywhere else.

Both *Melanoplus bivittatus* and [*M.*] *differentialis* are closely allied and they form a well defined natural group worthy of at least sub-generic separation. This is shown by the large egg-sac with its great number of eggs and the unusual colour of the eggs.

The small unalike *Melanoplus dawsoni* follows next in our present classification but it does not seem to fit. Indeed the short egg-sac suggests [*Melanoplus*] *islandicus* as a near relation and this is also indicated by the egg, especially in the rather wide posterior ring. The nymph of *dawsoni* however, is very unlike any other species of the genus and it seems to have *luridus* [*Melanoplus keeleri luridus*] as its nearest ally. *Femur-rubrum* [*Melanoplus femurrubrum*] and *borealis junius* [*Melanoplus borealis*] may come next; this is suggested by the nymphal instars. There seems no doubt that [*Melanoplus*] *infantilis* and [*Melanoplus*] *gladstoni* are closely related, while [*Melanoplus*] *occidentalis,* [*Melanoplus*] *confusus,* and perhaps [*Melanoplus*] *kennicottii* seem to follow in a fairly natural sequence. *Mexicanus* [*Melanoplus sanguinipes sanguinipes*] and [*Melanoplus*] *bruneri* form a poorly defined group which seems to have strong affinities with the previous one. The two species [*Melanoplus*] *flavidus* and [*Melanoplus*] *bowditchi canus* constitute another group with suggestions towards the next, represented by *packardii* [*Melanoplus packardii packardii*]*, foedus* [*Melanoplus foedus foedus*]*,* [*Melanoplus*] *stonei* and [*Melanoplus*] *angustipennis. Melanoplus fasciatus* seems to have affinities with *mexicanus* [*Melanoplus sanguinipes sanguinipes*]*,* [*M.*] *islandicus* and perhaps [*Melanoplus*] *montanus.*

The species [*M.*] *montanus* in the recent lists is placed before *dodgei huroni* [*Melanoplus huroni*] and the nymphal instars suggest this may be correct but there seems, in our mind, no doubt that the latter represents a well defined separate genus. This is suggested in all stages of development.

It is doubtful, as we have intimated above, whether *Asemoplus* should be associated near the first groups, or as it is in present lists, at the end of *Melanoplus*.
The genus *Phoetaliotes* seems poorly defined from *Melanoplus*, the nymphs are very like those of *M. luridus* [*M. keeleri luridus*].

Key to the Genera of the "Cyrtacanthacrinae"

[**Note:** the nomenclature in this key is that used by Criddle; the reader should consult the species treatments that follow to find the current names of taxa.]

	Sacs not more than three times as long as wide, the walls thick and tough. Eggs on a single plane or more rarely in two layers [but see contradictory statement below for *Asemoplus*].	1
	Sacs usually more than three times as long as wide; less tough; the eggs in elongate rows	4
1	Opening to sac on the side, concave, exceeding half the length of sac	*Aeolopus*
	Opening on top, oblique or not, length less that half that of sac	2
2	Sac cylindrical or sub-cylindrical	*Hypochlora*
	Sac pyriform or oval	3
3	Sacs almost as wide as long, the opening usually oblique, eggs approximately on the same plane number 9 to 14.	*Hesperotettix*
	Sacs, as a rule, distinctly longer than wide the opening horizontal or nearly so; eggs in 2 or 3 rows, 7 to 8 in a sac	*Asemoplus*
4	Sacs very large, eggs exceeding 35 to a sac	5
	Sacs of medium size the number of eggs rarely exceeding 25	6
5	Sacs 45 mm long, the walls somewhat felty. Eggs without definite arrangement, 35 to 64 in number.	*Schistocerca*
	Sacs less large, about 30 mm long, the walls not felty. Eggs in an irregular 4 row formation *varying* in number from 34 to more than 100; colour brown-pink	*Melanoplus bivittatus* and [*M.*] *differentialis*
6	Sacs narrow, elongate-cylindrical, usually abruptly curved at lower third, the egg-free portion occupying two-thirds of sac; length 24-27 mm. Eggs in two or three rows; polished, reticulation fine, without colour contrast except at the posterior extremity where it is darker.	*Phoetaliotes*
	Sacs usually less narrow and not as long. Reticulation darker than background, not in contrast at the extremity; colour usually pale yellow	*Melanoplus* proper
	Sac sub-pyriform or definitely wider below. Chorion thick, opaque, the surface sub-foveolate or obscurely reticulated, the meshes round, oval or oblong, not angulate, interspaces wide; colour reddish-brown	*Melanoplus dodgei huroni*

Hypochlora alba (Dodge) [Melanoplinae]

[Drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Cylindrical to narrowly pyriform, the empty portion occupying about a third of the total length of sac; opening horizontal or a little oblique; walls moderately thick and tough; length 12 to 14 mm.

Egg.– The eggs are in an oblique position but when the sac rests naturally, point directly upward; they vary from 7 to 16 in number. Generally five or six rest side by side with others lower down in less regular formation. In other sacs the arrangement is almost exactly like that of

Hesperotettix. Posterior ring plain or not, usually darker than the rest of chorion; reticulation well defined, usually five-sided. Colour bright clay-yellow; length 4 mm.

The specimens were obtained from North Dakota. Some 70 sacs of eggs were examined.

***Hesperotettix viridis pratensis* (Scud.) [Melanoplinae]**
[Drawing of chorion sculpture in Tuck and Smith (1939)]

Egg-sac.– Short, semi-round or pyriform only slightly longer than wide, the opening usually at an angle, concave, occupying almost half the length of sac; walls thick and tough; length 8 mm, width 6.5 mm.

Egg.– The eggs are at somewhat different elevations but appear almost on the same level when the sac is in its natural position, they number from 9 to 14. To begin with the eggs are tightly packed in the sac. Posterior cap produced into a button-like protuberance, the ring obscure. The chorion is a little thicker than that of *Hypochlora*, the reticulation smaller and less definitely angulate. Colour dull clay-yellow, lighter where it comes in contact with other eggs; length 5 mm.

Description made from 45 sacs of eggs obtained at Estevan, Sask., and Lethbridge, Alberta.

***Aeolopus turnbulli* (Thom.) [*Aeloplides turnbulli* (Thomas)] [Melanoplinae]**
[Drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Short sub-cylindrical, about twice as long as wide, the upper side flattened and somewhat concave for more than half the length of sac. There is no empty neck; walls moderately thick and very tough; length 10 mm, width 5 mm.

Egg.– The eggs are tightly packed in rows of four so that their upper extremity faces the elongate opening in the side of the sac; the number of eggs to a sac range from 16 to 34, the average being 22. Posterior cap produced into a broad button-like projection, ring narrow, concave; chorion moderately thick, the reticulation large, the meshes angulate usually five or six-sided, the dividing ridges stout and well defined. Colour clay-yellow, darker at the extremities; length 4.2 mm.

Adults were collected at Kincaid and Hatton, Sask.

***Asemoplus montanus* (Brun.) [Melanoplinae]**

Egg-sac.– Short sub-pyriform, the best defined sacs having a slightly rimmed, short neck with a deeply concave top; the walls are thick and tough; length 8 to 14 mm, width 5 to 6 mm.

Egg.– The eggs are in two or three rows and number from seven to eight, since, however, the sac rests sub-horizontally the eggs point almost directly upwards. They are tightly packed and stuck

together. Posterior cap slightly produced, the ring narrow; chorion of moderate thickness; dividing lines of reticulation with strong pointed tubercles. Colour clay-yellow; length 5 mm.

More than 50 egg-masses were examined, the adults coming from British Columbia.

***Asemoplus somesi* Hebard [*Buckellacris nuda nuda* (Walker)] [Melanoplinae]**

Egg-sac.– Apparently like [*A.*] *montanus*. The specimens came from Waterton Lakes, Alberta.

***Schistocerca lineata* Scud. [Cyrtacanthacridinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, the lower third containing the eggs, distinctly dilated; walls moderately thick, somewhat felty; length 52 mm, width of neck 6.5 mm, egg-chamber 10 mm.

Egg.– The eggs are in an elongate mass without definite arrangement, most of them point upwards, others are oblique; the number varies from 35 to 64. Posterior cap rounded, the ring wide, concave. Chorion rather thick the reticulation more or less coated over with a film of sub-opaque matter. Colour Van Dyke brown, paler where the eggs come in contact with each other; length 6.4 mm.

The specimens came from Medicine Hat and were secured by the aid of Mr. S.F. Carr.

***Melanoplus bivittatus* (Say) [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934); photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, usually curved, the egg-free portion occupying about half the total length. Walls moderately thick but easily broken; length about 35 mm.

Egg.– The eggs are in very irregular four rows, rarely five, and occasionally reduced to three at the extremities. Number to a sac from 34 to 114, 68 being an average. Posterior ring obscure; reticulation rather large; colour brown-pink, or greenish-orange, gamboge yellow when freshly laid; length 5.1 mm.

***Melanoplus differentialis* (Thom.) [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934); photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Practically as [*M.*] *bivittatus.*

Egg.– The irregular arrangement of the eggs, their number and colour closely resemble those of *bivittatus*.
Specimens were secured from Utah and South Dakota.

***Melanoplus femur-rubrum femur-rubrum* (DeG.) [*Melanoplus femurrubrum* DeGeer] [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934); photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, not appreciably wider below, the egg-chamber occupying half the total length; walls moderately thick, rather brittle; length 4.5 mm [Probably an error as the egg-sac cannot be shorter than egg length].

Egg.– The eggs are in an irregular three-row formation and number about 23 to a sac. Posterior ring obscure a little concave; reticulation close and even; colour clay-yellow, the cap darker; length 5 mm.

***Melanoplus keeleri luridus* (Dodge) [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-cylindrical, a little more narrow above the egg-chamber occupying from a third to half the sac; walls moderately thick and brittle; length 18 mm.

Egg.– Number of eggs to a sac 10 to 20 arranged in fairly regular two or three rows. Posterior ring narrow; chorion rather thick the surface strongly reticulated; colour bright clay-yellow; length 5 mm.

***Melanoplus dawsoni* Scud. [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Sub-cylindrical, widest below the egg chamber comprising about two-thirds the length of sac; walls thick and tough; length approximately 12 mm.

Egg.– Average number of eggs 11, these are in a close-packed double row. Posterior cap somewhat produced, ring wide, concave; reticulation prominent; colour bright clay-yellow; length 4.8 to 5 mm.

***Melanoplus occidentalis occidentalis* (Thom.) [*Melanoplus occidentalis* (Thomas)] [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, rather slender, the egg-chamber occupying about half the total length; walls rather thin and weak; length 20 mm.

Egg.– The eggs are in two rows and number 5 to 14. Posterior ring narrow, reticulation normal; colour pale clay-yellow; length 5 mm.

The single adult was obtained from the Marias Hills, Montana.
***Melanoplus borealis junius* (Dodge) [*Melanoplus borealis* (Fieber)] [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, the egg-chamber occupying half the entire length of sac; walls rather thin and weak; length 21 to 25 mm.

Egg.– The eggs are in two or three rows and average 14 to a sac. Posterior ring rather narrow; reticulation normal; colour bright, pale, clay-yellow; length 5.5 mm.

***Melanoplus infantilis* (Scud.) [Melanoplinae]**

Egg-sac.– Elongate cylindrical, the egg-chamber occupying more than a third the length of sac; walls rather thin and weak; length 15 mm.

Egg.– The eggs are in two row formation and number about 12 to a sac; other features normal, colour pale clay-yellow; length 5 mm.

***Melanoplus gladstoni* Scud. [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934); photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, a little narrower above, the egg-chamber about two-thirds the total length of sac, occasionally the neck is longer; walls moderately thick; fragile; length 12 to 21 mm.

Egg.– The eggs are in three irregular rows and number 10 to 18. Posterior cap a little produced, the ring poorly defined; reticulation normal; colour bright clay-yellow; length 5 mm.

***Melanoplus kennicotti kennicotti* (Thom.) [*Melanoplus kennicotti* Scudder] [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, a little wider below; egg chamber occupying half the sac; walls normal for the genus; length 19 to 28 mm; width 4 mm.

Egg.– The eggs are in two rows of unequal height, they number 8 to 12 in a sac. Posterior ring wide, shallowly concave; chorion thin reticulation uniform; colour pale clay-yellow; length 5 mm.

Specimens were obtained from Jasper, Alberta. The study included 44 sacs of eggs.

***Melanoplus confusus* Scud. [Melanoplinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, the walls moderately thick but easily broken; egg-chamber occupying half the length of sac; length 22 mm.

Egg.– Arranged in two or three rows and average 14 in number. Posterior cap a little produced, the ring narrow; chorion of moderate thickness; reticulation like that of [*M.*] *kennicottii* but more irregular. Colour bright clay-yellow; length 5 mm.

***Melanoplus mexicanus* (Saus.) [*Melanoplus sanguinipes sanguinipes* (Fabricius)] [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, usually a little wider below, the egg chamber occupying half the length of sac; walls of moderate thickness but easily broken; length 19 to 28 mm.

Egg.– The eggs are generally in three rows, more rarely in two rows; they number 10 to 20 to a sac. Posterior cap somewhat produced the ring moderately wide, concave, reticulation very like that of [*M.*] *confusus*; colour pale clay-yellow; length 5.5 mm.

***Melanoplus bruneri* Scud. [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, very like that of *mexicanus* [*M. sanguinipes sanguinipes*]; length 24 mm.

Egg.– The eggs are in three rows and average 16 to a sac, the greatest number found being 22. Posterior ring fairly wide, concave; chorion as in *mexicanus* [*M. sanguinipes sanguinipes*]; colour clay-yellow, the cap a little darker, length 5.3 mm.

***Melanoplus bowditchi canus* Hebard [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, slightly wider below, the walls thin and flimsy, breaking away from the eggs very readily; about a third is free of eggs; length 20 mm.

Egg.– The eggs are in a rather irregular three-row formation and number from 8 to 20. Eggs tapering rather abruptly at the posterior end, the ring moderately wide, concave, giving the cap the appearance of being dilated. Chorion rather thick the reticulation fine with indistinctly angulate meshes. Colour pale cream to bright clay-yellow; length 5 to 6 mm.

The specimens came from Medicine Hat, Alberta. Only eleven sacs of eggs were examined.

***Melanoplus flavidus* Scud. [Melanoplinae]**

Egg-sac.– Elongate- cylindrical, a little wider below; the egg-chamber occupying from a half to two-thirds of the entire length of sac; walls thin and weak; length 23 mm.

Egg.– The eggs are in three irregular rows and number about 10 to a sac. Posterior cap a little produced, the ring wide, concave; chorion rather thick, reticulation as in *canus* [*M. bowditchi canus*]. Colour pale clay-yellow; length 5 mm.

***Melanoplus packardii* Scud. [*Melanoplus packardii packardii* Scudder] [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934); drawing of chorion sculpture and photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, rather stout, walls fragile; length 18 to 24 mm.

Egg.– The eggs are in three irregular rows more rarely in four rows, and average 18 to a sac. Posterior cap scarcely produced, the ring indefinite; chorion rather thick, the reticulation fine. Colour pale clay-yellow; length 5.5 to 6 mm.

***Melanoplus foedus foedus* Scud. [Melanoplinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Very like that of *packardii* [*M. packardii packardii*]

Egg.– We can discern no constant difference between this egg and those of *packardii* [*M. packardii packardii*].

***Melanoplus foedus stonei* Rehn [*Melanoplus stonei* Rehn] [Melanoplinae]**

Egg-sac.– Elongate-cylindrical. Very like *foedus* [*M. foedus foedus*]; the egg-chamber comprising from a third to half the total length of sac; walls fragile; length 18 to 22 mm.

Egg.– The eggs are arranged in a three or four row formation and number from 6 to 22, 14 being an average. Posterior cap a little produced, the ring moderately wide, smooth; chorion rather thick, reticulation well defined; length 5.5 mm.

Described from 36 sacs of eggs.

***Melanoplus angustipennis* Dodge [Melanoplinae]**
[Photomicrograph of whole egg in Tuck and Smith (1939)]

Egg-sac.– Elongate-cylindrical, the egg-chamber occupying from a third to half the sac; walls thin and fragile; length about 20 mm.

Egg.– Usually in three rows, rarely in two rows, they average 14 to a sac; posterior cap a little produced, the ring narrow; chorion rather thick, the reticulation fine; colour pale clay-yellow; length 5 to 5.5 mm.

***Melanoplus islandicus* Blat. [Melanoplinae]**

Egg-sac.– Elongate, sub-cylindrical usually distinctly wider below, more rarely of almost equal width throughout; the empty part comprising about half the total length of sac; walls moderately thick and fairly tough; length 12 to 15 mm.

Egg.– The eggs are in two or three rows which overlap so that when the sac rests naturally they are almost on a level; posterior cap a little produced, the ring moderately wide, concave; chorion thick, opaque; reticulation fine, irregular. Colour clay-yellow becoming brown with age, lighter adjacent to other eggs; length 5.5 mm.

***Melanoplus fasciatus* (F. Walk.) [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, a little wider below, the egg chamber occupying half the total length of sac; walls moderately thick and tough; length 14 to 16 mm.

Egg.– The eggs are in an irregular four-row formation and average 11 to a sac; posterior ring narrow, smooth; chorion moderately thick; reticulation fine and irregular. Colour bright clay-yellow with darker suffusions, length 5 mm.

***Melanoplus montanus* (Thom.) [Melanoplinae]**

Egg-sac.– Elongate-cylindrical, the egg-chamber occupying from a third to three-quarters of the entire sac; walls of moderate thickness; length 24 mm, width 5 mm.

Egg.– The eggs are in two rows and vary in number from 10 to 12. Posterior cap a little produced, the ring obscure; chorion of moderate thickness, the reticulation fairly uniform. Colour clay-yellow; length 5 mm.

Twelve sacs of eggs obtained from Blairmore, Alberta.

***Melanoplus dodgei huroni* Blat. [*Melanoplus huroni* Blatchley] [Melanoplinae]**

Egg-sac.– Sub-cylindrical or elongate, pyriform, variable but usually distinctly wider below and tapering apically; walls rather thick and tough; length 20 mm.

Egg.– The eggs are in a fairly uniform three-row formation and number about 20 to a sac. Posterior cap obtuse at tip, the ring rather wide, concave; chorion thick, opaque, the pattern semi-foveolate or obscurely reticulated, the meshes round, oval or oblong, interspaces wide. Colour reddish-brown, paler at the junction of other eggs; length 6 mm.

***Phoetaliotes nebrascensis* (Thom.) [Melanoplinae]**
[Photomicrograph of chorion in Bushland (1934)]

Egg-sac.– Elongate-cylindrical, usually abruptly curved at lower third, the eggs occupying about a third of the sac; walls of moderate thickness and fairly strong; length 24 to 27 mm., width 3 to 4 mm.

Egg.– The eggs are in two rows, rarely three rows, they vary in number from 10 to 20. Posterior cap a little produced, the ring consisting of a row of elongate, dark punctures; chorion of moderate thickness, the reticulation obscured by an over-coating of sub-opaque material. The dividing lines are fine and being of the same colour as the background are difficult to see. The lines on the posterior cap are dark thus providing a marked contrast to the rest. Length 4.5 to 5 mm.

Specimens were secured in North Dakota and Alberta.

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APPENDIX: Slides of egg chorions prepared by N. Criddle and his colleagues and now in the J.B. Wallis/R.E. Roughley Museum of Entomology, University of Manitoba.

Notes:

1. With the exception of the column headed "Current Name", all information in the table is exactly as presented on the slide labels.
2. It should be noted that specimens listed below are not necessarily those upon which Criddle based his descriptions and keys.

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Contypides		{perhaps *Cratypedes*]	14.ix.1931	1931	R.M.W.	15	BC
Acrolophitus	*Hirtipes*	*Acrolophitus hirtipes* (Say, 1825)	25.ix.1930	1930	N. Criddle	45	Egg Chorion Lethbridge Alta
Eeoloplus	*Turnbulli*	*Aeoloplides turnbulli turnbulli* (Thomas, 1872)	23.x.1931	1931	R.M. White		Egg Chorions of
Aerochoreutes	*carlinianus Thom*	*Circotettix carlinianus* (Thomas, 1870)	7.ix.32	1932			Alberta
Aerochoreutes	*carlinianus Th*	*Circotettix carlinianus* (Thomas, 1870)	7.vii.1932	1932		62	Sask
Aerochoreutes	*carlinianus*	*Circotettix carlinianus* (Thomas, 1870)	23.x.1931	1931	R.M. White		Egg Chorion of
Arphia	*Frigida*	*Arphia conspersa* Scudder, 1875	20.vii.29	1929	N. Criddle	22	Aweme Man.
Arphia	*Frigida*	*Arphia conspersa* Scudder, 1875	20.vii.29	1929	N. Criddle		Aweme Man
Arphia	*Frigida*	*Arphia conspersa* Scudder, 1875	7.vii.37	1937	DSS	3 8489	Egg chorion
Arphia	*Frigida*	*Arphia conspersa* Scudder, 1875	7.vii.37	1937	D.S.S.	4 8489	Egg chorion
Arphia	*pseudonietana*	*Arphia pseudonietana* (Thomas, 1870)	1.xi.1929	1929			
Arphia	*pseudonietana*	*Arphia pseudonietana* (Thomas, 1870)	13.x.1930	1930	N. Criddle	46	Egg Chorions
Asemoplus	*Montanus*	*Asemoplus montanus* (Bruner, 1885)	14.ix.1931	1931	RMW	6	Egg Chorion
Asemophlus	*herpedulus*	*Asemoplus montanus* (Bruner, 1885) [probably]				17	Waterton Alta
Aulocara	*Elliotti*	*Aulocara elliotti* (Thomas, 1870)	14.ix.1931	1931	R.M.W.		Egg Chorion
Bruneria	*Brunnea*	*Bruneria brunnea* (Thomas, 1871)	2.xi.1929	1929			
Bruneria	*Brunnea*	*Bruneria brunnea* (Thomas, 1871)	2.v.1929	1929		21	
Camnula	*Pellucida*	*Camnula pellucida* (Scudder, 1862)	4.xi.1932	1932			Carman, Man
Camnula	*Pellucida*	*Camnula pellucida* (Scudder, 1862)	29.iv.'29	1929			
Camnula	*Pellucida*	*Camnula pellucida* (Scudder, 1862)	4.xi.1932	1932		53	Carman, Man
Camnula	*Pellucida*	*Camnula pellucida* (Scudder, 1862)	Ap. 22 1932	1932		50	Altona Man

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Camnula	*Pellucida*	*Camnula pellucida* (Scudder, 1862)	2.v.1929	1929		25	
Chrysochraon	*abdominalis*	*Chloealtis abdominalis* (Thomas, 1873)	4.xi.1929	1929		20	
Choealtis	*Conspersa*	*Chloealtis conspersa* (Harris, 1841)	25.ix.1930	1930	N. Criddle	41	Egg Chorions Aweme Man.
Chorthippus	*curtipennis*	*Pseudochorthippus curtipennis curtipennis* (Harris, 1835)	13.x.1930	1930	N. Criddle	42	Egg Chorions
Circotettix	*Rabula*	*Circotettix rabula* Rehn & Hebard, 1906	1.xi.1929	1929	NC		
Circotettix	*Rabula*	*Circotettix rabula* Rehn & Hebard, 1906	1.xi.1929	1929		26	
Cordellacris		*Cordillacris occipitalis* (Thomas, 1873) [probably]	14.ix.1931	1931	R.M.W.		
Cratypedes	*Neglectus*	*Cratypedes neglectus* (Thomas, 1870)	2.xi.1929	1929		23	
Cratypedes	*Neglectus*	*Cratypedes neglectus* (Thomas, 1870)	Ap 22 1932	1932		51	B.C.
Cratypedes	*neglectus Sc.*	*Cratypedes neglectus* (Thomas, 1870)	12.viii.1932	1932	NC	54	Aweme Man
Dissosteira	*Carolina*	*Dissosteira carolina* (Linnaeus, 1758)	1.xi.1929	1929		29	
Dissosteira	*carolina ?*	*Dissosteira carolina* ? (Linnaeus, 1758)	2.v.1929	1929		25	
Dissosteira	*carolina ?*	*Dissosteira carolina* ? (Linnaeus, 1758)	2.v.1929	1929		25	
Hadrotettix	*trifasciatus*	*Hadrotettix trifasciatus* (Say, 1825)	23.x.1931	1931	R.M. White	13	Egg Chorion of
Hesperotettix	*pratensis*	*Hesperotettix viridis pratensis* Scudder, 1897	25.ix.1930	1930	N. Criddle	39	Egg Chorions - immature Estevan Sask
Hesperotettix	*pratensis*	*Hesperotettix viridis pratensis* Scudder, 1897	30.ix.1929	1929		16	Egg Chorion
Hypochlora	*alba*	*Hypochlora alba* (G.M. Dodge, 1876)	28.x.1929	1929	N. Criddle	14	
Melanoplus	*angustipennis*	*Melanoplus angustipennis* (G.M. Dodge, 1877)	29.iv.'29	1929		16	
Melanoplus	*angustipennis*	*Melanoplus angustipennis* (G.M. Dodge, 1877)	30.iv.1929	1929		23	
M	*angustipennis*	*Melanoplus angustipennis* (G.M. Dodge, 1877)	2.v.1929	1929		24	
Melanoplus	*angustipennis*	*Melanoplus angustipennis* (G.M. Dodge, 1877)	30.iv.1929	1929		23	
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	30.iv.'29	1929		13	
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	15/8/39	1939	DSS	8489-10	Egg Chorion
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	Dec. 3.1931	1931		2	Wiley, Colorado
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	Dec. 3 1931	1931			Wiley, Colorado
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	15/viii/39	1939		8489-9	Egg Chorion
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	8.x.1932	1932	NC	65	Souris Man

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Melanoplus	*bivitattus*	*Melanoplus bivittatus* (Say, 1825)	1.v.29	1929			Xylol 2.40 NaOH-20
Melanoplus	*borealis extremus*	*Melanoplus borealis* (Fieber, 1853)	12.viii.1932	1932		55	Aweme Man
Melanoplus	*extremus*	*Melanoplus borealis* (Fieber, 1853)	30.iv.'29	1929		7	
Melanoplus	*bowditchi canus*	*Melanoplus bowditchi canus* Hebard, 1925	13.x.1930	1930	N. Criddle	37	Egg Chorions
Melanoplus	*bruneri*	*Melanoplus bruneri* Scudder, 1897	12.viii.1932	1932		57	Aweme Man
Melanoplus	*bruneri*	*Melanoplus bruneri* Scudder, 1897	2.xi.1929	1929		3	
Melanoplus	*confusus*	*Melanoplus confusus* Scudder, 1897	8.viii.1930	1930	N. Criddle	34	Egg Chorions
Melanoplus	*confusus*	*Melanoplus confusus* Scudder, 1897	8.viii.1930	1930	N. Criddle	34	Egg Chorions
Melanoplus	*dawsoni*	*Melanoplus dawsoni* (Scudder, 1875)	13.x.1930	1930	N. Criddle	36	Egg Chorions
Melanoplus	*dawsoni*	*Melanoplus dawsoni* (Scudder, 1875)	12.iv.'39	1939		8489-#	
Melanoplus	*dawsoni*	*Melanoplus dawsoni* (Scudder, 1875)			DSS	8489-12	Egg Chorion
Melanoplus	*dawsoni*	*Melanoplus dawsoni* (Scudder, 1875)	12.iv.'39	1939		8489-12 (crossed out)	Chorion
Melanoplus	*dawsoni*	*Melanoplus dawsoni* (Scudder, 1875)			DSS	8489-13	Egg Chorion
Melanoplus	*differentialis*	*Melanoplus differentialis nigricans* Cockerell, 1917	Dec. 3 1931	1932		1	Wiley, Colorado
Melanoplus	*differentialis*	*Melanoplus differentialis nigricans* Cockerell, 1917	Dec. 3 1931	1931			Wiley, Colorado
Melanoplus	*fasciatus*	*Melanoplus fasciatus* (F. Walker, 1870)	2.xi.1929	1929		6	
Melanoplus	*femur-rubrum*	*Melanoplus femurrubrum* (DeGeer, 1773)	8.x.1932	1932	NC	67	Aweme Man
Melanoplus	*f.r. femur-rubrum*	*Melanoplus femurrubrum* (DeGeer, 1773)	14/8/39	1939	DSS	8489-16	
Melanoplus	*f.r. femur-rubrum*	*Melanoplus femurrubrum* (DeGeer, 1773)			DSS	8489-14	Egg Chorion
Melanoplus	*femur-rubrum*	*Melanoplus femurrubrum* (DeGeer, 1773)	2.xi.1929	1929		5	
Melanoplus	*flavidus*	*Melanoplus flavidus* Scudder, 1878	1.xi.1929	1929		10	
Melanoplus	*flavidus*	*Melanoplus flavidus* Scudder, 1878	15/8/39	1939	DSS	8489-17	
Melanoplus	*flavidus*	*Melanoplus flavidus* Scudder, 1878	14/8/39	1939	DSS	8489-18	
Melanoplus	*foedus foedus*	*Melanoplus foedus foedus* Scudder, 1878	16/8/39	1938	DSS	8489-20	
Melanoplus	*foedus foedus*	*Melanoplus foedus foedus* Scudder, 1878	16/8/39	1939	DSS	8489-21	
Melanoplus	*foedus foedus*	*Melanoplus foedus foedus* Scudder, 1878	16/8/39	1939	DSS	8489-19	
Melanoplus	*gladstoni*	*Melanoplus gladstoni* Scudder, 1897	2.xi.1929	1929			No 2

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Melanoplus	*huroni*	*Melanoplus huroni* Blatchley, 1898	3.v.1929	1929		11	
Melanoplus	*huroni*	*Melanoplus huroni* Blatchley, 1898	3.v.1929	1929		71	
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	16/8/39	1939	DSS	8489-24	
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	23.viii.37	1937	DSS	8489-7	Egg Chorion
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	12.iv.'39	1939		8489-48	Chorion
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	16/8/39	1939	DSS	8489-23	
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	23.viii.'37	1937	DSS	8489-8	Egg Chorion
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	12.iv.39	1939		8489-7 ?	Chorion
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	16/8/39	1939	DSS	8489-22	
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	4.xi.1929	1929			
Melanoplus	*infantilis*	*Melanoplus infantilis* Scudder, 1878	4.xi.1929	1929		8	
Melanoplus	*islandicus*	*Melanoplus islandicus* Blatchley, 1898	8.viii.1930	1930	N. Criddle	710	Egg Chorions
Melanoplus	*lurida*	*Melanoplus keeleri luridus* (G.M. Dodge, 1876)	23.x.1931	1931	R.M. White	3	Egg Chorion of
M.	*luridus*	*Melanoplus keeleri luridus* (G.M. Dodge, 1876)	2.v.1929	1929		9	
Melanoplus	*kennicoti*	*Melanoplus kennicottii* Scudder, 1878	26.ix.1932	1932		63	Jasper, Alta.
Melanoplus	*kennicoti*	*Melanoplus kennicottii* Scudder, 1878	16.ix.1932	1932	N. Criddle		Jasper, Alta.
Melanoplus	*montanus*	*Melanoplus montanus* (Thomas, 1873)	30.x.'30	1930	N. Criddle	35	Egg Chorions Blairmore Alta
Melanoplus	*montanus*	*Melanoplus montanus* (Thomas, 1873)	20.vii.1932	1932		56	Blairmore Alta.
Melanoplus	*occidentalis*	*Melanoplus occidentalis* (Thomas, 1872)	23.x.1931	1931	R.M. White		Egg Chorion of
Melanoplus	*packardi*	*Melanoplus packardii packardii* Scudder, 1878	6.ix.1932	1932		61	new eggs Goodlands Man
Melanoplus	*packardi*	*Melanoplus packardii packardii* Scudder, 1878	8.ix.1931	1931		61	Old eggs Goodlands Man
Melanoplus	*packardi*	*Melanoplus packardii packardii* Scudder, 1878	1.xi.1929	1929		12	
Melanoplus	*atlantis*	*Melanoplus sanguinipes sanguinipes* (Fabricius, 1798)	29.iv.'29	1929		4	
Melanoplus	*mexicanus*	*Melanoplus sanguinipes sanguinipes* (Fabricius, 1798)	14.ix.1931	1931		4	Egg Chorion
Melanoplus	*stonei*	*Melanoplus stonei* J.A.G. Rehn, 1904	25.ix.1930	1930	N.C.	38	Egg Chorions Cowan Man
Metator	*pardalinis*	*Metator pardalinus* (Saussure, 1884)	22.viii.1930	1930	N. Criddle	48	Egg Chorions Estevan Sask
Metator	*pardalinis*	*Metator pardalinus* (Saussure, 1884)	22.viii.1930	1930	N. Criddle	99	Egg Chorions Goodlands Man

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Orphulella	*palidna*	*Orphulella pelidna* (Burmeister, 1838)	2.xi.1929	1929		18	
Orphulella	*speciosa*	*Orphulella speciosa* (Scudder, 1862)	4.xi.1929	1929		19	
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	7.vii.37	1937	DSS	6 8489	Egg Chorion
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	23.vi.1932	1932			Aweme Man
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	13.vi.1932	1932		52	Aweme Man
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	vi.16.37	1937		1 8989	Chorion of… Egg taken from oviduct & unfixed
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	?.vii.37	1937	DSS	2 8489	Egg Chorion
Pardalophora	*apiculata*	*Pardalophora apiculata* (Harris, 1835)	7.vii.37	1937	DSS	5 8489	Egg Chorion
Phoetaliotes	*nebrascensis*	*Phoetaliotes nebrascensis* (Thomas, 1872)	4.ix.1929	1929		15	
Psolossa	*delicatula*	*Psoloessa delicatula* (Scudder, 1876)	16.vii.32	1932		64	
Schistocerca	*lineata*	*Schistocerca lineata* Scudder, 1899	13.x.1930	1930	N. Criddle	40	Egg Chorion
Schistocerca	*lineata*	*Schistocerca lineata* Scudder, 1899	17.x.1930	1930	N. Criddle	40	Egg Chorion
Spharagemon	*collare*	*Spharagemon collare* (Scudder, 1872)	12.viii.1932	1932	N.C.	58	Aweme Man
Spharagemon	*bolli*	*Spharagemon bolli* Scudder, 1875	1.xi.1929	1929		30	
Spharagemon	*collare*	*Spharagemon collare* (Scudder, 1872)	30.iv.'29	1929		17	
Spharagemon	*collare ?*	*Spharagemon collare* ? (Scudder, 1872)	2.v.1924	1924		26	
Spharagemon	*aequale*	*Spharagemon equale* (Say, 1825)	10.x.1930	1930	N. Criddle	49	Egg Chorions From Medicine Hat, Alta.
Spharagemon		*Spharagemon* sp.	2.v.1929	1929		31 27	
Steiroxys	*trilineatus Thom*	*Steiroxys trilineata* (Thomas, 1870)	30.x.'30	1930	N. Criddle	37	Egg Chorion Blairmore, Alta. Tettigoniidae
Stethophyma	*gracile*	*Stethophyma gracile* (Scudder, 1862)	13.x.1930	1930	N. Criddle	68	Egg Chorion
Stethophyma	*lineatum*	*Stethophyma lineatum* (Scudder, 1863)	13.x.1930	1930	N. Criddle	44	Egg Chorions
Sticthippus		*Sticthippus* sp. ?	14.ix.1931	1931		9	Egg Chorions
Mestobregma	*kiowa*	*Trachyrhachis kiowa* (Thomas, 1872)	1.xi.29	1929		27	This genus does not appear in the key.
Mestobregma	*kiowa*	*Trachyrhachys kiowa* (Thomas, 1872)	1.xi.29	1929	N.C.		This genus does not appear in the key.
Trachyrachus	*kiowa ?*	*Trachyrhachys kiowa* (Thomas, 1872)	20.ix.1932	1932		60	? This genus does not appear in the key.
Trimerotropis	*agrestis*	*Trimerotropis agrestis* McNeill, 1900	2.xi.1929	1929		32	
Trimerotropis	*agristis*	*Trimerotropis agrestis* McNeill, 1900	17.viii.1932	1932	NC		Onah Man

Genus on Label	Species on Label	Current Name	Date	Year	Preparator's Name	Slide Number	Comments
Trimerotropis	*agristis*	*Trimerotropis agrestis* McNeill, 1900	17.viii.1932	1932	NC	59	Onah Man
Trimerotropis	*campestris*	*Spharagemon campestris* McNeill, 1901	25.ix.1930	1930	N. Criddle	50	Egg Chorions
Trimerotropis	*campestris*	*Spharagemon campestris* (McNeill, 1901)	25.ix.1930	1930	N. Criddle	50	Egg Chorions
Trimerotropis	*maritima Harr*	*Trimerotropis maritima* (Harris, 1841)	27.x.1932	1932		66	Ontario
Trimerotropis	*maritima Harr*	*Trimerotropis maritima* (Harris, 1841)	27.x.1932	1932			Ont.
Trimerotropis	*salina*	*Trimerotropis salina* McNeill, 1900	1.xi.1929	1929		28	
Trimerotropis	*pistrinaria*	*Trimerotropis pistrinaria* Saussure, 1884	14.ix.1931	1931	RMW	14	Egg Chorion
T	*bruneri*	*Trimerotropis pistrinaria* Saussure, 1884	14.x.1931	1931	R.M. White		Egg Chorion (specimen and coverslip fallen off)
Trimerotropis	*sordida*	*Trimerotropis gracilis* (Thomas, 1872)	23.x.1931	1931	R.M. White	12	Egg Chorions of
Trimerotropis	*sp. No. 1*	*Trimerotropis* sp. No. 1	23.x.1931	1931	R.M. White		Egg Chorions of
Trimerotropis	*sp. No. 1*	*Trimerotropis* sp. No. 1	23.x.1931	1931	R.M. White		
Trimerotropis	*sparsa*	*Trimerotropis sparsa* (Thomas, 1875)	23.x.1931	1931	R.M. White	16	Egg Chorion
Circotettix	*verruculatus*	*Trimerotropis verruculata verruculata* (W. Kirby, 1837)	14.ix.1931	1931	RMW	10	Egg Chorion
Xanthippus	*latifasciatus*	*Xanthippus corallipes* (Haldeman, 1852)	20.vii.1929	1929		?4	Aweme Man
Xanthippus	*montanus*	*Xanthippus montanus* (Thomas, 1872)	8.viii.30	1930	N. Criddle	47	Egg Chorions - immature
Xanthippus	*montanus*	*Xanthippus montanus* (Thomas, 1872)	14.ix.1931	1931	R.M.W.	11	Egg Chorions