August 2017

Studies of the life histories of grass feeding Jassidae

Herbert Osborn
Iowa State College

E. D. Ball
Iowa State College

Follow this and additional works at: http://lib.dr.iastate.edu/bulletin
Part of the Agriculture Commons, and the Entomology Commons

Recommended Citation
Available at: http://lib.dr.iastate.edu/bulletin/vol3/iss34/2

This Article is brought to you for free and open access by the Extension and Experiment Station Publications at Iowa State University Digital Repository. It has been accepted for inclusion in Bulletin by an authorized editor of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
In various papers published in these Bulletins during the past five years attention has been called to the injuries caused in grass land and pastures by the numerous species of Jassidae which swarm, often by millions to the acre, upon various species of grass.

In these papers it has been shown that the loss, though seldom noticed, must be really enormous and that by the use of the tar-pan or "hopper-dozer" the insects may be to a great extent destroyed. Further than this, however, our knowledge has been too meager to furnish a certain basis for remedial measures. It is true studies were made of a few species and some facts learned as to their life-history which warranted the belief that burning, mowing or other methods more satisfactory than the tar-pan might be of service but still so much remained unknown regarding the most common species that there seemed a necessity for a more extensive study. At the beginning of the present season a study was planned, the essential features of which were: 1st, the determination of the life histories of as many as possible of the species known to feed upon grasses; 2nd, the determination of the range of food plants for each species especially in the larval stages and 3rd, the collection of all species occurring on grasses and their careful identification with a close study of the specific limits of each as a basis for further life-history studies.

*Full technical descriptions of the species hitherto undescribed and here credited to the authors, are included in a forthcoming paper in the Proceedings of the Iowa Academy of Sciences which also includes a technical revision of the genus Deltocepalus. The great importance of the species in this genus as grass feeding species rendered its careful systematic study almost imperative.
Any facts suggestive of successful treatment of particular species have been carefully noted but it has been deemed essential in this study to hold in reserve general conclusions as to treatment and to gather as a basis for rational treatment, all facts possible bearing on the life and habits of the species.

Insectary studies have consisted in rearing as far as possible, all species in breeding cages consisting of glass globes or netted frames over grass in large pots along with continuous field study, the one as check to the other. In the investigation some sixty species have come under observation as grass feeders, not to mention some sixty more referred to other food plants and has involved the examination of many thousands of individuals in all stages.

Of a number of species we are able to present sufficient details of life-history to warrant final conclusions while of others the record is yet too fragmentary to be more than a starting point for future work.

Some of the results which seem to be general in nature may be mentioned here.

The species of Jassidae have as a rule a decided limitation as to food plant usually holding closely to one species of plant almost invariably limited to one plant for breeding but feeding more indiscriminately in maturer stages.

So far as known all the species deposit eggs upon the stems under the leaf sheaths or in the leaves of the plants used as food.

There is a wide difference in life-histories, some having one brood, the majority of the grass feeding species two, and still others three in a season, and the successive stages occurring at widely different times.

Except in the case of adult hibernation the ordinary life of a brood of adults does not exceed two months and for the individuals of a brood rarely over one. The males appear a week or ten days before the females and disappear as much earlier. In general one brood of adults will have disappeared before the larvae of the next have matured, so that individuals collected at any time may be referred with assurance to a particular brood.
It follows also that eggs for each brood are deposited within a limited time and that a period may be defined during which all eggs of a given brood for a given species will have been deposited and during which measures for their destruction may be applied.

Observations were made to ascertain whether simply cutting the grass and leaving it in the field would prevent hatching and in no case were eggs observed to hatch from stems cut green. Part of the stems from a plant in which eggs were fully developed were cut and left to dry. The second day after the eggs hatched in the uncut stems but no larvae issued from those that were cut, and on examination the eggs were found to be crushed and distorted from the shrinking of the plant tissues and by the curling of the edges of the sheaths in drying. Even if hatched they would have been unable to escape from the rigid incurved edge.

*Diesrocephala mollipes* Say.

This is a very conspicuous and well known species on account of its long narrow form and acutely pointed head as well as from the fact that it occurs from central Canada to southern Mexico and from the Atlantic to the Pacific. It also possesses a wide range in food plant, being found on all kinds of vegetation during the greater part of the summer. It is especially abundant upon the annuals and after their maturity in the fall it may be found in abundance on blue grass and on second growths of both annual and perennial grasses. It apparently passes the winter as both larvae and adults as both have been found late in the fall and early in the spring, but probably the greater majority in this latitude deposit eggs in the stems of second growth perennials like *Elymus canadensis* sometime in September or October from which larvae appear the following spring to develop into adults by the fore part of July. These deposit eggs from which larvae appear in August developing as adults for the fall deposition of eggs.

*Diesrocephala novaeboracensis* Fitch.

This is a larger and lighter colored species than *mollipes* and may be further distinguished by the blunter
head and the two black spots at the tip. It has been found to occur only in sloughs or in heavy grass adjacent to them especially slough grass (*Spartina cynosuroides*).

The adults were taken the last of June and through July and again from the middle of August through September. It seems to be decidedly limited in its range of food plant and would be of little economic importance except where slough grass is used for hay.

*Diedrocephala coccinea* Forst.

This is the brightest colored species of the genus occurring at Ames and is intermediate in size between *molliipes* and *noveboracensis*.

The vertex and scutellum are bright yellow. The pronotum is variously marked with green, red and yellow. The elytra are bluish green with two broad purple stripes and a narrow yellow margin. Below, all yellow except a narrow black line just under the vertex. Length 9 to 10 mm. Readily separated from *versuta* by the absence of dark markings on the vertex and the larger size.

The larvae are of a pale yellow color throughout. Head much inflated convexly pointed; thorax broad, abdomen long and slender. The pupae are still lighter colored and have a scarlet mark on each wing pad.

This species is two brooded; the larvae were taken nearly full grown about the first of June. Adults were taken from about the middle of June through July and again through September and October.

They were taken from woody regions but usually swept from the undergrowth of grass and weeds. Adults of the second brood were taken from coarse grasses long after the trees had shed their leaves.

*Xerophloeoa viridis* Fab.

This grotesque species occurs throughout the entire United States at least. VanDuzee reports it from New York to Florida, Texas, Colorado and California. In addition to this specimens are at hand from Oregon, Utah, Arizona and Nebraska, and it has been collected at Ames rather commonly.
The adults are six or seven millimeters long by two millimeters wide across the pronotum; the head is slightly narrower than the pronotum, eyes small, vertex flat, produced and roundingly angled in front, anterior margin very thin; the elytra are long and angularly pointed behind, the claval area is nearly flat while the corium is strongly deflected becoming perpendicular at the tip, giving the insect a wedge shaped appearance. The entire dorsal surface is coarsely pitted. The females are bright green with the tips of elytra lighter, sometimes clouded or minutely dotted with darker along the margins; the males have in addition a broad median smoky line on the vertex and an irregular transverse dark band on the pronotum more or less strongly margined with lighter before.

Larvae similar in form to the adult but with a broader body and longer head; vertex one-half longer than wide acutely angled before, margin very thin; whole depth of head less than one-fourth of the vertex; abdomen short, dorsally carinate color green the entire surface covered with short white hairs arising from minute black spots; a pair of larger black spots near the base of the wing pads and another pair on the posterior margin near the inner angle.

Larvae were found nearly full grown in August, the adults were taken from the second week in August until October. They were swept from a native grass pasture where they were fairly abundant. Specimens from Nebraska and Utah bear dates from May to July indicating that the species is two brooded. Observations were not made upon this area during the first half of the season which would account for its not being found sooner.

THE EIGHT LINED GYPONA.
(Gypona octo-lineata, Say)

Although the Gyponas have never been recorded as grass feeding species, observations this season show that for some of them at least this is a normal habit and a notice of those showing this habit is in place.

Gypona flavilineata was described by Fitch and separated from octo-lineata Say by the lack of reticulations
on the clavus. In other characters it so closely simulates that form as to have occasioned endless confusion in collections and references, as even this character by its intergradations was unsatisfactory.

Our observations the present season indicate that flavilineata is simply the first brood of octo-lineata.

It occurs upon the wild grasses of wood lands especially and while not likely to prove a serious pest in blue grass pastures or the better kept grass lands, has unquestionable economic importance in pasture ranges including wood land or wild grasses.

The larvae very strongly resemble the adults. The head is abruptly narrowed in front of the eyes but projected centrally. The antennae are very long, the basal joint nearly as long as vertex, while the bristle reaches to the middle of the abdomen. The abdomen is long, rather slender, color green.

The pupa as compared with the larva is broader, shorter, darker green, two spots at the inner angle of the wing pads.

Larvae appear June 16th. Small to half grown; abundant till the middle of July. First adults appeared about the first of July, continuing till the middle of August.

Second brood larvae occurred in latter part of August and September adults appearing in September and October.

The larvae very strongly resemble the adults, the head abruptly narrow in front of the eyes but projected centrally. The antennae are very long and the basal joints nearly as long as the vertex while the bristle reaches to near the middle of the abdomen; the abdomen is long, rather slender, color green.

The pupa as compared with the larva is broader, shorter, darker green with two spots at the inner angle of the wing pads.

Larvae, appeared June 16th, small to half grown, abundant till middle of July. First adults appeared about the first of July and continued to middle of August.

Larvae indistinguishable from the above occur in latter part of August and September, but adults appearing
in September and October are usually of the form referred to *octo-lineata*.

_Euacanthus acuminatus_, Fab.


Fitch's description of _orbitalis_ and the specimens at hand agree in every respect with the description of _acuminatus_ and with European examples of the species so that there seems to be no question as to their specific identity.

This species occurs throughout the whole of central Europe and probably has an equally general distribution in this country. It has already been reported from Canada, New York and Michigan, and specimens are at hand from Washington, D. C., and Vancouvers Island. Besides adults and larvae taken at Ames this season.

The adult is very stout bodied with a broad vertex and small round eyes. Length, 6 mm; width on center of costa, 2 mm.

Vertex about equalling pronotum in length; nearly twice broader than long; obtusely angled anteriorly, medially and laterally carinate; ocelli on the vertex near the carinate anterior margin, about equally distant from eye and tip; front broad above, rounding to the small clypeus; base of the antennae overhung; pronotum short; elytral venation simple, first sector only once forked color shining black with margin of eyes, tip of vertex, elytral nervures and a large spot near the base of the costa, white.

Genitalia: Ultimate segment of the female long, rounding, posterior margin arcuated or slightly notched. Male valve obtuse short; plates long and very narrow, exceeding the pygofer.

Larvae: Head white and similar in form to the adult, much more inflated and produced, one-third the length and nearly half the size of the whole insect, four times the length of the bead-like eyes, evenly and finely covered with short white hairs; antennae extending beyond the middle of the abdomen; thorax narrower than the prominent eyes; abdomen slender, dorsally carinate, tipped with coarse white spines; entire body covered with fine white pubescence; thorax and abdomen sparsely set with
curved black hairs pointing backward. Length of full grown larvae, 5.50 mm.

Larvae and adults were taken the first week in July; adults continuing to be found throughout the month. Swept from woody pasture in which numerous compositae abounded. Larvae in cages fed indiscriminately on a variety of plants taken from similar situations.

THE SHOVEL NOSE LEAF HOPPER.

*Dorycephalus platyrhynchus*, Osborn.

This very peculiar insect has hitherto been recorded only from Ames, Iowa; and West Point, Neb., and has been considered as very rare, only three or four specimens in all having been seen prior to the present season and nothing was known as to its life history or food habits. During the present season, however, it has been found in large numbers and since it has bred freely in the breeding cages it has been possible to determine its complete life history.

At first sight one would infer that it would be a very conspicuous object and an easy victim for natural enemies or the obstrusive collector. As a matter of fact, this proves to be only a remarkable adaptation to its food plant, *Elymus canadensis*, in color and life history.

The linear aspect and the dark dorsal stripe, more or less broken or obscured, harmonize so well with the ordinary rusty Elymus stem to which it closely adheres and from which it can scarcely be driven, either in larval or adult stages, that it is detected with great difficulty. They rely on this mimicry for protection rather than upon flight or leaping. So perfect is this protection that one may look for some time at a few stems of grass, where dozens of the insects are known to occur and yet fail to locate them.

The figures show the distinctive features sufficiently, and a full description is unnecessary here; but it may be proper to call attention to the fact that there are two forms of females, one having the elytra very short (the wings proper rudimentary) as figured; the other with much longer elytra and wings, a smaller body and a more pointed vertex; more closely resembling the males. This
form flies readily, while the other is entirely incapable of flight and never leaves the plant on which it was hatched. The males are all long winged.

It is single brooded, the adults appearing about the middle of May and continuing in decreasing numbers until the end of July. During the last week in May and the first week in June the eggs are deposited; the female selects a spot about two inches above the base of the first or second leaf from the bottom; having selected the spot apparently with much care she takes her position, head upwards, legs placed close together and tarsi clasping the stem; then raising the body the length of her legs and curving the abdomen upward, she unsheaths the ovipositor from the pygofers and brings its tip down against the grass stalk, pointing backward slightly from the perpendicular; she then moves slowly around the stem, keeping the body parallel with it and the guides pressed against it until they catch under the edge of the encircling leaf sheath; having done this they are gradually forced under the sheath, usually extending almost half way round the stem. As they are gradually forced in the abdomen straightens and then hollows until when the ovipositor is fully inserted the abdomen is curved down and the pygofers are pointed upward and backward at more than a right angle with the guides. Having reached this position she works slowly backwards, opening the sheath with a peculiar sawing motion alternating with a slight pause for the deposition of an egg.

The eggs are one and one-half millimeter by one-third millimeter, cylindrical, gradually tapering from a point near the head back to an obtusely rounded tip; the anterior end is cut off obliquely from one side and rounded from the other, coming to an obtuse point. They are deposited in a continuous row from thirty to fifty, side by side, curving slightly around the stem with their heads toward the edge of the sheath from which they are distant about one-third the circumference. The time occupied in actual deposition is from twenty to forty minutes, but the selection of a location and the catching of the sheath edge often occupies several hours.
Although the eggs were deposited through a period of two weeks or more they apparently all hatched at about the same time—the time evidently depending considerably upon favorable conditions of temperature and moisture—for up to July 2nd no larvae had been observed either in the cages or in the field. On this afternoon the air was very oppressive and remained so until cleared by a heavy thunder storm during the following night. On the morning of the third they were observed just emerging from the eggs in the cage and examinations showed that they had hatched in the field also. The earliest deposition from which they were observed to issue on this date was made May 28th and the latest on June 9th, while the majority were deposited June 4th and 5th. This gives from twenty-six to thirty-eight days with an average of about one month as the period of incubation.

The freshly hatched larvae have shorter and blunter heads than the adults and are much more active, but within a week or two the head has elongated and it has adopted the sluggish habit of the adult.

Upon hatching the larvae immediately arrange themselves along the base and margins of the broad leaves parallel to the veins where they remain stationary for weeks at a time, so closely resembling the rust spots and discolorations occasioned by their own punctures that the chance of their detection is slight. Or, they ascend to the head where they conceal themselves so effectually among the glumes and sheaths upon which they feed that one might carefully examine a head and pronounce it free from them only to find on shaking it violently that it contained a whole colony. Here they stay until the head ripens in September when they descend to feed on the second growth and the surrounding grasses until winter when they crawl into the thick clump of the Elymus and hibernate, appearing again in early May and changing to pupae. From then on till the middle of the month they feed on any green thing near enough to be reached, crawling at last to the top of some blade of grass and issuing as adults over ten months from the time of hatching from eggs.
This species in common with the others which occur in long and short winged forms are usually very thick where they occur at all, but the eggs being deposited only upon the wild rye, they are limited in their range to a radius of a few feet at most from their host.

They have been observed to feed upon the heads of *E. virginicus* indiscriminately with those of *canadensis* where the two grasses are near together or near enough for migration, and in the spring when the larvae were large and abundant and the grasses small and inconspicuous they were found upon every thing occurring within a reasonable distance of the host.

In view of the fact that wild rye is one of the most deleterious of our grasses and has been the cause of considerable loss to our stockmen in the past through its propensity to ergotism its eradication from pastures and meadows would of itself be beneficial and at the same time avoid any possibility of further injury from this leaf hopper. Another method of treatment which would accomplish both ends sought and still enable us to make use of its valuable food properties, would be to closely mow the grass clumps the latter part of each June. This would cut off the head-forming stems before they had developed ergot and would destroy the eggs of the shovel nose and at the same time leave the grass in good condition for the immediate pasture, or if not pastured produce a better crop of hay than without the mowing.

**THE SPOON BILL LEAF HOPPER.**

(*Helelus lineatus* Uhler.)

This species is closely related to the preceding but has a stouter form and is quite active. It has hitherto been considered rare but very few specimens ever having been taken.

The female is about eleven millimeters long with a broad flat head and a narrow pointed abdomen. Its color is bright green with the veins of the elytra and four longitudinal stripes on the head and pronotum reddish orange.

The male is much smaller than the female with the head and pronotum of the same color and pattern, but the elytra have two black bands enclosing a transparent area
on the posterior half and the tip of the abdomen ends in two long black style-like appendages. Hitherto this has been regarded as a distinct species and called *H. fenestratus*, a not surprising error, in view of the great difference in appearance of the two sexes, but our observations the past season have proven their identity.

The larvae are very similar to the female in color in appearance slightly narrower and the stripes extend the entire length of the body.

During August of the past season the species was found in considerable numbers as larvae and adults on slough grass, *S. cynosuroides*, to which it seemed strictly confined. The larvae all matured before the end of the month, the adults continuing until October. They were discovered too late in the season to determine their complete life-history, but from what is known, it is probable that the species is single brooded with an adult hibernation or a late fall egg deposition.

*Parabalocratus viridis* Uhl.

Occurring only on the wild oat (*Stipa spartea*) this species furnishes another example of a leaf hopper confined strictly to one species of grass as a host and to which it is remarkably adapted in coloration and life-history.

The adult female is about 7½ mm. long by 2 broad, with a parabolically curved thin edged vertex and a stout abdomen attenuating posteriorly and extending beyond the rounding elytra. The males are smaller and have the vertex shorter and more obtusely pointed. The abdomen is smaller and does not extend beyond the narrow and very parallel margined elytra.

They are both of a uniformly deep green color above somewhat lighter below with a narrow band under the sharp vertex and the eyes dark; the exserted tip of the ovipositor orange red.

The first brood of the adults appeared the first week in May and remained until the middle of June, disappearing gradually. They feed principally upon the leaves usually about the middle, feeding on either side and either end up with epual ease.
The eggs are deposited during the last of May and the first week in June. The females usually selecting a position just above the first leaf base and invariably placing themselves head downward, exsert the ovipositor and insert it under the flap of the sheath gradually working backwards up the stalk for a distance of two inches of more and depositing from seventy to one hundred and twenty eggs within an hour.

The eggs are 1\(\frac{1}{2}\) mm. long by 1 mm. broad cylindrical of nearly uniform size and obtusely pointed at both ends arranged in a single series side by side curving considerably around the small stem.

The larvae appeared the last week in June, giving an incubation period of fifteen to twenty days. Upon bursting the egg case the larvae crawl part way out from under the sheath and remain quiescent in this position for an hour or two when becoming suddenly active, a flock of very small larvae may be seen ascending the stalk and distributing themselves upon the leaves while a row of freshly shed skins with the abdomens still remaining under the sheath, their tips scarcely free from the egg shells, explains the cause of the delay.

When first hatched the larvae have a characteristic head, depressed, light colored, soon deepening however and in some assumes more or less definite stripes of darker, which in the most extreme forms coalesce and a black specimen is the result. In normally colored specimens there is on either side of a median light line, a narrow black stripe originating in a spot on the interior margin of the vertex obscured across the disk and becoming marked again upon the posterior margin enlarged and lobate on the thorax, then narrow with definite parallel margins to the last segment of the abdomen where they expand and meet at the tip. Besides these there is a broad stripe extending from the inner angle of the eye back across the thorax where it is margined internally with light to the abdomen where it margins all but the last segment.

They require about a month to develop maturing during the latter part of July and the first of August, the adults remaining until the middle of September.
The eggs for the second brood are deposited from the middle to the last of August and the larvae appear in September, becoming full grown before winter, when they hibernate, appearing to pupate about the first of May and becoming adults before the middle of this month.

Stipa is another troublesome grass but too widely and evenly distributed over the prairies to eradicate easily. It may however be mowed closely between the tenth and sixteenth of June to destroy the first brood of eggs and the troublesome barb of the grass at the same time, leaving an undergrowth of nutritious grass free from Jassids. Should the adults appear in considerable numbers in August, a second mowing during the latter part would effectually dispose of the second brood of eggs.

*Stipa* is a very valuable grass to the stockman of the prairie regions where blue grass has not been introduced as it appears two or three weeks earlier than the other wild or upland grasses thus furnishing much earlier grazing than could otherwise be obtained.

*Platymetopus cinereous* O & B.

This is the smallest species of the genus and the most abundant at Ames occurring everywhere in abundance that wild grasses are found. Specimens have also been received from Kansas, Nebraska and Arizona showing it to have a wide distribution throughout the prairie and plain region at least.

The adults are similar in form to *P. acutus* but are smaller and lighter colored, being about four millimeters long; head yellow above with light dashes; pronotum and elytra cinereous with lighter maculations and dark nervures. Male smaller and shorter, vertex uniformly darker tip of elytra deeply clouded.

Larvae are very conspicuously marked and easily recognized. They are about 3½ mm. long, 1½ mm. wide when full grown, widest just in front of the middle, gradually and regularly narrowing to an acute point at either end. In color they have a broad lemon yellow stripe from vertex to tip of abdomen bordered on either side by a dark line as wide as the eye in front of which it is narrow and
lighter colored, meeting below the vertex. The larvae of P. acutus is similar in form and ormentation, but the dorsal stripe is less.

The larvae were first observed in June when they were nearly full grown and by the third week had disappeared. The adults appeared very thickly by the middle of June and continued in decreasing numbers until after the middle of July. The second brood of larvae appeared by the last of July and continued in large numbers up to the middle of August. The second brood of adults appeared the second week in August and continued through September.

By a process of elimination of grasses not occurring in one or more places where the larvae were found abundantly its list of host plants may be reduced with a reasonable degree of certainty to three, A. scoparius, B. hirsuta and curtis pendula and from its scarcity on a field of nearly pure scoparius its probable host is Bouteloa. This agrees well with its known habits; being also that of these grasses.

*Deltocephalus debilis* Uhler.

This well known species is comparatively rare here—a few specimens only being taken here each year.

During this season adults were taken from the first week in June through the first week in July. No larvae were found nor any food plant determined. They are usually found in woody regions however.

*Deltocephalus inimicus* Say.

Further observations during this season tend toward confirming the idea of two broods as follows: Larvae appearing about the first of May and maturing before the middle of July. The second brood of larvae appearing before the middle of July and mostly mature by the third week of August, adults again from the second week in August on through the season.

Close mowing the latter part of June would catch the eggs for the second brood and materially lessen their

*Note*—*D. debilis* of previous Bulletins should be read *D. melolontha*. 

Published by Iowa State University Digital Repository, 1894
number. Burning as before recommended would destroy the eggs for the first brood.

This species has a wide range in food habit and a consequent variability in its life history, the limits given above are for blue grass broods where it is under nearly constant condition and seems to be reasonably definite in its appearance. Its occurrence on annuals would be materially affected by the date of their appearance.

*D. melsheimeri* Fitch.*

Work was not commenced soon enough to fully determine the life history of this species, but broods are recognized on blue grass as follows: Adults from middle of May until last of June, larvae from first week in June till middle of July, adults from first week in July through August; larvae through August till the middle of September; adults from the middle of September through the season.

*Deltocephalus sayi* Fitch.

This species may be swept sparingly almost everywhere but occurs throughout the summer in immense numbers on blue grass in woody pastures either high or low.

The adult is short and compact with a rounding pointed vertex and broad almost truncate elytra. In color they are rich brown with the tip and two concentric bands on the vertex lighter, and two bands of lighter on the elytra; one at the base and a broader one back of the middle. On these bands the nervures are distinctly white.

The larvae are more elongated than those of *inimicus* and have a narrower and more definitely angled vertex. They are colored very much as in the adult, but the markings are different. There is a narrow median line of white extending from the tip of the vertex to the last abdominal segment where it broadens and nearly covers tip; the inner margin of the eyes, a concentric band near the point of the vertex and two spots just back of the center on either side are lighter. A broad marginal stripe from the eye back, an indistinct narrow one from the inner margin of the eye which breaks up into white spots, one on the posterior margin of each abdominal segment

---

*D. debilis* of previous Bulletins.
and a second row of dots midway between the first and the marginal stripe on either side complete the white markings of the body. The face is light with fuscous striations.

The larvae were first taken sparingly from upland prairie the second week in June. They were full grown and were probably belated ones as the adults had been taken during the first week. On June 16th the first observation on wooded pastures was made and the adults were swept in immense numbers from rank blue grass. They continued to be found in great numbers whenever observed throughout the remainder of the season. The larvae were next observed July 11th, when they were somewhat over half grown, and by the last week in July they were full grown, in abundance and fresh looking adults were also numerous. Again on the 5th of September nearly full grown larvae were observed to be numerous as also were the adults. Later in the month the larvae were becoming rare and the adults still very plenty as they continued to be throughout October. Six females dissected on the 27th of October, showed no signs of eggs from which it might be inferred that they had been deposited. On this assumption, which coincides well with the early appearance of the spring brood of larvae the following arrangement of broods would seem very probable and harmonize well with the dates given above.

First brood of larvae through May and the first week in June, adults from the last week in May until the middle of July, second brood of larvae last week in June till the first week in August, second brood of adults from middle of July through August, third brood of larvae from middle of August until the last week in September, third brood of adults from the first week in September through October.

*Deltocephalus configuratus* Uhl.

This widely distributed species is the largest of the genus in America and though the coloration is often so faint as to leave it almost unicolorous above it may be easily recognized by its broad blunt head as well as by
its peculiar genital structure, the last ventral segment of
the female terminating in an attenuate bifid black process
and the male plates strong, broad, and obliquely truncate.

In the definitely colored individuals there is a white
cross on a white margined vertex of fuscous and alternate­
ing light and fuscous stripes on the pronotum. The
nervures of the elytra are white, margined more or less
strongly with fuscous. The elytra vary in length usually
longer than abdomen a median impressed black line on
the vertex is never entirely wanting. Length, $4\frac{1}{2}$ to
5 mm.

The larvae may be separated from *sayi* by the broader
head, rounder vertex and stouter form and from any
other of the striped larvae by the fuscous striated front.
It is of a pale brown above with three indistinct stripes
and a row of dots just inside the narrow light margin on
either side the abdomen. Front light with indistinct
fuscous striations.

This species was first taken in great abundance as full
grown larvae and freshly issued adults on May 12th.
Within two weeks the larvae had all disappeared while
the adults were very numerous throughout June and a
few were found in July. On July 15th a half grown
larva was swept but no more adults or larvae were seen.

The field had been closely mowed June 25th and the
inference is that the eggs had all been deposited some­
where in the grass stems above the point of cutting and
must have been almost totally destroyed by the process.

From these facts and through comparisons with the
life-history of other species their life-history may with
seasonable certainty be completed as follows: Adults
from the first week in May through June; larvae from
the last week in June until the first week in August; sec­
ond brood of adults from the last week in July on into
September; second brood of larvae appearing sometime
in September and going through the winter to appear as
adults in May.

That close mowing the last week in June was an
effectual check was completely demonstrated for this
species (too completely for continuation of life-history
work).
Facts which materially strengthen this conclusion are that in the following species, *D. albidus*, known facts in regard to its life-history would indicate that its eggs had also been deposited before this time and it was also completely exterminated while other species occurring on the same area whose eggs are known to be deposited at other periods remained abundant throughout the season.

There would be a second period when mowing could be used effectually to catch the second deposition of eggs. This would be, according to the determinations above, toward the latter part of August.

*Deltocephalus albidus* O. & B.

This is an exceptionally well marked form and with the four following species introduces a group of five species which differ from all the other species described in having reflected costal veins and which closely allies them to a large European group.

This species has been taken at Ames for a number of years but has not been received from any other locality. The adults are creamy white above with four stripes on the pronotum, the inner central pair extending forward on to the vertex where they slightly diverge and backward across the scutellum. Vertex with an interrupted crescentiform band before the eyes; tip white, black margined. Elytra with an oblique interrupted band on the inner and posterior margin and the anterior margin of the reflexed veinlets black-lined. Length, 3.5 mm.

Larvae cream colored above with four dark stripes, inner pair narrowest and extending forward on to the vertex where they diverge and broaden, then converging and narrowing to the apex. A white spot on each abdominal segment located in the outer dark stripe. Eyes and an oblique band from the point of the vertex across the front to the outer angle of the genae, dark.

The larvae were first taken May 26th. They were then nearly full grown and remained abundant two weeks, disappearing by the middle of June. The adults were first taken this season on the 3rd of June and by the middle of the month were extremely abundant, continuing in decreasing numbers up to the middle of July.
This species also occurred on the field that was mowed early and the only appearance of a second brood was the capture of one adult male August 18th.

These facts indicate that it has a very similar life-history to *configuratus*, the broods, however, occurring from one to two weeks later. The same remedial measures applied at a proportionally later period would be equally successful.

No definite food habit can be assigned it as there was a rich collection of native grasses where it occurred so abundantly. It was not, however, found on a field of *Andropogon scoparius* or where the *Bouteloas* predominated. Insectary tests to ascertain its food plant failed because of its great susceptibility to *Sporotrichum* in confinement.

*Deltocephalus inflatus* O & B.

Specimens of this species have been collected at Ames for a number of years and have also been received from Colorado. The adult much resembles *configuratus* but has a narrower head and vertex and longer elytra, giving it a rather more slender appearance.

The adults measure 4.5 mm. in length; vertex broad and short; elytra long; body stout; male abdomen greatly enlarged at tip; pygoferes broad, obtusely pointed, compressed below and inflated above; last tergite much enlarged, inflated in the middle; compressed against the pygoferes at tip; plates small, sometimes notched at tip to receive the sharp edge of the pygofer. Color palid to light fuscous; dark ring on the tip of the vertex small; usually a large dark blotch in the third apical cell, sometimes wanting in lighter forms.

The enlargement of the male genitalia though not peculiar to this species alone is rendered all the more striking from the fact that it is ordinarily met with only in the short-winged form of males in the genus *Athysanus* while long-winged forms of the same species in that genus have genitalia of normal size. The males of this species, however, are all long-winged, have constant deltocephaloid venation and constantly enlarged genitalia.

Adults have been taken rather sparingly through the last half of June, rather commonly during the first week.
in July, and one battered specimen the first of August. No larvae have been taken nor any determination as to food plant except that it has always been swept from grasses.

*Deltocephalus reflexus* O. & B.

This species and the three following bear a very strong resemblance to each other. They are most accurately separated by the structure of the genitalia which have proved to be very constant in the hundreds of specimens studied as in fact they have for the whole genus, though tested by the study of nearly five thousand specimens.

The adults are 4 to 4½ mm. in length, head appearing narrow on account of the spreading reflexed elytra; vertex narrow; color light fuscous to cinereous marked as follows: Tip of vertex white with an interrupted dark margin as in *albidus* two circular spots at base and an interrupted band on the middle dark. Elytra light fuscous, terminal and reflexed veinlets white, lined anteriorly with dark traces of an oblique band; third terminal cell of the elytra largest; upper half of front black, lower half white.

Larvae resembling *sayi* more elongated, stripes more definite, oblique spots on the base of the vertex and the upper half of the face black like adult.

This species was taken for the first time June 3rd, when it occurred as full grown larvae and adult male. By the middle of June the larvae had disappeared and the adults were numerous, continuing so well into July. Small larvae were found the third week in July and from then on they were numerous until the second week in August when they had become full grown and begun to disappear. The adults appeared by the end of the first week in August, becoming abundant by the middle and continuing to be found throughout the fall. One female, dissected October 26th, showed three fully developed eggs and no smaller ones, probably indicating that the rest had been deposited before then.

This species occurs widely distributed over the prairie but was not found on a field of *Andropgon scoparius*.
This is a slightly smaller and darker species than *reflexus*, the vertex is less pointed and the elytra inclined to be less flaring, giving it a more compact appearance. It can be most readily separated, however, by the comb-like teeth on the last ventral segment of the female and the truncate plate of the male.

This species has been taken at Ames for a number of years but has not been received from other localities. The adults measure from 3.5 to 4 mm., vertex broadly pointed and elytra compressed, slightly reflexed at tip, third apical cell smaller than fourth. Color fuscous with indistinct markings as in *reflexus*. Face very dark above shading to lighter below on the clypeus; front usually all dark, no distinct line of separation of shades.

Larvae stouter, darker, less distinctly marked than those of *reflexus*, otherwise almost inseparable. The median stripe is distinctly marked while the next pair fade to mere dots on the abdomen.

The first adults were taken May 26th, becoming more numerous up to the middle of June, then decreasing in numbers into July. This species had not been recognized as distinct from the preceding until after the time for the first brood of larvae, so no observations were made upon them. The first larvae recognized as belonging to this species were taken August 4th in a different locality from the preceding and where *reflexus* did not occur. They were then nearly grown and the adults were beginning to appear. Two weeks later the adults were abundant and the larvae gone. The adults continued abundant into September and could be found until the end of the season.

The species was taken wherever *B. hirsuta* was found and never anywhere else during the season. *Bouteloa curtipendula*, however, usually occurs with *hirsuta*, so that it could not be excluded on that ground, but the latter also occurs very commonly where *hirsuta* does not and in no such localities has this species been taken as yet, while within the limits of the area it appears to feed indifferently on either plant.
Deltoccephalus abbreviatus O. & B.

This is the smallest species of the reflexus group, measuring only about three millimeters in length. This and its cinereous color will enable one to separate it from pectinatus to which its dark face allies it and separates it from reflexus, or it may be readily separated from either by comparison of the genitalia.

Larvae stout, compact forms, coloration much as in reflexus, dark stripes less distinct, a faint transverse line near the tip of the vertex white.

Adults and full grown larvae were first taken in company with the preceding species from Bouteloua hirsuta August 4th and 8th. By the middle of the month larvae had disappeared, adults continuing numerous through the month and on till near the middle of September. The spot where this species was found was a high gravelly pasture, the tops and sides of the knolls being covered with this grass to which it seemed strictly confined. Mowing could not be used successfully against this species on account of the small size of the grass and the character of the ground. Burning when the ground is dry would probably destroy most of the eggs for the spring brood.

Deltoccephalus compactus O. & B.

With this species we take up another group of the genus in which the costal veins are not reflexed, usually at right angles to the costa and the central anteapical cell is constricted, usually double. Here belongs inimicus and the two following species of our list.

This species has been received from Washington and collected at Ames. The adults of form and size nearly of D. weedii but with slightly shorter vertex and elytra. Color dark fuscous varied with lighter; vertex with a crescentiform interrupted band before the eyes; anterior to this lighter; with four black dots on the margin; ocelli black. Readily separated from weedii by the form of the male plates which are narrowly attenuated; three times the length of the valve.

Adults were first taken June 27th when they were swept rather sparingly from two different patches of Sporobolus hooker. They were taken from that time on until
July 22nd and then again probably of a different brood
August 15th and 19th, the latter ones, however, from a
different locality as the first two patches were mowed
before then.

_Deltocephalus signatifrons_ Van D.

This species which was described from Colorado and
has been received from Maryland, occurs very commonly
at Ames. It very closely resembles _inimicus_ in form and
color but is readily recognized by its smaller size and the
absence of dots of the former species.

The adult is 3.5 mm. long, narrow, elytra elongate,
closely folded giving it a very narrow appearance posteri­
orly. Vertex with six more or less distinctly marked
bars; anterior pair smallest; the nerves of the elytra alter­
nately fuscous and lighter central antepical cell elong­
ate constricted, rarely if ever divided, however.

Adults were taken rather commonly May 29th and
again June 4th, no more being taken until the last of
August, when they were again swept in fair numbers and
from then on until September 10th, when the last one
was taken. They were most abundant upon weedy
places, roadsides, etc., where Setaria and Panicum
abound. Considering the nature of the food plant no
economic measures need be suggested unless it should be
found to occur on Millet or Hungarian grass.

_Deltocephalus weedi_ Van D.

This pretty little species has also probably a very
wide range though only reported as yet for Mississippi.
It occurs at Ames, but so far has been taken only in limi­
ted numbers and during a single season.

Adults measuring about 3 mm. with a bluntly pro­
duced vertex sides sharply concave elytra slightly longer
than the abdomen, flaring central antepical cell divided
color testaceous brown with the anterior portion of the
vertex and nervures of the elytra light; four dark points
on anterior margin of vertex, front and venter dark; male
plates short together nearly circular in outline.

This species was taken at Ames in June but no deter­
mination as to its life-history has been made.
With this and the two following species we take up a group which also includes *melsheimeri*, in which the central antepical cell is never divided; usually not constricted, the specimens are usually unicolorous and strongly resemble each other in form.

This species closely resembles *melsheimeri* in general appearance but has a much sharper vertex and a narrower form. Vertex nearly twice longer at middle than next the eye distinctly longer than pronotum. Color green with faint traces of testaceous brown markings on vertex and pronotum; never fuscous as in colored specimens of *melsheimeri*. This is a widely distributed species, having been received from Maryland and Kansas. Specimens are in the Vanduzee collection from Ontario and it has been taken at Ames for a number of years.

It occurs only on blue grass in wooded areas where it may be found in immense numbers. It was first observed this season June 4th in considerable numbers and from then on nearly through July. Observations were not made again until September, when it was found as thick as ever. The larvae were not successfully separated from those of other species occurring in the same location, and so no separation into broods can be made at present.

*Deltocephalus oculatus* O & B.

This species is similar in size and form to the preceding with a slightly shorter vertex and abruptly narrowed plates. Color when fresh, light orange with a distinct purple spot on the eye. Old specimens and late fall brood approaching green with slight fuscous markings but never sufficiently pronounced but what the orange tint remains. It may be readily separated by the vertex and genitalia as well as by the distinctly different habitat.

The larvae closely resemble the adult in form and color; the spot on the eye being pronounced and serving as a ready means of separating this from other yellow larvae. In the stronger colored ones stripes are sometimes indicated but not defined. This species has been received from Colorado and has been taken here before
this season. It was first taken this year as adult the last week in May and from then on till July; larvae were taken abundantly during the second and third weeks of July, disappearing by the end. Adults were again found from the middle of July through August; larvae again appearing in August, maturing through September; adults from the first of September on through the season.

It has been found everywhere on *Andropogon scoparius* to which it seems strictly confined.

Mowing during the middle of June and again the first half of August or burning during the fall or spring would serve to check this species.

*Deltocephalus minimus* O. & B.

This is a very small and distinct species closely following the forms of the two preceding, but of a deep green color. The adult is scarcely three millimeters in length with a variable conical vertex; in the female usually acutely angled; in the male shorter and rounding. Color: vertex, greenish yellow, pronotum and elytra deep green; below darker.

The larvae are uniformly deep green above, darker below with nearly black legs. They are very distinct and easily separated from any other in the genus but might be mistaken for freshly hatched *P. viridis* larvae but for the flat head of the latter.

This species occurred abundantly on a patch of raw prairie adjoining the *Andropogon* field where *oculatus* occurred so thickly and was found at the same time and in the same places as the former throughout the season but not occurring on the isolated *Andropogon*. *Sporobolus heterolepis* and the *Stipa* were very plentiful where they were most abundant either one of which would harmonize well with its deep green color.

*Athysanus curtisii* Fitch.

This species is the best known and the most widely distributed member of the genus occurring throughout the eastern states and Canada and as far west as Michigan and Iowa at least, probably to the mountains. The adult is three and one-half millimeters in length by one and one-half broad with the vertex scarcely longer than
the width of the pronotum, obtusely convexly pointed; elytra exceeding the short ovipositor. Color, vertex yellow with large round spots before the middle, and tip black. Face yellow, an oblique black band extending from either eye to the base of the clypeus, then prolonged narrowly to the tip, forming a Y shaped mark. The pronotum yellowish green with a black crescent anteriorly; elytra dark, nervures yellowish green.

Larvae stout with a large convexly conical head; of a deep yellow color, with eyes and antennae dark. The body is covered with long stout hairs.

This species is confined strictly to blue grass in meadows and wooded pastures where it rivals *D. sayi* in abundance. First collected this season June 17th as adults in abundance. The larvae were found during July, becoming full grown and issuing as adults by the end of the month. Another brood of larvae matured during September, the adults continuing through the rest of the season, becoming scarce by the last of October, when a dissected female showed one fully developed egg, the rest probably deposited.

*Athysanus bicolor* Van D.

This species was described from Kansas and Mississippi, and had been reported from Iowa under the name of *virgulatus* Uhl (a MSS. name) before. The adults have nearly the same form and size as the preceding species; the vertex is more pointed and the attenuate ovipositor extends beyond the elytra.

In color the females are yellowish green with two large coalescent spots on the vertex, both margins of the pronotum, the entire claval suture and the tip of the wing black. Below all lighter. The males have the whole point of the vertex the sutural margin and an oblique band from the anal cell to the center of the costal margin black; below all black except a band across the middle of the face. It can be readily separated from *curtisii* by the absence of the Y on the face and the fact that the yellowish green of the elytra is not confined to the nerves.

The larvae are very light yellow, sometimes almost white, and the hairs are much smaller and finer than
those of *curtisii* which otherwise they closely resemble. They were first taken June 16th when the first adults of a brood were issuing; larvae remaining until the end of the month. The adults were very thick until well into July, disappearing before the end, appearing again toward the end of August and through September. They were thickest upon a patch of *Andropogon scoparius* where it was nearly free from other grasses.

*Athysanus obtutus* Van D.

This species was described from Mississippi and has been received from Kansas and taken at Ames prior to this season. The adults have almost exactly the form and size of *bicolor* but are readily distinguished by their color. The vertex is lemon yellow with two round spots just before the middle and two small oblique dashes near the base, darker. The remainder of the body is testaceous. Apical cells of the elytra hyaline, enclosing veinlets dark.

The larvae are light yellow when small but gradually darken to a chocolate brown in the pupa when they resemble the adults in form. The adults have been taken the last week in April rather commonly, indicating an adult hibernation; the larvae appearing in May maturing by the middle of June, the adults remaining through June and the greater part of July. Full grown larvae were found toward the latter part of July and again before the middle of September adults common throughout the season. This would indicate three broods during the season, the third one hibernating as adults though the larvae found in July may have been belated ones of the first brood.

The food plant is *Andropogon scoparius* and it was not until late in the season that the larvae of *D. oculatus* *Athysanus bicolor* and the small lighter ones of *obtutus* could be distinguished, so many confusing records interfering with the accurate determination of the later broods.
Osborn and Ball: Studies of the life histories of grass feeding Jassidae

EXPLANATION OF PLATES.*

PLATE I.

Fig. 1. *Xerophloeoa viridis* Fab. a, dorsal view; b, side view; c, face; d, female, e, male genitalia.

Fig. 2. *Xestocephalus coronatus*, dorsal view.

Fig. 3. *Eucaulicnius acuminatus*, a, dorsal view; b, larva.

PLATE II.

Fig. 1. *Dorycephalus platyrhynches*, Osb. a, female; b, male, dorsal view; c, head beneath; d, female, e, male, ventral segment; f, eggs in grass stem; g, eggs greatly enlarged; h, eggs with larva nearly ready to hatch; i, newly hatched larva; j, after first molt; k, after 2nd molt; l, pupa.

Fig. 2. *Hecalus lineatus*, Uhl. a, female; b, male, dorsal view; c, larva; d, head, beneath; e, female, f, male genitalia.

PLATE III.

Fig. 1. *Parabolocratus viridis*, Uh. a, male; b, female, c, larva, dorsal views; d, female, e, male, genitalia; f, eggs in grass stem; g, eggs enlarged; h, single egg greatly enlarged, showing young; i, larva newly hatched; j, after first molt.

Fig. 2. *Athysanus obtusus* Van D. a, ventral, b, lateral, c, dorsal view of female; d, female, e, male, genitalia; f, pupa; g, eggs, much enlarged; h, eggs in place under grass leaf sheath.

PLATE IV.

Fig. 1. *Deltoccephalus reflexus*. a, dorsal view; b, face; c, vertex; d, female, e, male genitalia; f, wing; g, larva; h, face of larva.

Fig. 2. *Deltoccephalus infulatus*. a, dorsal view; b, face; c, vertex; d, female, e, male, genitalia; f, wing; g, abdomen of male, lateral view.

Fig. 3. *Deltoccephalus pectorinus*. a, dorsal view; b, face; c, vertex; d, female, e, male, genitalia; f, wing; g, larva.

Fig. 4. *Deltoccephalus abbreviatus*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing; g, larva.

PLATE V.

Fig. 1. *Deltoccephalus albidus*. a, dorsal view; b, face; c, vertex; d, female, e, male genitalia; f, wing; g, larva; h, face of larva.

Fig. 2. *Deltoccephalus sayi*. a, dorsal view; b, face; c, vertex; d, female, e, male, genitalia; f, wing; g, larva.

Fig. 3. *Deltoccephalus configuratus*. a, dorsal view; b, face; c, vertex; d, female, e, male, genitalia; f, wing; g, larva.

Fig. 4. *Deltoccephalus oculatus*. a, dorsal view; b, face; c, vertex; d, female, e, male, genitalia; f, wing; g, larva.

PLATE VI.

Fig. 1. *Deltoccephalus melheimeri*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing; g, larva.

Fig. 2. *Deltoccephalus debilis*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing; g, head.

Fig. 3. *Deltoccephalus inimicus*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing; g, larva.

Fig. 4. *Deltoccephalus minimus*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing; g, larva.

PLATE VII.

Fig. 1. *Deltoccephalus signatifrons*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing.

Fig. 2. *Deltoccephalus weedi*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing.

Fig. 3. *Deltoccephalus compactus*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing.

Fig. 4. *Deltoccephalus sylvestris*. a, dorsal view; b, face; c, vertex and pronotum; d, female, e, male, genitalia; f, wing.

*All the figures included in the plates accompanying this article have been drawn by Miss Charlotte M. King, under supervision of the authors.
Fig. 1—Xeropipates viridis. Fig. 2—Xestocerhalbus coronatus. Fig. 3—Euacanthus acuminatus.
Osborn and Ball: Studies of the life histories of grass feeding Jassidae

Published by Iowa State University Digital Repository, 1894