

THE GENUS EUTETTIX

WITH ESPECIAL REFERENCE TO *E. TENELLA*, THE BEET LEAF HOPPER: A TAXI-
ONOMIC, BIOLOGIC AND ECONOMIC STUDY OF THE NORTH
AMERICAN FORMS

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INTRODUCTION

During the season of 1905 a small leaf hopper (*Eutettix tenella*) appeared in immense numbers in the beet fields of Utah and the surrounding region. Investigations were at once started to discover its life history and the best means of combating it. As the season progressed a large number of the beets were found to be affected with a peculiar condition, called "curly-leaf," which resulted in an immense damage to the crop.

In order to assist in determining whether this condition was the direct result of the attack of the leaf-hopper, a study was made of the effect of the other members of the group on their respective food plants. During this study it was found that certain species of leaf-hoppers that had been placed in different sub-families agreed with the members of this group in many structural characters and also, in some cases, in producing a similar injury to their food plant. The tracing of these relationships laid the foundation for a systematic revision of the group which is here presented with the results of the economic and biological studies.

SPECIFIC CHARACTERS.

The characters available for specific separation vary widely in the different groups of leaf-hoppers. In the group under consideration the shape of the vertex and its angle with the front varies with the different species and can be depended upon within certain limits. The relative length and width of either vertex or face is, however, of little value, as it varies between the sexes and still more so between large and small individuals.

The shape of the elytra and pattern of venation furnish good characters in many of the species. The genitalia, which in many Jassid groups furnish the court of last resort in the determination of the species, is of little value here. Occasionally good characters appear in a species, but in many cases the individual variation is greater than the difference between the species. Under *seminuda*, *scitula* and *strobi*, the ordinary form and different variations in these structures are figured. These variations are not due to changes in the shape of the segment itself as much as in differences in position and curvature, as will readily be seen in the series shown under *seminuda*.

With the exception of the *lurida* group the color, and especially the color pattern, has proven to be one of the best characters for the separation of species, and in the *strobi* group it is practically the only character available for the separation of some of the best known species, such as *strobi* and *seminuda*.

SPECIES AND VARIETIES.

For the purpose of the present study, forms have been considered as specifically distinct, where all the known specimens agree in possessing certain specific characters, the limits of whose variation do not reach the extreme variation of some other known form. On the other hand, even where the great majority of the individuals of two forms fall around certain definite and quite widely separated modes, but where in the remainder complete intergradation of characters can be shown, they have been considered as varieties.

In reality there is more difference between species and varieties than would be inferred from the above. Species usually differ by a number of different characters, such as size, form, color pattern and different structural modifications, any one of which might vary in the direction of another species while the rest remain constant, and would easily distinguish it. Varieties are, however, often separated on single characters or closely correlated groups of characters, and variation in these characters leaves nothing stable on which to found the species.

In practice, the question of distribution, food habits, larval characters and life-history, and the known stability or variability

of the other members of its group have all been considered in deciding as to the standing of a given form. Some varieties appear to be quite stable when taken only from the extreme limit of their specific range, as in the case of *subaenea* and *queri* in Colorado, and two or three forms recognized as species in this paper may prove to be only similarly isolated varieties when more thorough collecting is done nearer their centres of dispersal.

The *lurida* group presents a case of wide variability along a few very definite lines. In color they range from a shining black with a few white marks through brown, reddish brown and indefinitely spotted or washed forms to golden or greenish white, with almost every conceivable gradation between. In the something over one hundred specimens examined, while no two are exactly alike, the great majority of them seemed to arrange themselves around about eight forms, all but one of which has been described as species, but which must be treated as color varieties.

There is also a very wide variation in size in this group, which is, however, in no way correlated with the color variation, the largest and smallest forms occurring in the same color variety. Although intergradations occur, two forms of wing lengths are very common; one in which the elytra are long and rather flaring behind, giving the insect a narrow parallel-margined effect, and the other with the elytra closely folded behind, giving a very broad, compact appearance. These variations run through all varieties, but are most marked in some of the extreme forms.

MATERIAL USED AND ACKNOWLEDGMENTS.

In the course of this study practically all the material known to exist in American museums, including types of all described species excepting those of Say and Fitch, has been examined.

The United States National Museum material was especially rich in the varieties of the *lurida* group, in material from Texas and the southwest, and also contained a number of types. The collections of Dr. Uhler and Mr. Heidemann furnished most of the material from Maryland and the District of Columbia. The Cornell collection contained a fine series from Arizona and one type. The collection of the Iowa Agricultural College contains the Van Duzee collection and types, and the Iowa material and types of Osborn and Ball. The Colorado Agricultural College

collection contains part of the material and types of Gillette and Baker, and also of those species from Colorado described by the writer. Prof. Osborn's collection contains material from Iowa, Ohio, and smaller amounts from various places, as well as types of his species. Mr. Van Duzee's collection contains material from New York and a fine series of Colorado and Utah forms, including a number of types. Rev. Mr. Wirtner furnished material from Pennsylvania, and Prof. Snow from Kansas and the southwest. As the writer had worked and collected in this group for a number of years, his own collection was of the greatest help, containing material in ever species here listed, and types of over two-thirds of them.

The writer wishes to express his obligation to Dr. L. O. Howard for courtesies extended while working in the National Museum, and for material loaned; to Prof. Comstock for the loan of the Cornell material; to Prof. Summers for the loan of types from the Iowa collection, and to Prof. Gillette and Mr. Heidemann for assistance in verifying records, and other favors; to those named above who have furnished material; and especially to Prof. Osborn for material furnished and for his never-failing assistance and suggestions in the final preparation of this paper, the writer is deeply indebted. The life-history studies have extended through a number of years of field work, but the final summary has been prepared and most of the systematic work done in the Zoölogical Laboratory of the Ohio State University.

Genus *EURETTIX* Van Duzee.

Resembling *Phlepsius*, but with the ramosa pigmentation reduced to definite bands or wanting. Head short and slightly conical or moderately long and nearly flat, a transverse depression just back of vertex margin, more pronounced in the short-headed species. Elytra rather short, shorter and broader than in *Thamnotettix*. Face nearly flat; front broad, gradually narrowing to the clypeus, which is expanded at the apex.

As thus defined the genus *Eurettix* is made to include all the groups that have apparently sprung from a *Phlepsius* stock by reduction of the ramosa pigmentation. Three of these groups have been considered worthy of subgeneric rank and it is possible that they may eventually be considered as distinct genera; however, until the present confusion in the placing of Jassid genera is cleared up, little of value can be accomplished along that line.

KEY TO THE SUBGENERA.

- A Elytra with only one cross nervure between the sectors, costal margin destitute of supernumerary veinlets. Subgen. *Eutettix* Van D.
- AA Elytra with two cross nervures between the sectors or supernumerary veinlets to costa or both (in orange fulvous species these are sometimes obscure).
 - B Anterior margin of vertex rounding to front, without a definite line except near the apex. Second cross nervure always present, no black line under vertex. Subgen. *Nigra* nov.
 - BB Anterior margin of the vertex acutely angled with the front often, slightly produced and with a black line beneath. Subgen. *Mesania* nov.

Subgenus EUTETTIX Van Duzee.

Van Duzee, Psyche, VI, p. 307, 1892; Trans. Am. Ent. Soc., XIX, p. 300, 1892.

Rather stout, head of about the same width as pronotum. Vertex rather short, slightly sloping, distinctly transversely depressed, the apex often slightly conically upturned. Elytra moderately long, usually slightly flaring, venation simple, only one cross nervure between the sectors. Elytra without supernumerary veinlets or ramose lines, or with these reduced or aggregated into oblique bands (*paucosa* excepted).

This subgenus, as here restricted, contains all the species included in the genus by Van Duzee, in his catalogue, except one (*cincta*), and also one (*strobi*) which was there placed in *Phlepsius*. As now arranged it is made up of three closely-related groups of species.

ARTIFICIAL KEY TO THE SPECIES.

- A Elytra without distinct transverse bands or ramose lines.
 - B Large, some shade of brown or black, or if light, then without a tinge of green, and more than 5mm. long (*lurida* group).
 - C Ground color of vertex and pronotum yellow, elytra brown or dark, with a white commissural spot.
 - D A black band on anterior margin of vertex and another on posterior disc of pronotum, the latter often reduced.
 - E Elytra more or less black, with the margin and commissural spot light. Var. *picta* Van D.
 - EE Elytra not black.
 - F Elytra uniform brown, markings same. Var. *tristis* nov.
 - FF Elytra creamy, mottled with brown around the light commissural spot. Var. *stossoni* Van D.
 - DD Vertex and pronotum yellow, without definite markings.
 - E Elytra tawny, nervures indistinct, scutellum unmarked. Var. *lurida* Van D.

- EE Elytra subhyaline, nervures dark, scutellum with two black points on the margin. Var. *subacnea* Van D.
- CC Ground color of pronotum same as that of elytra, vertex often paler.
- D Elytra smoky, subhyaline or brown.
- E Elytra subhyaline, whole insect mottled with brown. Var. *marmorata* Van D.
- EE Uniform reddish or chestnut brown. Var. *southwicki* Van D.
- DD Pale straw, shading to golden brown. Var. *querci* G. & B.
- BB Smaller, green, pale green or golden yellow, often with black spots (*clarivida* group).
- C With two or four black spots on vertex margin. *clarivida* Van D.
- CC Vertex without spots.
- D Elytra with light flecks or black points, or both.
- E Elytra bright green, infusate at apex, with white flecks and sparse black points. *osborni* n. sp.
- EE Elytra subhyaline white, peppered with black points.
- F Black points, irregular, mainly along nervures, rarely almost wanting. *insana* Ball.
- FF Black points mainly in transverse rows and reticulations. *paupercula* Ball.
- DD Elytra greenish or golden without black markings. Species very small.
- E Golden yellow, head broad. *stricta* Ball.
- EE Greenish yellow, head narrow. *tenella* Bak.
- AA Elytra with oblique bands, rarely obscure (*albida*), sometimes connected into a median stripe, and rarely absent along costa (*strobi* group).
- B Elytra with a saddle or other pattern on the disc.
- C Markings on anterior half of claval areas, irregular or wanting. A definite oblique band across posterior half of clavus.
- D Pronotum and anterior half of elytra white or but faintly reticulate. *seminuda* Say.
- DD Markings on pronotum and anterior part of clavus distinct, same color as saddle.
- E Whole insect suffused with reddish. *strobi* Fitch.
- EE Ground color light yellow or white.
- F Posterior half of vertex and basal third of corium without markings. *scitula* Ball.
- FF Posterior half of vertex and basal third of corium irregularly inscribed. *pullata* Ball.
- C Markings on claval areas united into a definite median stripe narrowed in the middle, and usually dark bordered externally.
- D Saddle definitely margined, extending to costal margin of elytra.
- E Markings on pronotum and elytra pale olive, pronotum not definitely margined.
- F Color pattern of elytra margined with black, black spots behind eyes.

- G Vertex obtusely angulate; face, vertex and scutellum pale creamy or white, disc of the latter irrorate.
perlegantis Ball.
- GG Vertex rounding, face, vertex and scutellum orange yellow.
mildredae Ball.
- FF Color pattern of elytra very pale, without black margins.
snorzi n. sp.
- EE Markings on pronotum and elytra rich chestnut or brown, margin of pronotum narrowly lined with white.
- F Vertex pale, irregularly irrorate at base. *sauvia* Ball.
- FF Vertex chestnut, anterior margin narrowly light.
pulchella Bal.
- DD Saddle not definitely margined or not extending to costa.
- E Saddle obscure, whole elytra sparsely reticulate, face light.
albida Ball.
- EE Saddle definite, not extending to costa, face dark.
pannosa Ball.
- BB Elytra uniformly colored or reticulate before apex of clavus.
- C Pronotum and elytra uniformly irrorate with very pale brown.
levana n. sp.
- CC Elytra creamy, posterior third and pronotum heavily irrorate with black.
bicolorata Ball.

EUTETTIX SUBAENEAE (Van Duzee).

(For synonymy, see under varieties.)

A stout, broad-headed species, with an almost parallel margined vertex, and moderately long and simply veined elytra. Size and color very variable.

Vertex broad, over twice wider than its middle length, but very little longer on middle than against the eyes, disc sloping to the transverse depression, then flat or slightly elevated and transversely striated. As seen from the side the union of vertex and front is slightly produced, shading out toward the ocelli. Venation simple, only one cross nervure, central ante-apical cell very slightly narrowed in the middle, veinlet between fourth and fifth apical cells sloping back, rather long in stout and short-winged forms; approaching a right angle with the costa, in narrow, long-winged forms.

Genitalia: Female segment with the outer angles slightly rounding, posterior margin slightly excavated to rounding, according to position, with the median fifth triangularly produced into a broad, slightly notched tooth about as long as its basal width. Male valve broadly rounding, the apex slightly angularly produced; plates together, long, spoon-shaped, the margins clothed with long hairs and slightly emarginate just before the black apex.

Habitat: Specimens of the different varieties are at hand from Massachusetts, Long Island, Maryland, District of Columbia, New Jersey, Georgia, Florida, Texas, Indiana and California (all

from U. S. N. M. coll.: The Maryland forms from the Uhler collection: Florida forms from the Ashmead collection), Ohio and New York (Osb. coll.), District of Columbia and Maryland (Heid., Sanders), Florida (Slosson), Tennessee (Summers), Iowa, Colorado and Utah (Ball), Indiana and Arkansas (Osb. coll.), Michigan and Pennsylvania (Wirtner), and Mexico (Vienna museum).

In size, this species varies from 7^{mm} long in large females down to 4.5^{mm} in the smallest males; in width it is equally variable, ranging from 2.5^{mm} down to 1.5^{mm}. The variations in color are innumerable, but seem to arrange themselves around about eight forms, which are here described as color varieties.

EUTETTIX SUBAENEAE var. *PICTA* Van Duzee.

(Pl. I, Fig. 1.)

Eutettix pictus V. D., Trans. Am. Ent. Soc., XIX, p. 301, 1892 (Desc. Pa.); Catalogue, p. 297, 1894.

Eutettix magnus Osb., Ent. News, XI, p. 395, 1900 (Illinois and Arkansas).

Resembling *Thamnotettix ditellarius* but much stouter. Definitely black and yellow marked.

Color: Vertex, pronotum and scutellum lemon yellow or slightly fulvous, anterior half of vertex and posterior half of pronotum, omitting the posterior margin, glossy black, the margins of these bands often irregular, and the anterior one frequently bisected on the median line. Elytra shining black, a common oval spot on the suture before the apex of clavus and the anterior two-thirds of costal margin pale yellow. Size of both spot and margin very variable, sometimes wanting. Face black, with a broad band across under eyes and short arcs above yellow, varying to all yellow below except a basal band on front. In some specimens the black on the elytra fades out to brownish except along the margins of the yellow, and in others it breaks into spots.

Specimens are at hand from Baltimore, Maryland, District of Columbia, Pennsylvania, New Jersey, Florida, Tennessee, Indiana, Arkansas and Mexico, those from the coast regions being mostly smaller than those inland. The form, described as *magnus* by Osborn, from Illinois and Arkansas, is the largest, and those from Florida the smallest.

EUTETTIX SUBAENEAE var. *TRISTIS* nov.

(Pl. I, Fig. 2.)

With pronotum and head of *picta* and elytra of *southwicki* nearly.

Color: Vertex, face, pronotum and scutellum yellow, margin of vertex and base of front with a pair of black spots extending out to the ocelli and separated by a rather broad median line. Pronotum with the transverse band of *picta* reduced in size and fading to brown in color. Elytra of a uniform tawny brown becoming subhyaline toward costa, a very small sutural spot usually present.

Specimens of this form are at hand from Maryland, District of Columbia, New Jersey, Georgia, and Florida.

EUTETTIX SUBAENEAE *var.* SLOSSONI Van Duzee.

Eutettix slossoni V. D., Bull. Buf. Soc. N. S., V, p. 210, 1894 (Desc. Fla.); Catalogue, p. 314, 1894.

Pale creamy yellow, maculate with brown, black marks on vertex and traces of pronotal band as in *picta*.

Color: Face, vertex, pronotum and scutellum pale creamy yellow, a broad band on base of front, extending a trifle over onto vertex, bisected in the middle, black. A brownish transverse band faintly indicated on posterior half of pronotum. Elytra creamy, mottled with brown, especially against the scutellum and along sutural margins.

Specimens of this form are at hand from District of Columbia, Florida, and Texas (all females).

EUTETTIX SUBAENEAE *var.* MARMORATA Van Duzee.

Eutettix marmorata V. D., Trans. Am. Ent. Soc., XIX, p. 302, 1892 (Desc. N. C.); Catalogue, p. 297, 1894; Osborn in Smith Cat. Ins. N. J., p. 95, 1900 (N. J.).

Eutettix incerta Gill. and Bak., Hemip. Colo., p. 100, 1895.

Resembling *lurida* but with the fulvous on vertex and pronotum obscured by testaceous markings, and the elytra irregularly mottled with the same color.

Color: Vertex, pronotum and scutellum pale yellow, washed with dirty brown, and ornamented with testaceous lines and spots. Usually a line in the transverse depression of vertex and two spots at apex, four along the base, and the median impressed line testaceous. Scutellum with traces of about six stripes on the disc and a few submarginal spots testaceous. Usually a few dark spots behind the eyes. Elytra subhyaline blotched with testaceous brown, fading out toward the costa. Traces of a white spot on commissure as in *lurida*, except in the darkest males. Face with the arcs and a spot at base of front sometimes extending into vertex, testaceous.

Specimens are at hand from Massachusetts, New York, North Dakota, District of Columbia, Ohio, North Carolina, Florida, and Colorado.

EUTETTIX SUBAENEA var. SOUTHWICKI Van Duzee.

(Pl. I, Fig. 3).

Eutettix southwicki V. D., Bull. Buf. Soc. N. S., V., p. 209, 1894 (N. Y. City); Catalogue, p. 296 and 324, 1894; Osborn and Ball, Iowa Acad. Sci., V., p. 232, 1897 (Iowa); Osborn in 20th Rep. St. Ent. N. Y., p. 531, 1905 (list).

Eutettix brunneus Osborn, in 20th Rep. St. Ent. N. Y., p. 530, fig. 33, 1905 (western N. Y.).

Resembling *marmorata* but with the testaceous markings coalescing to form an almost uniform testaceous brown color above.

Color: Vertex dirty yellow with testaceous markings of *marmorata* coalescing to form an irregular wash, often deepening at apex and uniting with a brown band on base of front. Pronotum testaceous brown, elytra of uniform testaceous cast, often becoming smoky toward the tip in the females and all over in the males, in which case they present a slight coppery iridescence. Nervures concolorous, those to costa on the smoky specimens slightly fuscous.

Specimens are at hand from New York, Maryland, District of Columbia, and Iowa.

This species was described from males only; the females are larger and lighter. Some of the smaller smoky males superficially resemble certain species of the genus *Athysanus*. In Osborn's figures, a nervure in the under wing showing through the elytron was taken for a second cross nervure and the genitalia were drawn from damaged specimens and are not typical of the species.

EUTETTIX SUBAENEA var. LURIDA (Van Duzee).

(Plate I, Fig. 4.)

Thamnotettix lurida V. D., Can. Ent., XXII, p. 250, 1890 (Desc. Iowa and Mich.).

Eutettix lurida V. D., Psyche, VI, p. 307, 1892 (Type of genus); Catalogue, p. 296, 1894 (Add. Md.); Osborn and Ball, Iowa Acad. Sci., IV, p. 232, 1897 (Iowa list); Osborn, Ohio Acad. Sci., 8th Ann. Rept., p. 67, 1900 (Ohio); in 20th Rept. St. Ent. N. Y., p. 530, 1905 (N. Y.).

Resembling *tristis* with the dark markings on the vertex and pronotum lost, and the light spot on the commissure enlarged.

Color: Vertex, pronotum and scutellum fulvous, elytra testaceous brown, fading out to subhyaline towards costa, the common commissural spot and

sometimes the apex of scutellum creamy yellow. Face light testaceous brown, the sutures darker, the frontal area light.

Specimens are at hand from Maryland, Georgia, Florida, New York, and Iowa, and Van Duzee gives Michigan.

EUTETTIX SUBAENEA *var.* SUBAENEA (Van Duzee).

Thamnolettix subaenea V. D., Ent. Am., VI, p. 77, 1890 (Desc. Calif.); Psyche, VI, p. 307, 1892.

Eutettix subaenea V. D., Trans. Am. Ent. Soc., XIX, p. 303, 1892; Catalogue, p. 296, 1894.

Resembling *lurida* closely in color pattern, but with faint testaceous markings on vertex and pronotum, and subhyaline elytra with the costal nervures embrowned. Narrower and with the vertex slightly more angled than in typical *lurida*.

Color: Vertex and pronotum pale fulvous, the transverse depression, median line and two irregular spots at base of the vertex and six stripes on pronotum obscurely testaceous. Scutellum pale yellow, with a black point on either side the apex. Elytra subhyaline shading to testaceous next the scutellum, and along the sutural margin, omitting a light spot, the apices of elytra and nervures to costa smoky.

Specimens are at hand from Fort Collins, Colorado, and Los Angeles, California.

EUTETTIX SUBAENEA *var.* QUERCII Gill. and Baker.

(Plate I, fig. 5.)

Eutettix querci G. and B., Hemip. Colo., p. 101, 1895 (Southern Colo., on oak).

Resembling a pale *stossoni*. Similar to *southwicki*, but much paler. Greenish yellow or pale golden yellow.

Color: Vertex and scutellum creamy yellow, pronotum and elytra pale whitish or brownish straw, shading up in the males to pale golden yellow. Entire elytra subhyaline with dark bands on abdomen showing through, apical cells and costal nervures in the males often marked with smoky.

Specimens are at hand from District of Columbia, Colorado Springs, Palmer Lake and Grand Junction, Colorado, and Salt Lake, Utah.

Larvae: Stout, vertex flat, half longer than in adult, roundly right-angled with a sharp margin, color very variable, commonly a pale creamy, with four quadrate areas on the vertex, three series of triangular ones on the pronotum, scutellum and wing pads pale brown, the abdomen usually heavily irrorate omitting an oblique band or row of spots on each side the middle.

Some of the larvae are more or less suffused with reddish and some have the color areas joined into a broad black median stripe, narrowest on the wing pads, and often wanting on the vertex.

Variety *quercii* is strictly confined to the oak in both larval and adult stages, most of the specimens of *marmorata* have been taken from oak, *livida* is apparently an oak feeder, and it is likely that all of the varieties will be found to feed on oak, when the life history is known.

EUTETTIX CLARIVIDA Van Duzee. (Pl. I, Fig. 6.)

Eutettix clarivida V. D., Can. Ent., XXVI, p. 138, 1894 (Colo.); Catalogue, p. 297, 1894; Gill and Baker, Hemip. Colo., p. 100, 1895 (list).

Form and structure of *subaenea* nearly, smaller, stouter, with a fuller front. Pale green with two or four black spots on vertex. Length ♀ 5.2^{mm}. ♂ 4.5^{mm}; width 1.4^{mm}.

Vertex with the disc slightly convex, transverse depression shallow, slightly longer on middle than against eye. Front strongly inflated along the middle line, sometimes visible from above, less inflated below; clypeus stout, prominent, scarcely constricted. Elytra rather short, closely folded at the apex, venation simple as in *subaenea*, with occasionally a few weak supernumerary veins in the claval areas and in the fifth apical cell.

Color: Pale green, the vertex and elytra often a trifle yellowish green. A pair of large round black spots on vertex margin just inside the ocelli and a pair of minute points inside the apex, brown or black.

Genitalia: Female segment rather long, posterior angles rounding, posterior margin truncate or slightly rounding, median sixth produced into a short and usually bidentate tooth. Male valve obtusely angular, short, plates broad at base, triangular, their apices slightly attenuate, a trifle longer than their basal width.

Specimens are at hand from Fort Collins, Los Animas, Pueblo, Palisades, and Grand Junction, Colorado; Cisco, Thompson's, Moab, Layton, Manti, and Salina, Utah, all collected by the author, and Delta and Montrose, Colorado (Gill).

Larvae: Resembling the adult, but with a longer and more angular head. Green, with two black spots on the vertex; these correspond to the outer pair of the adult, and are sometimes wanting in the younger larvae.

The green color with the black spots on vertex will at once distinguish this species. It lives on *Atriplex canescens*, to which its green color adapts it. From this plant it spreads to other species of salt bush and related plants. It will, no doubt, be found widely distributed on its food plant in the arid region.

EUTETTIX OSBORNI n. sp. (Pl. I, Fig. 7.)

Form and structure of *clarivida* nearly, the head a trifle shorter. Deep green, the elytra with milky flecks and smoky apices. Length ♀ 4.6^{mm}, ♂ 4^{mm}; width 1.3^{mm}.

Vertex with the margins evenly rounding or slightly tumid at apex, disc convex, the transverse depression very faint, front broad, slightly convex, but little narrowed until suddenly rounding in to the clypeus, clypeus broad with the margins nearly parallel, elytra moderately long, closely folded, giving a wedge-shaped appearance to the insect. Venation simple, obscure, the anteapicals slightly longer than in *clarivida*, and the central one with the apex slightly more enlarged.

Color: Vertex and face pale green, pronotum deep green, irregularly mottled on disc, paler anteriorly. Elytra deep green to just beyond the apex of clavus, then smoky, subhyaline. Several irregular white flecks on the green portion, an irregular band between the green and smoky, a round spot in the apex of the central anteapical cell, and the costa back of the middle, white. The nervures towards the apex are light, with a smoky shade intensified against them, especially against the fifth apical veinlet, where it appears margined with fuscous, interrupting the light costal area. Traces of minute black dots appear on the green portions of pronotum and elytra in two specimens.

Genitalia: Female segment rather short, outer angles bluntly rounding, posterior margin rounding and slightly produced in the middle; male valve equilaterally triangular, acutely pointed, clothed with light hairs along the margin.

Described from one female and two males from Galveston, Texas, taken in May by Prof. Snow.

EUTETTIX INSANA Ball. (Pl. I, Fig. 8.)

Eutettix insana Ball, Can. Ent., XXXII, p. 203, 1900 (Desc. Colo.).

Form of *clarivida* nearly, smaller, with a longer vertex and more flaring elytra. Greenish white peppered with black points. Length ♀ 4^{mm}, ♂ 3.3^{mm}; width 1.1^{mm}.

Vertex slightly angled, apex rounding three-fourths of the length of the pronotum, disc almost flat, margin thick, front not inflated, resembling *lurida*. Pronotum short, deeply inserted into apex. Elytra rather short and broad, venation regular except that claval veins often approach each other in the middle.

Color: Vertex and face pale creamy, a few black dots on vertex. Pronotum pale greenish white or dirty white, sparingly peppered with black dots. Elytra greenish white or subhyaline, thickly sprinkled with minute black points, the greater number of them on or close to the nervures.

Genitalia: Female segment rather long, posterior margin triangularly

excavated half its depth, from the bottom of which arises a strap-shaped tooth about as long as its basal breadth. Male valve very broad, short, plates together very broad at base, equilaterally triangular, with the apices produced and upturned. Margins with fine hairs.

Specimens are at hand from Las Animas, Pueblo, Salida, Delta, Rifle, Palisades, Grand Junction, and Loma, Colorado; Cisco, Thompson's, and Moab, Utah, all collected by the author.

Larvae: With a sloping conically pointed vertex, half longer than the adult, white with irregular brown markings, similar to those of *queri*, the margins of the brown areas set off by black points. Below pale, an olive band under the vertex, about three rows of brown dots on upper part of front and a few larger black spots on lore and genae.

The fine black dots on the pale ground color harmonize well with the dirty greenish white leaves of the shad scale (*Atriplex confertifolia*), on which the insect lives. There are, apparently, two broods in a season.

EUTETTIX PAUPERCULA (Ball). (Plate I, Fig. 9.)

Phlepsius paupercula Ball, Can. Ent., XXXV, p. 228, 1903 (Desc. Colo.).

Resembling *insana*, shorter, stouter, with a flatter and more angled vertex, creamy white with black points on elytra arranged in ramose lines. Length 1.3^{mm}, ♂ 3^{mm}; width 1.1^{mm}.

Vertex nearly as long as pronotum, roundly rightangled, disc flat, anterior margin thick, slightly acutely angled with the front. Front inclined to be tumid. Pronotum transversely wrinkled, depressed just back of the anterior margin. Elytra short, broad, venation obscure.

Color: Pale creamy or greenish white, elytra milky white with minute black points along the nervures and in transverse ramose lines.

Genitalia: Female segment with the posterior margin nearly truncate, slightly notched in the middle and slightly sinuate either side. Male valve short, obtusely rounding, plates equilaterally triangular, their margins with a few coarse bristles.

Habitat: Specimens are at hand from Grand Junction, Colorado (Van Duzee and Ball), Thompson's, and Monroe, Utah (Ball).

This species is found on a very small species of salt bush growing in the desert region and from its host plant often spreads to several other species of the same genus. The shape of the vertex will at once separate this species from any of the other small species in this group.

EUTETTIX STRICTA Ball. (Pl. I, Fig. 10.)

Eutettix stricta Ball, Can. Ent., XXXII, p. 204, 1900 (Colo.).

Form of *insana* nearly, smaller, the elytra less flaring. Resembling *tenella*, but with a broader head and golden yellow in color. Length ♀ 4^{mm}, ♂ 3.5^{mm}; width 1^{mm}.

Vertex as in *insana*, rather large, obtusely angular, flat, the margin rounding to front, scarcely a transverse depression, two-thirds the length of the pronotum, elytra rather closely folded, the venation obscure similar to *tenella*.

Color: Vertex pale yellow, sometimes washed with orange, and with a pair of round fuscous dots one-third of the way back from the apex. Scutellum pale yellow, sometimes a pair of spots on the disc. Pronotum and elytra golden yellow. Below lemon yellow, sometimes about seven short brown arcs on front.

Genitalia: Female segment rather long, posterior margin concave with the median third roundly produced. Male valve short, obtusely rounding, plates broad, triangular, their apices produced and upturned.

Specimens are at hand from Phoenix, Arizona (Kunze), Victoria, Texas (U. S. N. M.), and San José de Guaymas, Mexico (L. O. Howard, U. S. N. M.).

This species is closely related to *tenella*, but can at once be distinguished by the color and the genitalia of either sex.

EUTETTIX TENELLA (Baker). (Pl. I, Fig. 11; IV, Figs. 4-5).
(The Beet-leaf Hopper.)

Thamnolettix (Jassus) tenella (Uhl. MSS.) Gill and Baker, Hemip. Colo., p. 100, 1895 (Colo., on sugar beets).

Thamnolettix tenella Baker, Psyche, VII, Supp., p. 24, 1896 (Desc. N. M. and note); Ent. News, VIII, p. 54, 1897.

Eutettix tenella Forbes and Hart, Bull. 60, Ill. Exp. Sta., p. 423 and 523, 1900 (after G. and B.); Ball, 16th Ann. Rept. Utah Exp. Sta., p. 16, 1907 (injury to beets).

Eutettix stricta Howard, Rept. U. S. Ent. for 1905, p. —, 1906 (injury to beets).

Form of *stricta* nearly, smaller, paler, pale yellowish green. Length ♀ 3.5^{mm}, ♂ 3.1^{mm}; width .9^{mm}.

Vertex rather short, rounding, about one-fourth longer on middle than against eye, disc nearly flat, transverse depression obscure, the margins rounding over to front. Elytra rather long, closely folded, venation regular, simple, except the base of the outer and antecubital cell is sometimes pedunculate and the apical veinlets are long and narrow.

Color: Vertex and face creamy or pale orange yellow, scutellum lemon

or greenish yellow, pronotum pale green, the margins often pale yellow, elytra greenish or milky subhyaline, the dark tergum showing through. Occasionally specimens are entirely pale yellow and still more rarely they are suffused with red.

Genitalia: Female segment with the posterior margin produced on the median half and then narrowly, semicircularly emarginate more than half way to the base of the segment. Male valve large, semi-circular, inflated, plates short, together wider than long, widest at apex, where they are roundly truncate. A row of about ten short stout spines set a little distance back of the margin.

Habitat: Specimens are at hand from Fort Collins, Lamar, Trinidad, Buena Vista, and Grand Junction, Colorado; Moab, Thompson's, Monroe, Lehi, Salt Lake, Ogden, Logan, and Garland, Utah, all collected by the author; Phoenix (Kunze, Ball), Hot Springs (Barber and Schwarz, N. M.), and Flagstaff, Arizona (Barber, N. M.), and it was described from Las Cruces, New Mexico.

Larvae: Vertex slightly conical, half longer than in the adult. Color variable; a few are pure white, a few others are white with an irregular broad, black, median stripe; the majority are white with a brown saddle on the abdomen and irregular faint brown markings on the thorax; a few others have these markings irrorate with red.

The strikingly distinct genitalia of either sex will at once serve to distinguish this species from any other in the group. Its small size and greenish color render it liable to be mistaken for insects of several other groups, but even here its genitalia will at once separate it.

It is single-brooded; the adults hibernate and lay eggs in the summer to produce adults from late July on until fall. The original food plant was probably *Sarcobatus*, from which it has spread to the sugar beet.

EUTETTIX SEMINUDA (Say). (Pl. II, Fig. 1.)

Jassus seminudus Say, Jour. Acad. Nat. Sci. Phil., VI, p. 307, 1831 (Ind.), (Complete writings II, p. 138, 1869); Harris in Hitchc. Geol. Mass., 2d Ed., p. 580, 1835.

Pythoscopus seminudus Fitch, Homop. N. Y., St. Cab., p. 58, 1851 (See Lintner's 9th Rept., p. 398, 1893). (N. Y. and note). Walker, Homop. B. M., IV, p. 1161, 1852 (mention); Dimmock, Psyche, IV, p. 241, 1885 (after Fitch). Packard, 5th Rept. U. S. Ent. Comm., p. 543, 1890 (after Fitch); Ashmead in Smith Cat.

- Ins. N. J., p. 445, 1890 (N. J.); Southwick, Science, XIX, p. 318, 1892 (after Smith).
- Thamnotettix seminudus* Uhl., Stand. N. Hist., II, p. 246, 1884; Osborn, Iowa Acad. Sci., I, Part II, p. 120, 1892 (Iowa).
- Athysanus seminudus* Van Duzee, Psyche, V, p. 389, 1890.
- Eutettix seminudus* Van Duzee, Psyche, VI, p. 307, 1892; id: in Lintner's 9th Rept., p. 410, 1893; Bull. Buff. Soc. N. Sc., V, p. 199, 1894 (N. Y. and note); Catalogue, p. 297, 1894 (eastern U. S. and Can.); Ashmead, Ins. Life, VII, p. 323, 1895 (on cotton, Miss.); Forbes and Hart, Bull. 60, Ill. Exp. Sta., p. 414 and 423, 1900 (Econ. Summary and on Beets III.); Osborn, Ohio Acad. Sci., 8th Ann. Rept., p. 68, 1900 (Ohio); Ohio Nat., I, p. 11, 1900 (S. E. Ohio); in 20th Rept. St. Ento. N. Y., p. 529, 1905; Wirtner, Ann. Carn. Mus., III, p. 223, 1904 (Pa. and Notes).
- Milky white, with a broad testaceous brown saddle, and a few reticulations on apex of elytra. Length ♀ 5^{mm}, ♂ 4.5^{mm}; width 1.5^{mm}.

Vertex slightly longer on middle than against eye, transversely convex, sloping, with a weak depression before margin; margin blunt, rounding, indistinct even at apex. Elytra moderately long, venation regular and indistinct.

Color: Vertex, face and below pale creamy, pronotum creamy white, rarely faintly irrorate with brown. Scutellum often irregularly marked with pale tawny or brown. Elytra milky white with a broad testaceous brown saddle occupying the posterior half of claval area and narrowing to half that width on the costa, margins irregularly darker, the anterior one oblique. A testaceous cloud centering in the fourth apical cell, often surrounded by few reticulations and sometimes a few pale reticulations appear on base of clavus. The spines on posterior tibia and pygofers arise from black spots.

Genitalia: Ultimate female segment with the posterior margin truncate or slightly rounding with a wedge-shaped median tooth, slightly notched in the middle. Male valve roundly rightangled, plates long, triangular, their apices narrowly truncate, margins clothed with filamentous hairs.

Habitat: Specimens have been examined from Connecticut (Britton), Maryland and District of Columbia (Heid.), North Carolina (Fiske, Sherman), Tennessee (Summers), Pennsylvania (Wirtner), Niagara, Canada (Osborn), Ohio (Osborn and Cornell coll.), Illinois (Titus and Osborn coll.), Iowa (Osborn and Ball), Missouri (Snow), Kansas (Effingham, Van Duzee; Manhattan, Cornell coll.), Texas (Victoria, U. S. N. M.); it has been reported from Massachusetts, New York, Indiana, and Mississippi, above.

Larvae: Resembling the adults, vertex slightly longer, white with slight irregular cloudings on the posterior portion of the vertex and pronotum, a transverse band across the wing pads and a definite saddle on the abdomen brownish irrorate. Beneath pale, with black points on hind tibiae.

There are two broods in a season, the adults appearing in late May, and June, and again in August and September. The type of this species has been lost, but there can be no question about the determination, as it is the only species in that range that could answer the description. It is widely distributed in the Eastern and Middle States, extending westward into Kansas and Texas, beyond which it is replaced by *scitula*.

EUTETTIX STROBI (Fitch).

(Pl. II, Fig. 2; IV, Fig. 3.)

Bythoscopus strobi Fitch, Homop. N. Y. St. Cab., p. 58, 1851 (on pine N. Y.) (Lintner's 9th Rept., p. 398, 1893); Trans. N. Y. St. Ag. Soc., XVII, p. 739, 1857; Walker, Homop. B. M., III, p. 876, 1851 (mention); Rathvon, Momb. Hist. Lanc. Co., Pa., p. 551, 1869 (list); Packard, Bull. 7, U. S. Ent. Comm., p. 216, 1881 (after Fitch); 5th Rept. U. S. Comm., p. 802, 1891 (after Fitch).

Phlepsius strobi Van Duzee, Psyche, V, p. 390, 1890, id. in Lintner's 9th Rept., p. 410, 1893; Trans. Am. Ent. Soc., XIX, p. 67, Pl. I, fig. 3, 1892 (Desc. N. Y., Ohio, Tex.); Southwick, Sci., XIX, p. 287, 1892 (after Van Duzee); Van Duzee, Catalogue, p. 299, 1894; Osborn, Iowa Acad. Sci., I, pt. III, p. 103, 1893 (Iowa and notes on food plants.)

Eutettix strobi Baker, Psyche, VII, Supp., p. 24, 1896; Osborn, Iowa Acad. Sci., VII, p. 39, 1899; Ohio Acad. Sci., 8th Ann. Rept., p. 68, 1900 (Food plants, Ohio); Wirtner, Ann. Carn. Mus., III, p. 223, 1904 (Pa.); Osborn in 20th Rept. N. Y. St. Ent., p. 531, 1905 (N. Y. and note on type).

Thamnotettix seminudus Osborn, Sci., X, p. 166, 1887 (Coloring leaves of *Chenopodium*).

? *Allygus* sp. Bruner, U. S. Div. Ent., Bull. XXIII, O. S., p. 17, 1891 (on *Chenopodium* and beet).

Form of *seminuda*, fulvo-testaceous, elytra milky white with the saddle and an irregularly reticulated band at either extremity, testaceous. Length ♀ 5.25^{mm}, ♂ 4.5^{mm}; width 1.6^{mm}.

Vertex slightly more produced than in *seminuda*, almost angled with the front at apex, face evenly convex in both diameters. Elytra moderately long, venation regular but obscured by the reticular lines.

Color: Vertex, pronotum and scutellum sordid fulvous or fulvo-testaceous, irrorate. Elytra milky white with the saddle, a basal and an apical band of minute testaceous brown irrorations. Irregular pigment lines along nervures tend to join saddle and basal band along the sutural margin and the saddle and apical band on the disc. Eyes rich testaceous, face fulvous, below pale yellow, pygofers brown.

Genitalia: Female segment with the margin variable, as in *seminuda*. In fresh specimens often rounding with only faint indications of median lobes. Male valve distinctly obtusely angled, plates together triangular, broad at base, then rapidly rounding in to the elongate filamentous tips, margins clothed with long hairs.

Habitat: Specimens have been examined from Massachusetts, Connecticut (Britton), New York (Van Duzee), Niagara, Canada (Osborn), Pennsylvania (Wirtner), Ohio (Osborn), Iowa (Osborn, Ball), Missouri (Heid. coll., Osborn coll.), Nebraska (Bruner), Kansas (Snow, Crev.), Colorado (Gill., Ball), Utah (Ball), Texas (College Station, Sanderson; Victoria, U. S. N. M.).

Larvæ: Resembling *seminuda* in form, the head much longer and flatter than the adult. Ground color white, so heavily irrorate with red as to be obscure. Usually a pair of dark red spots on the apex of vertex, a few pale ones on the disc, and others on the abdomen.

The larvæ live on lamb's quarter, where their punctures cause purple spots on the leaves. There are two broods in a season, adults appearing in June and again in August. This is another species in which there can be no question about the determination, as no other one approaches it in coloration. It is widely distributed and will, no doubt, be found clear across the continent in the northern United States at least.

EUTETTIX SCITULA Ball. (Pl. II, Fig. 3.)

Eutettix seminuda Gill. and Baker, Hemip. Colo., p. 102, 1895 (Colo.); Baker, Psyche, VII, Supp., p. 24, 1896 (Western var.).
Eutettix scitula Ball, Can. Ent., XXXIII, p. 47, 1901 (Desc. Colo.).

Form and color pattern of *strobi* nearly, ground color of *seminuda* with the markings darker testaceous. Length ♀ 5.5^{mm}, ♂ 4.75^{mm}.

Vertex distinctly longer on middle than at eye, anterior submargin flat, margin thick, forming an angle with the front, front very weakly convex, elytra rather long, venation as in *strobi*.

Color: Vertex pale creamy yellow, six pale fulvous spots along anterior margin and a large pair on basal half near eyes on well-marked specimens. Pronotum milky white, heavily irrorate and reticulate with dark brown, omitting the anterior margin between the eyes and traces of three narrow stripes. Elytra milky white with a saddle slightly narrower than in *seminuda*, an irregular spot against the scutellum, and a cloud against the apex, of dark brown irrorations. Usually the apical cloud is connected with the saddle near the middle and there may be a few black dashes against the costa. Usually three pairs of black dots along the common suture and a lobate light spot in the middle of the saddle. The apical cloud is interrupted by one or more circular light spots. Face and below pale, a few faint olive fuscous arcs on front, pygofers washed with brown.

Genitalia: Female segment with posterior margin truncate or gently rounding, with two blunt median teeth, separated by a notch equalling them in width. Male valve short, rounding, plates rather narrow, long-triangular, their margins continuing almost straight to the filamentous tips.

Habitat: Specimens have been examined from Julesburg, Fort Collins, Pueblo, Salida, Buena Vista, and Grand Junction, Colorado (Ball), Berkeley (Osborn coll.), and Montrose, Colorado (Gill.), Mesilla, New Mexico (on *Populus*, Cockerell), Wellsville, Utah (Ball), Caliuero Mt., Arizona (Hubbard, U. S. N. M.).

Larvæ: Resembling *seminuda* but lacking the saddle on abdomen. Vertex long, slightly sloping, the margin distinct, roundly angled in front. Pale pink, with a powdery "bloom" slightly hiding it on anterior portion of body. Abdominal segments margined with reddish bands and often with black dots along the base.

This species closely resembles *seminuda* but may be distinguished by the longer head and color pattern on pronotum and base of elytra. It is only known from the Rocky Mountain region. The larvæ feed on lamb's quarter, the adults flying up to cottonwood trees. There are two broods, as in *strobi*.

EUTETTIX PULLATA Ball. (Pl. II, Fig. 4.)

Eutettix pullata Ball, Can. Ent., XXXIII, p. 48, 1901.

General appearance of *scitula* but narrower and darker. Elytral pattern of *strobi*, but not as dense. Dirty hyaline white, irrorate with brownish fuscous on pattern. Length ♀ 5.5^{mm}, ♂ 5^{mm}; width 1.4^{mm}.

Vertex narrower and slightly more angled than in *scitula* or *strobi*, sloping from behind down to the transverse depression. Margin flat on the middle third, slightly rounding near the eyes. Elytra appressed posteriorly, giving a wedge-shaped appearance. Venation distinct, definitely lined with brownish fuscous.

Color: Vertex creamy yellow or white and irregularly lined in the transverse depression, four small dots in front of this and three subquadrate reticulated areas behind, the latter sometimes coalescing. Pronotum milky white, irregularly irrorate, often partly omitting the anterior disc; scutellum with the angles brownish fuscous, the disc creamy yellow, elytra dirty subhyaline white with brownish fuscous markings in the pattern of *strobi*, but with less irrorations and more reticulations. Basal third of corium with the pigment lines reduced to black points, sutural margins with the six black points and light areas of *scitula*. Face and below, pale yellow.

Genitalia: Female segment with the margin broadly rounded, median fourth triangularly excavated, the apex of excavation broad and slightly roundly produced. Male valve obtuse, plates narrow long-triangular, the outer margins straight and tips attenuate.

Habitat: Manitou and Salida, Colorado (Van Duzee, Ball), Las Vegas, New Mexico, Bright Angel, Arizona (Barber and Schwarz, U. S. N. M.), Arizona (Cornell coll.), and Richfield, Utah (Ball).

The adults have been taken late in July and August from pine trees in southern Colorado and Utah. They were taken only in sheltered situations and this is probably the northern limit of its range.

EUTETTIX PERELEGANTIS Ball.

(Pl. II, Fig. 5.)

Eutettix perelegantis Ball, Can. Ent., XXXIII, p. 46, 1901.

Form of *mildredae*, nearly. Vertex more angled, pattern and marking resembling *scitula* and *pullata*, but of a solid olive fuscous shade, with few reticulations. Length ♀ 5^{mm}, ♂ 4.75^{mm}; width 1.7^{mm}.

Vertex obtusely angulate or slightly rounding, half longer on middle than against eye, disc sloping, the transverse depression shallow, margin distinct, often slightly produced. Elytra moderately long, only slightly depressed, venation rather weak and obscured against the apex.

Color: Vertex and face creamy white, four equidistant pale fulvous spots on anterior margin of vertex and some irregular irrorations at base. Pronotum pale olive, four irregular black marks behind each eye, joined at their bases. Disc with faint brown irrorations usually emphasized as two broad stripes near the light median line. Scutellum with a minute ivory white point in each angle set off by a larger brown one, apical brown spot quadrangular and separated from the basal one by an angular ivory white spot, disc sparsely irrorate with brown; sometimes the disc and white markings washed with yellow. Elytra ivory white, with the saddle and entire claval areas before disc, omitting a triangle at base, and an angular strip along the suture, brownish olive edged with black. Apical portion reticulated and

clouded with brown, omitting three large irregular light spots on margin and often a few small circular ones on disc. Sutureal margins with a pair of black spots. Below, pale.

Genitalia: Female segment with the posterior margin slightly rounding or almost truncate, median fourth angularly emarginate with a stout blunt tooth filling the notch. Male valve angularly rounding, apex trilobate, plates together triangular, apices acute filamentous.

Habitat: Specimens are at hand from Fort Collins, Salida, Ridgway, and Durango, Colorado, Cisco and Richfield, Utah, all collected from red cedar by the author. The solid color pattern will at once separate this species from *pullata*, which it otherwise closely resembles.

EUTETTIX MILDREDÆ Ball.

(Pl. II, Fig. 6.)

Eutettix mildredæ Ball, Can. Ent., XXXIII, p. 45, 1901.

Form and general appearance of *perlegantis* nearly, vertex rounding, yellow, scutellum with the disc yellow, unmarked. Length ♀ 5.5^{mm}, ♂ 5^{mm}; width nearly 2^{mm}.

Vertex broad, shorter than in *perlegantis*, resembling *strobi* but slightly angled, strongly sloping to a thick margin, transverse depression shallow. Elytra as in *perlegantis*.

Color: Vertex and face fulvous or orange yellow. Vertex unmarked or with but traces of the markings of *perlegantis*. Pronotum with the markings of *perlegantis* but paler, the black markings reduced to an irregular line behind the eyes. Scutellum fulvous or orange with an irregular reticulate area against each basal angle and a dash on either side of the apex brown. Elytra with the pattern and color of *perlegantis* except that the white area on outside of clavus is smaller and nearly semicircular instead of wedge-shaped, and the clouding at apex is usually denser.

Genitalia: Female segment broadly rounding, or almost truncate, with the median third produced into black, marked, evenly-rounding lobes. Male valve obtusely rounding, plates slightly longer than their basal width, their apices filamentous.

Habitat: Specimens are at hand from Manitou, Colorado (Van Duzee, Ball), Las Vegas, New Mexico (Barber and Schwarz, U. S. N. M.), and Arizona (Cornell coll.).

This pretty species, *perlegantis*, and *pullata*, form a group of closely related tree-inhabiting forms. This species is found with *perlegantis* on the red cedar, but only in sheltered situations. From the latter species it may be readily separated by the yellow scutellum and distinct genitalia.

EUTETTIX SNOWI n. sp.

(Pl. II, Fig. 7.)

Form and general appearance of *saucia*, nearly, much paler, pattern and color of *mildredae*, nearly, but lacking the black markings. White, with a very pale brownish olive color pattern. Length ♀ 4.75^{mm}; width 1.5^{mm}.

Vertex rather long, very slightly angled, disc almost flat, the margins thick, elevated, slightly acutely angled with front. Elytra rather short, venation regular, the apical cells short.

Color: Vertex pale creamy white, sometimes with six faint brown spots on anterior margin and traces of irrorations on the disc. Pronotum finely irrorate with pale olive, with a brownish cast. Elytra hyaline, with the pattern of *mildredae*, or *saucia*, nearly, very pale brown olive, the saddle fading out towards the costa, pattern covering the entire claval area except for a narrow ivory white margin along suture on anterior half. Saddle with the anterior margin sloping rapidly backwards and fading out before reaching costa, rather broadly connecting with the apical cloud inside the middle of the disc. Three or four points on outer margin of claval pattern, one on anterior edge of saddle, another at apex of clavus and a few against the third and fourth apical veinlets, brownish or fuscous.

Genitalia: Female segment with a posterior margin gently rounding, a pair of minute acute median teeth set off by a slight notch on either side.

Habitat: Described from three specimens from Douglass, Arizona, altitude 3,750 feet (F. H. Snow), one from Catal Springs, Arizona (Barber and Schwarz, U. S. N. M.), and one from Cornell U. coll. labelled "Ariz. Lot 34," all females.

EUTETTIX SAUCIA Ball. (Pl. II, Fig. 8.)

Eutettix saucia Ball, Can. Ent., XXXIII, p. 46, 1901.

Form and color pattern of *pullata*, nearly, darker, and without the pattern on vertex. Much more definitely marked than in *snowi*. White, with a definite color pattern. Length ♀ 4.6^{mm}, ♂ 4.2^{mm}.

Vertex shorter than in *snowi*, about equalling *pulchella* in length, but more angulate, one-third longer on middle than against eye. Disc sloping, the transverse suture strongly marked on middle half, before which the margin is flat and nearly right-angled with the inflated and strongly curved front. Elytra as in *pulchella*, venation simple, distinct.

Color: Vertex pale yellow, six minute points on anterior margin and three irregularly irrorate patches on the posterior disc brown. Pronotum white, coarsely irrorate with dull brown, omitting three irregular lines on disc and the lateral margin. Scutellum finely irrorate with brown, three

ivory white points in an apical triangle and sometimes a yellow stripe on the disc. Elytra ivory white with a pattern as in *snowi* or *pulchella*, of dull brown slightly edged with fuscous, a few coarse brown or fuscous reticulations on base of corium and two or more light spots along the common suture.

Genitalia: Female segment with the posterior margin truncate or slightly rounding, median fourth excavated and bearing two slightly protruding median teeth. Male valve obtusely rounding, plates narrow, long-triangular, the apices acute, attenuate, clothed with fine hairs.

Habitat: Specimens are at hand from Greeley, Fort Collins, Denver and Buena Vista, Colorado, Cisco, Utah (Ball), and Los Angeles county, California (Coquillett).

Utah specimen was taken from a place where the bottle weed (*Eriogonum inflatum*) was abundant, while the Colorado specimens were swept from places where another species of *Eriogonum* grew.

EUTETTIX PULCHELLA Baker. (Pl. II, Fig. 9.)

Eutettix pulchella Baker, Psyche, VII, Supp., p. 24, 1896 (Desc. N. M.).

Eutettix scaber Osborn and Ball, Dav. Acad. Sci., VII, 1898 (Desc. Iowa); Iowa Acad. Sci., V, p. 235, 1898 (list).

Superficially resembling *strobi*, but with much more definite pattern and with darker chestnut color. Length ♀ 4.7^{mm}, ♂ 4.4^{mm}.

Vertex broad, short, scarcely longer on middle than against eyes, disc very slightly sloping, transversal depression faint or obsolete except back of apex. Front receding, gently rounding, slightly acutely angled with vertex, the margins thick. Elytra of median length. Venation obscure.

Color: Milky or ivory white, minutely heavily irrorate, with testaceous brown as follows: all of vertex except an ivory line in front of the transverse depression, into which extends four equidistant brown points, all of pronotum except an ivory line on each lateral margin, scutellum except three white dots, forming an apical triangle and often four more on disc; elytral pattern as in *saucia*, only denser and more definitely margined. The ivory line along claval suture narrow and definite, with a few acute brown projections, to just before the saddle, where it broadens into a semioval spot. Three equidistant white dots along sutural margin. Face and below, pale yellow.

Genitalia: Female segment with the posterior margin gently rounding, median fourth slightly emarginate, with two minute teeth extending a trifle beyond the margin. Male valve very short and obtuse, plates similar to *saucia*, long-triangular, their apices acute.

Habitat: Specimens are at hand from Ames, Iowa (Ball), San Augustine, New Mexico (Cockerell), Tucson (Hubbard, U. S. N. M.), Baboquivaria Mts., Arizona (Snow), and Arizona (Cornell coll.).

This is probably a southern species, as no specimens have been taken in Colorado or Utah. Baker's specimens from Fort Collins, Colorado, no doubt belonged to *saucia*, as he speaks of them as darker in color and different in other points. The types of *scaber* are very much larger and especially broader than the western specimens of *pulchella* and may possibly be distinct, but it is not possible to separate them on structure or pattern with the material at hand. This species is closely related to *saucia*, and from their color it is probable that both will be found to feed on species of *Eriogonum*.

EUTETTIX ALBIDA (Ball). (Pl. II, Fig. 10.)

Phlepsius albidus Ball, Can. Ent., XXXII, p. 203, 1900.

Resembling *scitula*, but smaller and much paler with very obscure saddle of ramose lines. Length ♀ 4.5^{mm}, ♂ 3.8^{mm}; width 1.2^{mm}.

Vertex flat, scarcely sloping, longer than in *scitula*, and slightly more evenly rounding. Transverse depression faint, anterior margin broadly rounding over to front. Elytra moderately long, appressed behind.

Color: Vertex pale creamy white, six faint dots on the anterior margin and about six dashes at base brown. Pronotum pale, sometimes faintly washed with olive and with a few brown irrorations. Elytra milky white, with scattered brown pigment lines heaviest in the male. These pigment lines usually aggregate so as to form a very obscure pattern like that of *saucia*, but often wanting along costa. The basal half of corium with a few coarser reticulations than those of pattern. A spot at apex of clavus and about three smaller ones along edge of claval pattern, on the basal half, black. Below, pale.

Genitalia: Female segment with the posterior margin slightly rounding and weakly notched in the middle. Male valve broad, triangularly rounding, plates equilaterally triangular, their apices slightly acute, not as long as the pygofer.

Habitat: Specimens are at hand from Pueblo, Palisades, and Grand Junction, Colorado; Thompson's, Helper, and Monroe, Utah, all collected by the author, and Douglass, Arizona (Snow).

This species, *insana* and *snowi* have reached a similar pale condition by quite different routes. In this species it has been by reduction in number and size of the ramose lines until it resembles the color of *Atriplex confertifolia*, on which it feeds.

EUTETTIX PANNOSA Ball. (Pl. II, Fig. 11.)

Eutettix pannosa Ball, Can. Ent., XXXIV, p. 12, 1902.

Superficially resembling *saucia*, but smaller, darker, and more

coarsely reticulate. Vertex long, face dark. Heavily and coarsely reticulate above with dark brown, except the costal third of elytra. Length ♀ 4.5^{mm}, ♂ 4^{mm}; width 1.2^{mm}.

Vertex long, right-angled, the apex a trifle rounding, half longer on middle than against eye. Disc almost flat, the anterior margin thin, angle with face acute. Elytra rather long, narrow, venation regular, distinct, dark lined; rarely a second cross nervure present.

Color: White, the entire dorsal surface heavily, coarsely reticulate with brownish fuscous, except the narrow lateral margin of pronotum and outer half of elytra. Usually six irregular black spots on anterior margin of vertex. The reticulations on elytra are heaviest near the outer edge of pattern, shading out to irregular pale areas along the suture. Outer half of elytra with a few irregular reticulations and ramose lines along veins and costa. Face heavily irrorate with brownish fuscous. Below, washed with brown.

Genitalia: Female segment with the posterior margin rounding, the median fourth produced in two bluntly rounding lobes as in *mildredae*. Male valve narrow, slightly obtusely angular, plates rather broad, equilaterally triangular, their margins convex and apices slightly produced.

Habitat: Known only from the types from Los Angeles county, California (Coquillett, U. S. N. M.). The long flat vertex and white stripe along costa will at once distinguish this species.

EUTETTIX TEXANA n. sp.

Form of *strobi* or *seminuda*, nearly, but entirely lacking their color pattern, resembling *albida* but pale creamy yellow, entirely covered by coarse reticulations of very pale rusty brown. Length ♀ 4.6^{mm}, ♂ 4.2^{mm}; width 1.6^{mm}.

Vertex nearly as in *strobi*, a trifle angled before, disc slightly sloping, in the same plane as pronotum, transverse depression shallow, margin thick and indefinite except at apex, where it is slightly acutely-angled with the front. Elytra as in *strobi*, venation regular but very much obscured by the reticulations.

Color: Pale creamy yellow, coarsely and rather evenly reticulate with pale rusty brown, often wanting on the vertex. Pronotum and elytra often with a few scattered ivory white dots, face and below pale. Sometimes the reticulation becomes so pale as to be scarcely visible.

Genitalia: Female segment with the posterior margin truncate or slightly rounding, median fourth excavated either side of two rounding approximate lobes that equal or slightly exceed the margins. Male valve very short, obtuse, plates long-triangular, acutely pointed.

Habitat: Described from five females and two males from Brownsville, Texas (Snow), and Victoria, Texas (U. S. N. M.); easily distinguished from the other pale forms by the saffron color and absence of definite pattern.

EUTETTIX BICOLORATA Ball. (Pl. II, Fig. 12.)

Eutettix bicolorata Ball, Can. Ent., XXXVII, p. 212, 1905 (Ark. and Utah).

Form of *strobi*, nearly, but entirely different in color and pattern. Pale greenish white with heavy black reticulations, omitting the elytra from the apex of clavus forward. Length ♀ 6.2^{mm}, ♂ 5.7^{mm}; width 1.7^{mm}.

Vertex narrow, moderately long, very slightly produced in the middle, disc strong, convexly sloping to the deep transverse depression, beyond which the margin is very slightly sloping. Front very strongly inflated, almost angled as seen from side, meeting vertex in a slightly obtuse angle. Elytra long and narrow, venation weak, obscure on basal part, slightly broken by the heavy reticulations on apical third.

Color: Vertex ivory white, four points on anterior margin, and a subquadrate reticulate area occupying the middle of either side of the disc, black; often a black dot against eye in the transverse depression, connected by a line with the quadrate area. Pronotum ivory white, heavily reticulate with black, usually omitting a few large spots on anterior submargin, a narrow median stripe and a line along posterior margin. Scutellum brown, irregularly maculate with black and white, a definite spot on each lateral margin and apex ivory white. Elytra dirty cream color with a greenish cast to just beyond the edge of clavus, then milk white with heavy black veins and coarse reticulations. Usually a black cloud at apex containing a small round light spot. Upper half of face greenish white, a small black point under either eye, lower half heavily irrorate with dark brownish fuscous. Below, brown or black, genitalia light.

Genitalia: Female segment with the posterior margin slightly rounding, slightly angularly produced in the middle fourth with a weak median notch. Male valve small, obtusely rounding, plates long-triangular, acutely pointed.

Habitat: Specimens are at hand from Richfield, Utah (Ball), and Hot Springs, Arkansas (Barber, U. S. N. M.).

Larvæ stout, the vertex almost conical. Pale greenish white with dark brown mottlings on back of vertex and pronotum. Upper half of face white, lower half dark brown or black; below, dark brown.

This species is found only on *Ephedra*. When resting on a stem it resembles a frayed sheath, such as encircles the joints, so well that it will often escape detection.

Subgenus ALIGIA nov.

Allygus Van Duzee, Ent. Am., VI, p. 93, 1890; Trans. Am. Ent. Soc., XIX, p. 299, 1892; Catalogue, p. 294, 1894.

(Not *Allygus* Fieb., Cat. Europ. Cicad., p. 13, 1871, or of other European authors).

Vertex short, sloping, rounding to front without a definitely angled margin except near apex, transverse depression faint or curved posteriorly in the middle and ending at the ocelli; front long, wedge-shaped, margins not constricted between antennal sockets. Elytra subhyaline, the nervures distinct, dark, two cross nervures present between the sectors and usually a number of supernumerary veinlets along costa and claval sutures.

Type of subgenus *jucunda* Uhl.

This subgenus includes the forms in which the ramose pigment lines have broken up into veinlets and many of them have disappeared. There is in some forms a fairly definite saddle and the head is still short, but is not conical as in the typical *Eutettix* and the transverse depression has been pushed back.

This group agrees with *Allygus* in possessing a second cross nervure, but in other characters is widely separated and has, no doubt, had a very different origin.

ARTIFICIAL KEY TO THE SPECIES.

- A Vertex nearly right-angled, the apex slightly produced. *inscripta* V.D.
- AA Vertex rounding, the margins nearly parallel.
 - B Nervures and markings on elytra brown or fuscous, nervures distinct.
 - C Vertex fulvous, eyes bright red, female under 5mm. *oculca* Ball.
 - CC Vertex pale, washed with brown, eyes dark brown or black. Female 5mm. or over.
 - D Form narrow, vertex white with definite dark markings. General color brownish fuscous. *jucunda* Uhl.
 - DD Form broader, vertex washed with brown obscurely marked. General color brown. *munda* Ball.
 - BB Nervures and marking on elytra tawny, nervures often indistinct on basal part.
 - C A number of supernumerary veinlets along costa and claval suture. Males darker than females. *modesta* Osb. & B.
 - CC At the most only one or two supernumerary veinlets along costa or claval suture. Males golden. *manilon* Ball.

ECTETRIX (ALIGIA) INSCRIPTA Van Duzee.

(Pl. III, Fig. 1.)

Allygus inscriptus Van Duzee, Ent. Am., VI, p. 92, 1890 (Desc. Calif.); Catalogue, p. 294, 1894.

Resembling *jucunda*, but paler and with a definitely angled vertex. Length ♀ 5.5^{mm}, ♂ 4.5^{mm}; width 1.5^{mm}.

Vertex almost right-angled, apex acute, nearly twice as long as against eye, two-thirds the length of pronotum, transverse depression on a line with the ocelli. Elytra long, rather narrow, venation similar to that of *jucunda*, the reticulations not as definite.

Color: Vertex pale creamy, two dots at apex, a short transverse line in the depression and two dots at base brownish fuscous. Pronotum pale, washed and faintly irrorate with brown. Elytra pale, the nervures and transverse veinlets brown, often a brown cloud omitting the base and a narrow transverse band across the second cross nervure.

Genitalia: Female segment with the posterior margin truncate, median fourth slightly produced. Male valve short, broadly triangular, plates long-triangular, their apices upturned.

Habitat: Specimens are at hand from Los Angeles, California (Coquillett), and Mountain View, California (Fhrhorn).

The pointed vertex will at once separate this species from any other member of the group.

EUTETTIX (ALIGIA) OCULEA Ball.

Eutettix oculea Ball, Can. Ent., XXXIII, p. 50, 1901.

Form of *jucunda*, nearly, smaller, with a narrower, longer vertex. Lighter than *munda*, with a fulvous vertex and red eyes. Length ♀ 4.75^{mm}, ♂ 4.25^{mm}; width 1.3^{mm}.

Vertex narrow, slightly longer on the middle than against eye, with the apex slightly rounding, not quite twice wider than long. Flytra parallel-margined, slightly flaring, venation and reticulations as in *jucunda*.

Color: Eyes bright testaceous red, vertex and face bright fulvous with a crescentic line on the depression and spot on the disc against either eye testaceous. Pronotum milky white, sparsely irrorate with fuscous on anterior disc omitting the median line. Scutellum with the markings of *jucunda*, the fuscous replaced by fulvous. Elytra milky white, the nervures and reticulations fuscous in sharp contrast. Traces of three fuscous bands as in *jucunda*, but with pigment spots reduced in size, leaving the general effect of a milky white wing with dark nervures.

Genitalia: Female segment resembling that of *munda* but with the projection less sharply bi-lobed. Male genitalia similar to that of *jucunda*, the valve shorter but similarly pointed at apex.

Habitat: Specimens are at hand from Rifle, Ridgway, Dolores and Durango, Colorado (Ball).

This species is apparently strictly confined to the sarvice berry (*Peraphyllum ramosissimum*). Adults were taken commonly in late July and early August. The red eyes and reddish cast of the dorsum harmonizes well with the red twigs of its food plant.

EUTETTIX (ALIGIA) JUCUNDA (Uhl.). (Pl. III, Fig. 2.)

Jassus jucundus Uhler, Bull. U. S. Geol. and Geog. Surv., III, p. 469, 1877.

Paramesus jucundus Osborn and Ball, Dav. Acad. Sci., VII, p. 97, 1897 (foot-note); Gill and Baker, Hemip. Colo., p. 84, 1895 (in part) (after Uhler).

(See under *cincta* and *modesta* for eastern references.)

Superficially resembling *nigridorsum*, but paler and with a rounding head. Longer and more nearly parallel-margined than any *Eutettix* proper. Length ♀ 5.5^{mm}, ♂ 5^{mm}; width 1.7^{mm}.

Vertex evenly rounding, scarcely longer on middle than against eyes, two and one-half times wider than long, transverse depression deep. Elytra long, narrow and flaring, about fifteen veinlets between inner sector and the claval suture, half that number along costa, a few between the sectors of clavus and in the posterior end of the central anteapical cell, and often other irregularities in venation.

Color: Vertex white or pale yellow, the transverse depression, two spots at apex, a dash on margin against ocellus, an elongate spot against either eye, a line inside and sometimes the median line brownish fuscous. Pronotum pale, mottled with brownish fuscous, omitting the posterior border and the narrow median line. Scutellum with five narrow longitudinal stripes and the transverse suture black, dividing it into compartments. Outer angular compartments, apex and a spot on margin between them, ivory white. Second compartments orange or dark brown, median compartments pale creamy, a round black spot in each in front of suture, median stripe terminating in an enlargement just back of suture. Elytra milky white, the nervures and veinlets dark rusty brown, traces of three transverse bands, one midway between the cross nervures, another at apex of clavus and a third at apex of elytra. The first two bands of brown cloudings and fuscous brown areas in the center of the cells, apical one dark smoky, containing an oval light spot. The common suture with four pairs of black spots and three pairs of larger ivory white ones. Front brown, with light arcs, sutures of face brown.

Genitalia: Female segment with a posterior margin slightly rounding, median fourth obtusely roundly produced, pygofer long, narrow, ovipositor exceeding the pygofer by three times its width. Male valve short, obtusely angulate, apex produced, plates long, slightly convexly narrowing at base, then regularly narrowing to the subacute black-tipped apices, disc convex.

Habitat: Specimens are at hand from Fort Collins, Palmer Lake, Colorado Springs, Salida (Ball) and Manitou, Colorado (Van Duzee), Las Vegas, New Mexico, and Williams, Arizona (Barber and Schwarz) (U. S. N. M.), Soldier's Summit and Salt Lake, Utah (Ball).

This species is strictly confined to the scrub oak growing on the mountain sides at from five to eight thousand feet elevation.

Adults have been taken most abundantly in July and August.

The type of this species in the Uhler collection is from Manitou and is no doubt the one from which the description was mainly drawn, as it fits it exactly. No specimens of this species have been found in the East, and it is very probable that the specimens referred here by Dr. Uhler belong to *modesta*. Later workers, doubtless misled by the Maryland reference of Uhler, placed this name on what is now known as *cincta*, while the latter part of the Gillette and Baker reference probably refers to *nigridorsum*.

EUTETTIX (ALICIA) MUNDA Ball.

(Pl. III, Fig. 3.)

Eutettix munda Ball, Can. Ent., XXXIII, p. 48, 1901.

Closely resembling *jucunda* in structure and general appearance, much broader, with more flaring elytra. Vertex pale fulvous with few markings. Length ♀ 6^{mm}, ♂ 5.2^{mm}; width 2^{mm}.

Vertex broader and slightly more angled than in *jucunda*, transverse depression shallow. Face much broader, elytra broader, more flaring, and with more numerous transverse veinlets than in *jucunda*.

Color: Vertex dirty orange, with the markings of *jucunda* reduced to pale round spots or absent. Pronotum pale, with a few irregular mottlings on disc. Scutellum dirty orange or pale, an oval brown spot inside basal angle and a black dot either side the apex. Elytra subhyaline white with bands as in *jucunda* but broader and more diffuse in color, reticulations finer and lighter color, apical bands reduced to a few rusty brown margins to the nervures. Black and white spots along the common sutures, as in *jucunda*.

Genitalia: Female segment broad, short, posterior margin truncate with the median third slightly produced, and broadly bi-lobed. Pygofers shorter than in *jucunda*, only slightly exceeded by the ovipositor. Male valve triangular, plates broad at base, long, spoon-shaped, with bluntly rounding apices.

Habitat: Specimens are at hand from Palmer Lake, Salida, Ridgway, Dolores and Durango, Colorado (Ball), White Mountains, New Mexico (Cockerell), and Williams, Arizona (Barber and Schwarz, U. S. N. M.).

This is a duller colored and less plainly marked species than *jucunda*, some specimens even approaching *modesta* in shade; they however lack the tawny ground color to the elytra and the bands are differently placed. This species also occurs on the scrub oaks, but is much rarer than *jucunda* in the regions under observation.

EUTETTIX (ALIGIA) MODESTA Osborn and Ball.
(Pl. III, Fig. 4.)

Eutettix modesta Osborn and Ball, Dav. Acad. Sci., VII, p. 98, 1898 (Desc. Iowa).

Resembling *munda*, but stouter and more tawny, superficially resembling *subaenea*. Stout, fulvous or tawny, with a light band across second cross nervure. Length ♀ 5.5^{mm}, ♂ 4.5^{mm}; width 1.5^{mm}.

Vertex shorter and more sloping than in *manitou*, rounding to the front, the apex a trifle produced before the transverse depression. Elytra shorter than in *munda*, venation similar, the anteapical cells much shorter, supernumerary veinlets along clavus and costa inclined to be irregular and branching.

Color: Pale fulvous, inclined to be paler on the vertex and anterior part of pronotum. Vertex with a pair of tawny spots near apex and a pair of oblique marks inside the basal angles. Pronotum faintly irrorate with tawny. Elytra subhyaline white clouded with reddish fulvous, omitting an indefinite basal band and a narrow definite one across the second cross nervure.

Genitalia: Female segment almost truncate, with a broad slightly rounding median projection. Male valve triangular with the apex produced, plates long, spoon-shaped, the margins clothed with long hairs, except for the black-marked upturned tips.

Habitat: Specimens are at hand from Ames, Iowa (Ball), Maryland (Uhler coll., U. S. N. M.), District of Columbia (Heidemann) and Tryon, North Carolina (Fiske, Osborn coll.).

This species apparently feeds on oak and as it is the only eastern representative of the subgenus it cannot be confused with any other species. The specimens from North Carolina are more highly colored than those from the other localities.

EUTETTIX (ALIGIA) MANITOU Ball. (Pl. III, Fig. 5.)

Eutettix manitou Ball, Can. Ent., XXXIII, p. 49, 1901.

Form and general appearance of *modesta*, but smaller; smaller than *oculea*. Golden yellow with a lemon yellow vertex, female elytra subhyaline, both with transverse light bands. Length ♀ 4.5^{mm}, ♂ 3.75^{mm}; width 1.3^{mm}.

Vertex narrow, distinctly longer on middle than against eye, forming an obtuse angle, depression obscure, entire margin rounding to front. Elytra moderately long, very much flaring in female, appressed in the male. Venation as in *oculea*, but lacking the numerous cross nervures. Usually two or three cross nervures in the central anteapical cell, the posterior one often

forming an enlarged hexagonal compartment, an extra cross nervure to costa close to the fifth apical cell and usually a cross nervure on clavus. The fourth apical cell very large and almost circular. Male much smaller and narrower than female.

Color: Female, vertex and face lemon yellow, sometimes with two fuscous spots at apex of vertex. Pronotum pale cinereous, washed with golden omitting three faint stripes. Flytra pale milky subhyaline washed with testaceous brown on the disc, a definite light band across the second cross nervure and an irregular one before the apical cells. The nervures on anterior half concolorous, on posterior half brownish fuscous in sharp contrast, apex of clavus and the costal nervures fuscous. Male same as female except that the pronotum and anterior two-thirds of elytra are of a rich golden brown, the light band across the second cross nervure reduced to a few milky spots.

Genitalia: Female segment with the posterior margin slightly rounding, the median fifth slightly produced and bi-lobed, pygofers of medium length, scarcely exceeded by the ovipositor. Male valve rounding, the apex produced, plates as in *jucunda*, the apices curved up but not darkened.

Habitat: Specimens are at hand from Manitou (Van Duzee and Ball), Palmer Lake, Dolores (Ball), and Grand Junction, Colorado (Van Duzee), and Las Vegas, New Mexico (Barber and Schwarz, U. S. N. M.).

This is strictly an oak feeder and occurs on scrub oaks with *jucunda*. The adults are most common in August. The very small golden yellow male will at once distinguish this species from any other in the group.

Subgenus MESAMIA nov.

Paramesus Van Duzee, Trans. Am. Ent. Soc., XIX, p. 299, 1892;

Catalogue, p. 290, 1894; and other American authors.

(Not *Paramesus* Fieb., Ver. d'Zoo. Bot. Ges. Wien, XVI, p. 506, 1866, and European authors).

Vertex with the disc depressed, anterior margin usually elevated and acutely angled with the front, margin often slightly produced, front narrow, slightly constricted at antennal socket, then angularly widened to the ocelli, surface smooth polished, nearly flat above. Flytra subhyaline, the second cross nervure present (sometimes obscure) and the central anteapical cell slightly constricted. Usually with a number of supernumerary veinlets along the clavus and costa.

Type of the subgenus *nigridorsum* Ball.

This subgenus includes forms in which the ramose lines have been aggregated into definite nervures as in *Aligia*, but the head has been elongated and the vertex and face flattened. Even here the transverse bands or "saddle" type of marking predominates.

Some of the members of this subgenus have been placed in *Paramesus* by different American authors and in the flat and highly polished front they do closely resemble that genus; but in the shape of the front and the vertex, and still more in the structure of the elytra, they are apparently quite distinct and have, no doubt, arisen through very different lines of development.

ARTIFICIAL KEY TO THE SPECIES.

- A Species with fuscous markings or at least fuscous nervures.
 - B A number of fuscous reticulations between second sector and clavus.
 - C A dark saddle on elytra between the cross nervures. *nigridorsum* n. sp.
 - CC Without a definite dark band.
 - D Size of *nigridorsum*, vertex depressed, with four spots on anterior margin, connected by a line posteriorly, a broad band below vertex. *straminea* Osb.
 - DD Smaller than *nigridorsum*, vertex flat with a narrow line above and below margin, sometimes wanting. *coloradensis* G. & B.
 - BB No reticulations between first sector and clavus. A definite light band across the first cross nervure between the sectors.
 - C Vertex conical, without spots, species stout. *cincla* O. & B.
 - CC Vertex flat, with a marginal row of black spots. Species elongate. *fenestrata* Ball.
- AA Species fulvous yellow with light spots, or creamy with a median stripe, nervures concolorous.
 - B Vertex short, obtusely rounding, six black spots on anterior margin, two veinlets to costa. *johnsoni* Van Duzee.
 - BB Vertex much produced, roundly rightangled, unicolorous above. Four or more costal veinlets.
 - C Elytra fulvous, with light spots. *vitellina* Fitch.
 - CC Elytra creamy, with a common brown stripe along suture. *palliolata* Ball.

EUTETTIX (MESAMIA) NIGRIDORSUM n. sp.

(Pl. III, Fig. 6; IV, Fig. 6.)

Paramesus twiningi Osborn, Iowa Acad. Sci., I, pt. II, p. 120, 1892 (Iowa as *P. sp.*); pt. III, p. 104, 1893 (as *twiningi* and note); Van Duzee, Catalogue, p. 290, 1894; Osborn, Iowa Acad. Sci., VI, p. 39, 1899 (NW. Iowa); Wirtner, Ann. Carn. Mus., III, p. 221, 1904, (Pa. and notes).

Paramesus jucundus Gill. and Baker, Hemip. Colo., p. 84, 1895 (in part).

Milky white, posterior half of vertex, pronotum, scutellum and

a median saddle on elytra black or dark fuscous brown. Length ♀ 5^{mm.}, ♂ 4^{mm.}; width 1.7^{mm.}.

Vertex but little longer than half its basal width, obtusely rounding, one-third longer on middle than against eye. Disc depressed, anterior margin elevated and acutely angled with front. Elytra moderately long, flaring, parallel-margined venation regular, two cross nervures, a few cross veins on clavus, a series along the claval suture, and about seven strong and slightly reflexed ones along costa.

Color: Vertex with a black line between the ocelli, which sends forward a quadrangular spot on either side of the median line. Before this line the margin is ivory white, disc brown, face highly polished, shining, shading to black below, traces of about five pale arcs. Pronotum brown behind the eyes, behind this a narrow light band containing a pair of irregular dark spots on either side. Behind this the disc is brownish or fuscous irrorate. Scutellum irrorate with brown except for three ivory white points in a triangle. Elytra milky white, the nervures brown, a black or dark brown saddle across the posterior two-thirds of clavus and usually a narrow band at base and apex and the costal veinlets black. The saddle contains four white spots along the suture and some irregular ones on the corium.

Genitalia: Female segment rather long, posterior margin slightly angularly excavated, the median fifth produced into a broad strap-shaped tooth as long as its basal width, slightly narrowing and a trifle bi-lobed at the extremity, pygofers short and stout, very convex as seen from below, the ultimate segment curving around them. Male valve very obtusely angulate, almost concealed, plates small, a trifle longer than their basal width, slightly concavely narrowing to their acute apices, margins clothed with a few coarse spines.

Habitat: Specimens have been examined from Penn Station, Pennsylvania (Wirt), Black Mountains, North Carolina (Beutenmueller), Ames and Little Rock, Iowa (Ball), Sioux Falls, South Dakota (Osborn), Onaga, Kansas (Crevec), Lamar, Pike's Peak, Pueblo and Trinidad (Ball), and Colorado Springs, Colorado (Tucker), Provo, Lehi, Salt Lake and Logan, Utah (Ball), and Guerrero, Mexico (Biologia coll.). It is apparently a southern species and reaches its northern limit in Pennsylvania, Iowa, and Colorado.

The larvæ resemble those of *straminea* in shape and color pattern, but are somewhat darker, with the white spot smaller or partially wanting.

This species is two-brooded, the adults appearing in June and again in August. Both larvæ and adults feed on two species of *Helianthus*, causing black spots on the leaves.

This species has long been known in collections and has been

commonly determined as *twiningi* Uhler. The species described under that name by Uhler proved, however, on examination, to be the *vitellina* of Fitch, thus leaving this form without a name. Its milk-white elytra with the black nervures and black saddle in sharp contrast render it a strikingly distinct and easily recognized species.

EUTETTIX (MESAMIA) STRAMINEA (Osborn).

(Pl. III, Fig. 7; IV, Fig. 7.)

Paramesus stramineus Osborn, Iowa Acad. Sci., V, p. 231 and 241, 1898 (Desc. Iowa, S. D., and Neb.).

Size and form of *nigridorsum*, nearly, but of a uniform greenish straw-color, with dark veins. Length ♀ 5.5^{mm.}, ♂ 4.5^{mm.}; width 1.7^{mm.}.

Vertex slightly longer and more angled than in *nigridorsum*. Elytra distinctly longer and more flaring than in that species, the apical and antecapital cells longer, the central antecapital cells enlarged at the apex and sometimes divided.

Color: Disc of the vertex straw yellow, anterior and posterior margins ivory white, behind the anterior margin there is an irregular black line, interrupted in the middle, which is sometimes reduced to four black spots, a pair against the ocelli and a larger pair behind the apex. Anterior half of pronotum pale dirty yellow, posterior half olive and brown irrorate, and separated from the yellow portion by a darker line which arches forward in the middle. Scutellum with a pair of orange spots just inside the margin and seven light dots around the edge. Elytra subhyaline washed with brownish olive on the disc, except for three pairs of oval milky spots along the suture, nervures brown, a crescent at apex and the costal veinlets fuscous. Face pale, front brown, darkening above with a narrow black band under vertex, arcs of the front light.

Genitalia: As in *nigridorsum*.

Habitat: Specimens have been examined from Ames and Little Rock, Iowa (Ball), Sioux City, Iowa, and Sioux Falls, S. D. (Osborn), West Point, Neb. (Bruner), Onaga, Kansas (Crevec), Riley county, Kansas (Osborn coll.), Fort Collins and Palmer Lake, Colorado (Ball), American Fork, Lehi, Salt Lake, Layton and Logan, Utah (Ball). It is probably confined to the Mississippi Valley and western states, where its food plants abound, but will, no doubt, be found much farther south than at present recorded.

The larvae are elongate, the abdomen quite tapering, vertex distinctly longer than pronotum, longer and more angled than in the adult, but with the same depressed disc. Color light smoky or chocolate brown, with two

black dashes at apex of vertex, separated by a median stripe and a narrow crescent of white. A narrow median light stripe with an enlarged spot at each transverse suture extends back to the abdomen. An irregular row of white spots on each side near the margin, one on each abdominal segment, and two on each thoracic division. Pairs of intermediate spots on the pronotum, the wing pads, and the first three abdominal segments and four spots in a diamond on the fifth and sixth segments, white. Face white, a band below the vertex brown, the antennal sockets, lower half of front, and clypeus black, below and legs white. Femora annulate with black at apices, tibiae annulate at both extremities, spines on hind tibia arising from black points.

This species is closely related to *nigradorsum*, but can be readily separated by the absence of the saddle and by the greenish color. It has about the same life history as that species and also feeds on *Helianthus*, but is found only on the rough-leaved species.

EUTETTIX (MESAMIA) COLORADENSIS (G. & B.).

Allygus coloradensis G. & B., Hemip. Colo., p. 91, 1895 (Desc. Colorado).

Paramesus immaculatus Ball, Can. Ent., XXXVII, p. 211, 1905.

Form of *nigradorsum*, nearly, but slightly smaller, resembling a pale *straminea*, but much smaller and with a flatter vertex. Length ♀ 4.5^{mm}, ♂ 3.7^{mm}; width 1.6^{mm}.

Vertex flat, form of *straminea*, nearly, the apex a trifle more pointed, acutely angled with the front, but not produced. Flytra short and with the venation of *nigradorsum* except that usually there are more reticulations.

Color: Pale greenish white, often with a sparse wash of yellow and dirty brown. Vertex usually with a hair line of black along the margin, interrupted in the middle, and sometimes with two black spots at base. Pronotum pale straw anteriorly, immaculate, or with a few black spots around the eyes, disc irregularly irrorate with brown. Flytra pale or greenish brown, subhyaline, the nervure and reticulations brown, darkest along the costa. Sometimes a faint brownish cloud on the disc omitting a few milky spots. Pale specimens may be uniformly greenish white.

Genitalia: As in *straminea*; female segment pale, the margins of tooth embrowned.

Habitat: Specimens are at hand from Fort Collins, Home, Palmer Lake and Rico, Colorado; Soldiers' Summit and Logan, Utah, all collected by the author, and Orizaba, Mexico (Biologia coll.). A damaged specimen from Keatchie, Louisiana (Hine) probably belongs here.

The larvæ were not preserved. They were pale, with faint brown markings. Both larvæ and adults feed on a single species

of sage brush (*A. dracunculoides*). There are two broods in a season, the adults appearing in middle June and again in early August.

It was rather difficult to decide as to which name to apply to this species. *A. coloradensis* G. & B. was described from a single example, and what purports to be that example is now in the Colorado collection. The head is lost, but it is unquestionably a male of the previous species (*straminea* Osborn). Recognizing this the writer, while in Colorado, described this species as *immaculatus*. The description of *coloradensis*, however, applies much better to the present species, and later examinations have shown that the material sent out as *coloradensis*, as well as most of that remaining in the Baker collection, belongs to this species. If the species were placed according to the Colorado type, then *straminea* should be known as *coloradensis*, and this species as *immaculata*. If, on the other hand, the description is to be given greatest weight in fixing the species, and on account of the questionable character of all the Gillette and Baker types, this plan has been adopted in the present case, then the present arrangement is the correct one.

EUTETTIX (MESAMIA) CINCTA Osborn and Ball.

(Pl. IV, Fig. 1.)

Eutettix jucunda Van Duzee, Psyche, VI, p. 307, 1890; Osborn, Iowa Acad. Sci., I, pt. II, p. 120, 1892 (Iowa); Van Duzee, Catalogue, p. 297, 1894 (Md., Texas, Miss.).

Eutettix cincta Osborn and Ball, Dav. Acad. Sci., VII, p. 97, 1898 (Desc. Iowa, Texas and D. C.); Osborn, Iowa Acad. Sci., V, p. 235, 1898 (Iowa list); Ohio Acad. Sci., 8th Ann. Rept., p. 67, 1900 (Ohio); Wirtner, Ann. Carn. Mus., III, p. 223, 1904 (Pa. and note); Osborn, in 20th Rept. St. Ent. N. Y., p. 530, 1905 (Long Island).

Resembling *munda* in shape, the dark and light bands reversed. Larger than *nigridorsum*, with a sloping vertex. Length ♀ 6^{mm}, ♂ 5.3^{mm}; width 1.8^{mm}.

Vertex sloping, with a weak depression, margin subacute, nearly half longer on middle than against eye, the apex bluntly conical. Elytra compressed at apex, venation of the pattern of *nigridorsum* with the cross nerve carried forward or wanting, the claval nervures united and joined to

suture. Outer anteapical cell often divided, about four reflexed veinlets to the costa, broadened along the margin.

Color: Vertex and upper part of face pale, dirty greenish yellow washed with saffron, lower part of face rusty. Pronotum soiled greenish or yellowish brown, irrorate. Scutellum pale, a pair of spots on each lateral margin and a smaller pair on the disc. Elytra milky or greenish washed with saffron, the nervures reddish. A broad brownish or fuscous band crossing the posterior half of clavus and then sloping obliquely back to the costa. The nervures have a narrow saffron margin through this band and there are a few pale spots in the cells. The cross nervures on clavus broadly black, forming an oblique mark, an irregular area in the third apical cell, and the expanded costal nervures black.

Genitalia: Female segment with the posterior margin slightly rounded, a trifle produced in the middle. Male valve short, rounding, plates long, broad at base, concavely narrowing to the strap-like upturned apices, margins thickly clothed with fine hairs.

Habitat: Specimens are at hand from Plummer's Island, Maryland, District of Columbia (Heidemann), Greensburg, Pennsylvania (Wirtner), Castalia and Columbus, Ohio (Osborn), Michigan (Heid. coll.), Ames, Iowa (Osborn and Ball), Onaga, Kansas (Crevic), Texas (Osborn coll.), and it has been recorded from Long Island, New York, and Mississippi above. Specimens are also at hand from Mexico, Central America, and Brazil (Ball coll.).

The life history records are incomplete but indicate a single brood of adults appearing the last of July and through August. The food-plant and larvæ are unknown. The adults have been taken from weeds in damp woods.

This species is quite distinct in our northern fauna. The heavy costal nervures and oblique spots on clavus will separate it at once from any Jassid known. Its known distribution from New York to Kansas and down through Brazil indicates that it is able to adapt itself to widely varying conditions and it will, no doubt, be found throughout its entire range east of the plain regions, when more collecting is done. It was thought for a time that this was *Jassus jucundus* of Uhler, and was so listed. Later the real *jucunda* was found and this species described as *cincta*.

EUTETTIX (MESAMIA) FENESTRATA Ball.

Eutettix fenestrata Ball, Can. Ent., XXXIV, p. 12, 1902.

Structure of *johnsoni*, nearly, resembling *jucunda*, larger and more definitely marked. Pale, with brown markings and numerous milk white spots on elytra. Length ♀ 6^{mm.}, width 1.5^{mm.}.

Vertex short and flat, margins almost parallel, front narrow, a little expanded above, meeting vertex in an acute but rather thick margin. Elytra long and narrow, folded at the apex, venation similar to *jucunda* but lacking cross nervures along claval suture and with the second cross nervure faint or wanting. Claval nervures tied together and outer one to suture. Central anteapical cell very long, constricted, and with about three cross nervures, anterior end very much enlarged.

Color: Vertex pale yellow, a pair of crescentiform spots at the apex, a pair of dots on the margin against the ocelli, a dash against either eye in front, and a pair of spots on either side the disc, posteriorly brown or black. Pronotum pale, irrorate with brown posteriorly, irregularly spotted with black anteriorly. Scutellum as in *straminea*. Elytra milky white with a narrow dark brown band at base, a broader one between the cross nervures and a narrow smoky one at apex. Nervures dark in sharp contrast with the white bands.

Genitalia: Female segment with the posterior margin truncate next the lateral angles, the middle half obtusely angularly produced, the apex of which is again produced into a triangular tooth.

Habitat: Sierra Madre Mts., Chihuahua, Mexico (Townsend).

EUTETTIX (MESAMIA) JOHNSONI Van Duzee.

(Pl. III, Fig. 8.)

Eutettix johnsoni Van Duzee, Can. Ent., XXVI, p. 137, 1894 (Desc.

Pa.); Catalogue, p. 296, 1894 (N. Y.); Osborn and Ball, Iowa Acad. Sci., IV, p. 232, 1897 (Iowa); Osborn, in Smith Cat. Ins. N. J., p. 95, 1900 (N. J.); Wirtner, Ann. Carn. Mus., III, p. 223, 1904 (Pa.); Osborn, in 20th Rept. St. Ent. N. Y., p. 531, 1905 (N. Y.).

General appearance of *vittolina*, nearly, much smaller, with a shorter vertex. Orange fulvous, maculate with white, six black points on the vertex margin. Length ♀ 5.2^{mm}, ♂ 4.8^{mm}; width 1.3^{mm}.

Vertex slightly sloping, with a definite depression, rather short, one-third longer on middle than against eye, meeting the face in a slightly acute angle. Elytra moderately long, slightly flaring, the claval nervures often tied together and the outer to suture. No supernumerary veinlets on corium, and the second cross nervure often obscure or wanting, anteapical cells short, the middle one constricted, apical cells large, the fourth one unusually so.

Color: Orange fulvous; vertex margin with an interrupted line beneath and six dashes above, black: posterior margin of vertex, three stripes on the pronotum and numerous oval spots on the elytra, milky white.

Genitalia: Female segment suddenly narrowing at about half its length, then rounding slightly to the posterior margin, posterior margin roundly emarginate, slightly notched in the middle, the margins of the notch bear-

Jassus twiningi Uhler, Bull. U. S. Geol. and Geog. Surv., IV, p. 511, 1878 (Desc. N. D.). (Not *twiningi* of later authors.)

Paramesus furcalus Osborn, Can. Ent., XXXII, p. 285, 1900 (Desc. Maine).

Rich fulvous, with an oblique testaceous stripe on the elytra. Vertex long and acutely angled in front. Length ♀ 6.5^{mm.}, ♂ 5.5^{mm.}; width 2^{mm.}.

Vertex almost as long as pronotum, roundly angled at apex, the disc slightly depressed, almost flat, margin acute, a trifle produced. Elytra long, but little flaring, venation obscure, second cross nervure present, outer apical cell often divided, a number of veinlets to the costa.

Color: Vertex, face and all below, lemon yellow, a narrow black line under vertex in dark specimens. Pronotum testaceous, the anterior margin pale yellow, scutellum pale yellow, the basal angles clouded with testaceous, elytra pale golden, subhyaline, an oblique band at base and another parallel with it from the middle of costa to apex of clavus, testaceous; tips of costal veinlets black. Whole surface of elytra sprinkled with white spots, especially conspicuous on clavus and in the bases of apical cells.

Genitalia: Female segment rather long, posterior margin shallowly emarginate, with a narrow strap-like tooth arising from the middle. This tooth is half longer than its basal width and often expanded, bi-lobed at the apex. Male valve triangular and nearly as long as the ultimate segment, plates roundly narrowing to just before the acutely pointed and slightly produced apices, margins clothed with weak hairs.

Habitat: Specimens have been examined from Maine (Osborn coll.); New Hampshire (Slosson); Massachusetts (Uhler coll.); Sault Ste. Marie, Canada (Osborn coll.); Agassiz, B. C. (Osborn coll.); Wellington, B. C. (Taylor); District of Columbia (Heide-mann); Iowa, Nebraska and Colorado (Ball); Utah (Van Duzee); Washington (Osborn coll.), and it has been reported from New York, Pennsylvania, New Jersey, Michigan, South Dakota and North Dakota above. It is apparently a northern species extending clear across the continent in Canada and the northern United States, and reaching its southern limit in Pennsylvania, Iowa and Colorado. In Colorado it was only found on the plains in the northern part, while it extended to the southern border in the mountains.

Larvæ: (Not preserved). They were rich creamy yellow with rusty brown mottlings scattered on the dorsum, and were covered with a whitish bloom. The vertex was very similar to that in the adult.

There is apparently a single brood, the adults appearing in late

June and early July and continuing through two months. It feeds on wild rose, the larvæ curling the leaves.

The long vertex and fulvous yellow color alone will separate this from any other species in the group. Fitch also mentions the long elytra and dark spots on the costa near the apex. The northern forms are a trifle narrower and darker as a rule, and from these Dr. Uhler described *twiningi* and Prof. Osborn *furcatus*. Dr. Uhler evidently recognized this identity, as Prof. Heidemann informs me that there is a female in the Uhler collection in the National Museum, from Turtle Mountain, labeled "*Paramesus vitellinus* Fitch, *twiningi* Uhler." This is evidently a type of *twiningi*, as it was described from females from Turtle Mountain and Pembina. Gillette and Baker united the species and referred to the type of *twiningi* as a faded male. There is a male in the Uhler collection, from Turtle Mountain, labeled "*Jassus twiningi*," but this cannot be the type, as the description says "only females have been examined." This male was probably one of those species referred to by Uhler as "too much altered to admit of description." As stated under *nigridorsum*, later writers have considered that species as the *twiningi* of Uhler.

EUTETTIX (MESAMIA) PALLIOLATA Ball.

(Pl. III, Fig. 9.)

Eutettix palliolata Ball, Can. Ent., XXXIV, p. 13, 1902 (Desc. Texas).

Form and structure of *vitellina*, a trifle smaller. Creamy yellow, with the pronotum, scutellum, and a narrow stripe along the sutural margins of elytra, rich brown. Length ♀ 6^{mm}, ♂ 5^{mm}; width 1.9^{mm}.

Vertex and face as in *vitellina*, the former a trifle more depressed on the disc. Elytra scarcely inclined to be flaring, venation very obscure, similar to *vitellina*, the second cross nervure usually wanting, about four supernumerary veinlets to costa.

Color: Vertex pale lemon yellow, pronotum pale greenish white, with four obscurely defined brown stripes, the outer one with a definite outer border next to a narrow, creamy, lateral margin. Scutellum washed with brown, the apical triangle inclined to be yellow. Elytra with the scutellar and sutural margins narrowly bordered with brown. This stripe enclosing five or six small white spots on its outer margin, the rest of clavus creamy white, continuing the stripes on the margin of pronotum. Corium subhyaline white, nervures indistinct. Below, pale lemon yellow.

Genitalia: Female segment twice the length of the preceding, truncate posteriorly, with the median fourth produced into a blunt tooth, slightly notched at the apex. Male valve obtusely angulate, the apex rounding, plates long and narrow, margins rounding at base, concave towards the blunt upturned apices.

Habitat: The original material from the United States National Museum was simply labeled "Tex." Several specimens, probably from the same original lot, have been examined since, and one male received from College Station, Texas (Sanderson).

In structure this species is closely allied to *vitellina*, while in color pattern it is quite distinct. This is evidently an extreme southern form, while *vitellina* is the most northern one in the genus.

SPECIES NOT INCLUDED.

Eutettix exilis Gillette and Baker, Hemip. Colo., p. 100, 1895.

This species belongs to the genus *Athysanus*.

Eutettix terebrans Gillette and Baker, Hemip. Colo., p. 102, 1895.

Baker has since referred this to the genus *Athysanella*.

Eutettix vanduzeei Gillette and Baker, Hemip. Colo., p. 102, 1895.

This = *Jassus laetus* Uhler and belongs to *Cicadula*.

Athysanus irrorellus Stal., Freg. Eug. Resa. Ins., p. 295, 1859.

It has been impossible to recognize this species from the brief description. It is doubtless a *Phlepsius* or a *Eutettix*.

PHYLOGENY.

The genus *Eutettix* is apparently an offshoot from the same line of development that produced the genus *Phlepsius*. The close structural resemblance to the latter genus of the *strobi* group, together with the presence of the pigment lines, would indicate a common origin and if it were not for the presence of some rather generalized species, indicating other relationships, it might be considered as a recent outgrowth from that parent stock.

In the breaking up of the ramose pigment character two lines of development seem to have been followed. To one group in which the pigment lines were lost in certain areas and remained unchanged (at first) in others, the subgenus *Eutettix* has been restricted. In the second line of differentiation the ramose pigment lines were reduced in number and increased in size, and these pigment lines were apparently often followed by tracheæ,

forming true nervures from which the second cross nervure and other cross veinlets have arisen. This line apparently soon split on head characters and formed the subgenera *Aligia* and *Mesamia*.

The subgenus *Eutettix* seems to be made up of three quite distinct branches. The *strobi* group, in which the ramose lines were first confined to restricted areas, then gradually changed to definitely margined color patterns and finally in the highest forms became nearly solid colors. The *lurida* group, in which the pigment lines were apparently first replaced by diffuse color areas and then these varied in different ways. This group is still very plastic and apparently quite recent. Its relationship to the *strobi* group is evident but quite puzzling. In the case of the pigment lines it agrees with the *clarivida* group and it may have been an early offshoot from that source. The *clarivida* group, in which the pigment lines have been transformed into round black punctures or entirely lost. It would also be possible to look upon this as a group set off before pigment lines were developed, but in that case it would be necessary to consider *Eutettix* as the older genus and *Phlepsius* as the offshoot. The close resemblance in larval characters to the *strobi* group, and the fact that this group is confined to the arid region where pigment reduction is general, make it very certain that the former has been the line of evolution.

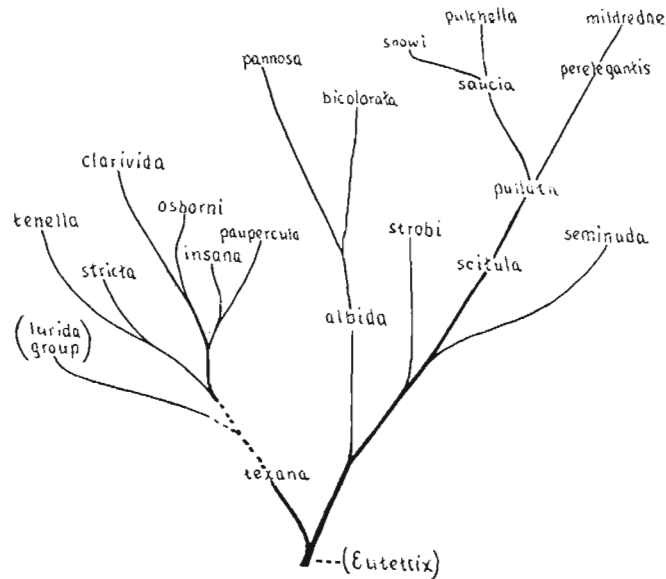
THE STROBI GROUP.

Starting from a hypothetical ancestry with pigmentation in the form of ramose lines, this group has developed along the line of reduction in the pigmented area and concentration into definite color patterns. In this *lexana* represents the first known step in this direction, but probably not in the direct line of the group. The tendency in this form is toward total reduction, which points very strongly towards it as the ancestral line of the *clarivida* group.

From an indefinite reduction in elytral pigmentation probably slightly emphasized at the base, two divergent lines soon sprang up: one in which the reduction was on a very definite slightly oblique basal area and an irregular subapical one; the other, in which the reduction was emphasized along the costa. In this, *albida* presents an intermediate type, probably the beginning of the second line of development. In *pannosa* this line has become

fixed and quite highly specialized in both structure and color, while in *bicolorata* a wide departure is again made in that the pigment has disappeared from all but the apical third of the elytra. This might easily arise from an extreme reduction in either a *pan-nosa* or *pullata* pattern, but the marking on the remainder of the body strongly suggests the former species.

In the first group a definite pattern as represented by *strobi* and *scitula* was apparently soon established, *strobi*, however, diverging from the direct line through a change in ground color from brown to red. *Seminuda* apparently arose from this same stem at about



the same time, but diverged in the further reduction of the color areas and in an increase in the density of the pigment. *Strobi* and *seminuda* are apparently extreme forms in different lines, while the further development of the group came through the more generalized *scitula* branch. Of this branch *pullata* still retains the generalized pattern and some of the pigment lines. The ground color has, however, changed from lemon to orange and the pattern is darker and more definitely margined. A still farther darkening of the margins and an olive cast to the center of the pattern gave *peregantis*, while still further reduction in pig-

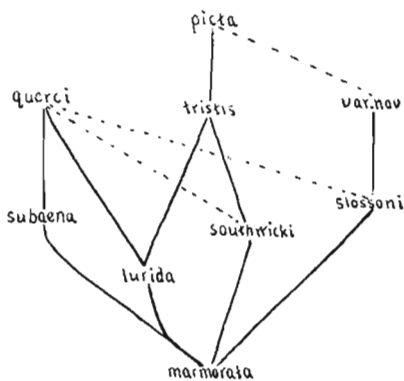
mentation on the body region gave *mildredae*. In *saucia* the pigment lines of *pullata* have coalesced into a finely irrorate condition on a brown pattern. This has been further modified in two different ways: deepening into a rich brown and extending onto the vertex in *pulchella*, or fading into a brownish olive in *snowi*.

THE CLARIVIDA GROUP.

This group contains three quite distinct elements. In one line the pigment lines entirely disappeared, leaving a golden yellow ground color in *stricta*, and even that has been lost in *tenella*. In the other line round dots have in part replaced the ramose lines; these again diverged, *insana* and *paupercula* retaining the dots over nearly the entire surface, while *osborni* and *clarivida* have lost most of them, *osborni* retaining a few on the elytra and *clarivida* only four, which have become greatly emphasized on the vertex margin.

THE LURIDA GROUP.

This group of varieties apparently arose from a *marmorata*-like form in which pigment lines had broken down into brown mottling omitting a more or less definite spot on the elytral suture. An increase in the size of the mottlings until they coalesced into a uniform reddish brown shade gave *southwicki*, a slightly farther darkening of the elytra and a segregation of the pigment on vertex and pronotum into transverse bands gave *tristis*, while a farther increase in the darkening and segregation formed *picta*, a black and yellow extreme. Through another line of variation from *marmorata* we get *lurida*, in which the brown pigment has spread out and taken a reddish cast on the elytra and disappeared from the rest of the dorsum. From these forms, with a little reduction on both areas, a golden green *querci* form results. Through a change in the ground color to a bright yellow, together with a reduction of pigment on the elytra

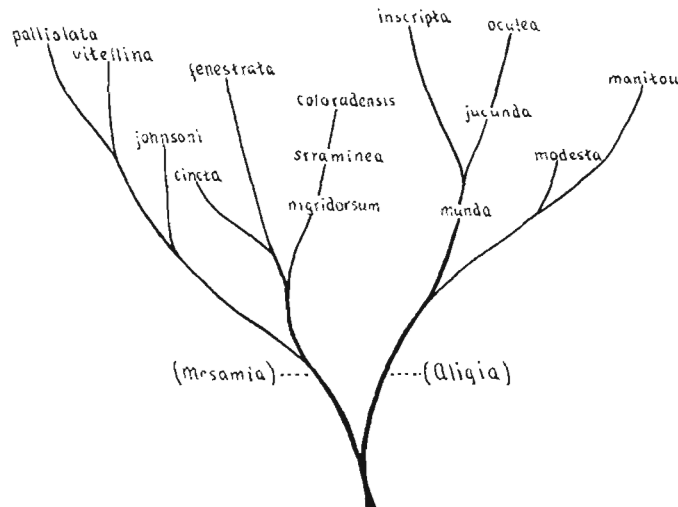


and a concentration of it into bands on the vertex and pronotum, *slossoni* is formed. If the elytral color is also segregated and deepened into black blotches in the cells, then an unnamed variety appears, and coalescence of these blotches is all that is required to form a *picta* again.

As *querci* is only the result of reduction of brown pigment to a minimum it would be possible for it to arise from either *southwicki*, *subaenea* or *slossoni*. In the same way the concentration of the pigment into bands on the vertex and pronotum of *lurida* would give a *tristis*. Thus it would be possible for forms apparently alike to have arisen through different lines of variation and in the material at hand this has apparently occurred.

SUBGENERA ALIGIA AND MESAMIA.

As mentioned above, these groups apparently sprang from a ramose pigmented form by reduction and concentration of the pigment lines. These lines apparently broke up and disappeared



first along transverse bands, the two principal ones falling into the regions of the two transverse nervures between the sectors, while between these bands the amount of pigment was considerably increased. While this was going on there was a separation into two groups on head characters; one group, which is here recognized as the subgenus *Aligia*, retained the short depressed head

and much of the original pigmentation, while the other branch developed a longer and flatter head with an acute margin to the vertex and carried the change from the pigment lines to definite nervures to the extreme. This latter group is here recognized as the subgenus *Mesamia*.

SUBGENUS ALIGIA.

The ancestral forms in this group have apparently been lost, as the known forms are already pretty clearly divided into two groups on the color and arrangement of the pigment. In one line the pigment is dark brown and still more or less ramose in character, while in the other it has changed to a tawny red and become diffuse in character on the bands. In the first group, which is apparently the older, *munda* represents the most generalized type; from this a reduction in the amount of pigment, especially on the median band, and a slight change in form gave *jucunda*, while still further reduction in pigment and size, together with a reddish cast, gave *oculea*. By another line of development from *munda* the pigment was again reduced and the head prolonged to form *inscripta*.

In the other line *modesta* has not materially changed in structure from the *munda* type, although the tendency to diffusion in the pigment areas is already well-marked, as is the tawny color. In *manitou* the ramose lines have almost all disappeared and in the male the tawny color has been concentrated into a uniform golden yellow.

SUBGENUS MESAMIA.

Like the preceding subgenus this group apparently first divided on color and arrangement of pigment, one group changing but little from the original brown at first and then darkening up, while the other changed to a diffuse fulvous red. In both groups the ground color has a tendency to appear in milky white spots in sharp contrast.

The group with the dark markings divided on the amount of reticulations on the elytra and on head characters, the first group starting with a definite saddle and only a few coarse reticulations in *nigradorsum*. From this pattern, by the loss of the saddle, *straminea* was formed, and by further reduction in pigment, *colora-*

densis, these three species forming a very closely related group. The other branch of this same stem contains quite similar forms, both, however, possessing considerable pigment in solid bands and therefore little in the form of transverse veins. This has resulted in a reduction in the second cross nervure, so that it is weak in *fenestrata* and often wanting in *cincla*. On account of not possessing the cross nervure the relationship of *cincla* to this group was not at first recognized. One of the first results, however, of the concentration of the ramosc lines is the formation of a number of transverse veinlets to the costa, and in the more specialized forms these become oblique. In *cincla* these veinlets are highly developed and it therefore appears to be an offshoot from this group with the second cross nervure moved forward or replaced by a doubling or even trebling of the first one.

The group, with the fulvous coloration again separated on head characters *johnsoni*, still retaining the short head and marginal spots of the ancestral group, while the others have developed a longer and flatter vertex, without markings. In the development of the long vertex *vitellina* is quite specialized, while in the saddle on the elytra it still shows its origin. *Palliolata*, on the other hand, has not gone as far in head development, but in the reduction and concentration of elytral pigment to a narrow strip on the inner margin it has departed widely from the general trend.

GENERAL CONSIDERATIONS.

The generalized color pattern everywhere, both in adults and larvæ, is the oblique band or saddle. This is retained throughout the entire *strobi* group, appears at least in the lower forms of every other group except the *clarivida* branch, and even here it appears in some of the larvæ. The origin of every color pattern from the "saddle" precludes the idea of having a true stripe appear. In *pannosa* and *palliolata* the markings strikingly resemble stripes, but the ramosc character and included light spots show that these patterns are very different in origin from true stripes.

As a group the head is very short, far shorter, no doubt, than it was in the primitive Jassid stem from which our genera have sprung. This would be shown in a comparison with some of the less specialized genera, as is easily seen in comparing the larvæ

with their adult forms. That the head is very variable is shown by the fact that forms with long vertexes have arisen independently in each of the groups. *Pannosa* in the *strobi* group is possibly questionable, but *paupercula*, *vitellina*, *coloradensis* and *inscripta* show unquestionable relationship and derivation from shorter-headed forms in their respective groups and lend strong support to the placing of *pannosa*.

The change from the ancestral ramose brown pigment to a diffuse fulvous red is another variation that has appeared independently in all groups except the *clarivida* one, in which both have been lost. In the *jucunda*, *nigridorsum* and *lurida* groups it appeared early and marked one line of development. In the *strobi* group it appeared early in *seminuda* and later in a different line, in *pulchella*.

Such an apparently trifling character as a dark line under the vertex margin appears in all three branches of the subgenus *Mesamia*.

GEOGRAPHICAL DISTRIBUTION AND ADAPTATION.

Both *Eutettix* and *Phlepsius* are widely distributed, the former being nearly world-wide in distribution, while the latter is known from both North and South America and forms have recently been referred to this genus from the Philippines (Kirkaldy), Ceylon, and East Africa (Melichar). Both genera have, however, reached their highest development in the Nearctic region, and species formation is apparently still in progress here.

In the present state of our knowledge of the distribution of our Jassid fauna, little more can be done than to point out general lines of dissemination. Distribution along the northern limits of this group is fairly well known, but from the southern part, to which we must look for the centers of dispersal, our material is as yet very meager and only from isolated localities. Some peculiar facts are, however, brought out in the study of even this imperfectly known distribution of our species. *Cincta*, with a distribution from New York to Kansas and south to Brazil, does not seem to have given rise to a single form in our fauna, while farther south its relatives are apparently the predominant group in the genus. The *lurida* group, with its varieties, is the next most widely distributed, ranging from Massachusetts and Michigan to

California and south to southern Mexico. Although prolific in varieties, none of the other species can be traced back to this group. In fact, with the possible exception of *nigridorsum* not one of these eastern species has given rise to any other form. Instead, the great development of the entire group has been in the southwest, and here the species have apparently become fixed and distinct and exhibit little variation. This is especially noticeable when the condition of the *lurida* group in the two regions is compared. In the East, and especially along the Atlantic coast, every known variety occurs with every gradation of the series. On passing westward, however, the number of varieties grows less until, in the Rocky Mountain region, from Colorado to California, only three forms have been found, *marmorata*, *subacnea* and *querci*, all representing one line of development, and for the latter two, at least, apparently fixed forms showing little tendency to vary. In fact, if *querci* and *subacnea* occurred in this region alone, they would be regarded as distinct specific types, but when considered in connection with their eastern extension it is impossible to do so. In the genus *Clastoptera* of the Cercopidæ the same conditions exist. In the northeastern United States the two species are widely and indefinitely variable while the same species in Colorado have only a few varieties and these very constant.

The reason for this variation can only be conjectured. It seems possible that the explanation may lie in the fact that under arid conditions the range of a particular food plant is often broken and isolated and that in this way the varieties have been separated until they became fixed. In the light of recent work on variation in insects, and especially Tower's exhaustive work on *Lep- tinotarsa*, it seems probable that much of this indefinite color variation in the eastern region is due to the varying humidity. In support of this is the fact that the black varieties of the *lurida* group have been found only in the humid regions, and in the greatest abundance along the Coast regions in Maryland and Florida, while the pale *querci* is the most abundant form on the dry mountain slopes in the Rockies. This same general distribution also holds in the *Clastoptera*. The black forms are most abundant from Maryland to New Hampshire and again around Lake Erie, while the pale and intermediate forms are the common ones in Colorado, and no black ones have been found there.

The geographical distribution of color in the entire group is in general harmony with Tower's conclusions, the darker and more solid colors being with one or two exceptions found in humid regions while the paler and more broken patterns are in the arid Southwest. Two apparent exceptions to this are easily explained. *Strobi* ranges from Massachusetts to Utah without changing color, but in the arid regions its distribution is limited to the moist conditions in which its food plant can grow, while *vitellina*, another eastern and northern species which has been taken in Colorado and Utah, occurs only in the mountains except in the northern part.

That changes in temperature and humidity have been important factors in modifying these color patterns is undoubtedly true, but that the subsequent fixation or further modification of these intricate patterns could have been brought about in this way is, in the light of our present knowledge, very doubtful.

Tower's experiments were made on a group already highly specialized along the line of "warning colors," and any tendency to vary along the line of adaptation to environment would have been eliminated in the fixing of the warning pattern. That any number of different patterns might be equally effective as far as warning is concerned is also probable, hence this was an ideal group on which to show the full effect of temperature and moisture. That the new patterns resulting failed to survive would not necessarily show a lack of value in the pattern, but rather a lack of education on the part of predatory animals.

In the present group, however, the development has been along entirely different lines. Every form of which we know the life-history shows in both larva and adult a remarkable adaptation to its food plant, and in many cases to some particular part of the plant or to some change in the plant brought about by the insect itself. Thus the larvæ of *strobi*, *scitula*, *nigridorsum* and *straminea* have become wonderfully adapted to the discolorations which their punctures make on their respective food plants, and as these discolorations are of the same color in both humid and arid climates the insects are constant in color throughout their range. On the other hand, *scitula* or some closely related form has, in the western region, given rise to a group of distinct but closely related species that have taken up other food plants, and in doing

so have been modified in both color and pattern to conform to some part of their host. In doing this the general change has been toward a decrease in pigment, apparently more for the reason that the general trend of the arid flora is toward decreased pigment and that was the line of selection necessary to adaptation, than because of any direct effect of the arid climate on the insects themselves. If the change was due to the climate it would affect all alike. Instead, we find *strobi* at the base of the series unchanged, and *pulchella* at the top of one line with a still deeper pigment than its ancestors in direct adaptation to its food plant. The remaining forms, although under the full effect of the arid climate, have either remained practically unchanged or else grown paler, but each one along the line that has adapted it to a particular environment, as in the case of the yellow and pale green of *mildreda* to the Juniper.

The reduction in pigment in the *clarivida* group has been extreme, but not more than was necessary to adapt them to the white or greenish white plants of the desert region, and each form has been modified along the same line as that of its food plant.

An interesting and convincing case of adaptation is shown in *bicolorata*. Here the saddle of the *strobi* group has entirely disappeared, while the rest of the markings have been intensified. This insect feeds exclusively upon the *Ephedra*, a bushy plant whose stems superficially resemble the scouring rush. The insect's body is about the size of a stem, and the pale creamy elytra, with the apical reticulations, so closely resembles a frayed sheath such as encircles the nodes that the deception is often complete.

Another apparently clear case of adaptation is that of *oculea*. Its nearest relatives, *munda* and *jucunda*, are oak-feeding forms, widely distributed in the Southwest. In southwestern Colorado a sarvice berry occurs with the oaks, and here *oculea* is found, slightly smaller and paler than *jucunda*, with bright red eyes and other reddish shading enough to admirably adapt it to the red twigs of its new host.

If the *lurida* group is to be looked upon as in the process of species-forming, then the criteria used by either Tower or Adams would point to the Atlantic coast region as the point of origin, for in this region occurs the greatest variation, the largest number of individuals, and probably the least dependence on a re-

stricted habitat. The occurrence of varieties distributed clear across the continent in the northern range of the species would, however, point to a much older and more southern origin, or else to a wide distribution of the species before the southern migration.

The greatest number and most closely related species of the *strobi* group are found in the Southwest, and that would point to that region as the center of dispersal for this group; but these species are evidently derivatives of more generalized types found generally distributed in the humid region. In the same way *nigridorsum* ranges from the Atlantic coast west to Utah at least and south to southern Mexico, while *straminea* and *coloradensis*, its nearest relatives, are restricted to the Southwest.

From the above facts it would seem that this group arose under humid conditions and that all of the main divisions were set off while still under those conditions; that representatives of each of these groups migrated into the arid regions of the Southwest and there gave origin to the dominant Jassid types of that region, twenty-nine out of the thirty-four forms here listed being found there.

As to the location of the original center of distribution of these humid forms our present knowledge gives no clue. It is possible that all these forms were set off before the southern migration of life and that their present distribution is a secondary one.

LIFE HISTORIES AND FOOD PLANTS.

(See Life History Chart.)

In order to work out the life history of a species with any certainty it is necessary to have a given locality under observation throughout an entire season, or else a series of observations on different localities running through several years. Of the two, the former is to be preferred, but a combination is still better than either one alone. The finding of the larvæ and watching their transformations is really the only satisfactory method of determining the number of broods. Next to this in value is the occurrence of the adults in numbers, especially the males, as the males rarely live as long as the females and their preponderance always marks the beginning of a brood of adults.

For the determination of the food plant, the finding of the

larvæ is also the best criterion. Single captures of adults are of little value and often misleading, as they usually prove to be accidental. Repeated captures of adults on a particular plant or the finding of a large number at one time have been accepted in some cases, but even here there is danger of error, as would have resulted from referring *scitula* to cottonwood, where the adults are found.

While working on the life history of the Orthoptera of Colorado, from 1898 to 1902, many observations were made on the species of leaf-hoppers occurring there. This work was continued in Utah and during the seasons of 1905-6 a special study was made of *E. tenella* in connection with its injury to beets. To assist in working out this problem all species of the genus found coloring or distorting leaves were carefully observed. During the season of 1906 this work was carried on in coöperation with the Bureau of Entomology of the Department of Agriculture, and the facts discovered are included here through the kindness of Dr. Howard.

Eutettix tenella.—The adults of this species were found in small numbers on the weeds in waste places early in May before the sugar beets were up. In early June they appeared on the beets in small numbers, gradually increasing for several weeks. Egg-laying began late in June and continued into August, the great majority of the eggs being deposited in the ten days preceding the middle of July. The larvæ appeared in small numbers by July 10th and continued through August; the great majority of them, however, appeared the last ten days of July and changed to adults some twenty days later. The eggs are elongate, slightly curved, tapering at one end, and are thrust into the beet stems in a slightly downward direction. At first they are scarcely visible, but as the stem grows the slits open and they are pushed out until at hatching time they are often over half free.

Twelve females were enclosed in a cage over a moderate-sized beet and from this beet, thirteen days later, two leaf stems were removed. These stems contained one hundred and sixty-one eggs and this did not represent more than one-sixth of the beet top, indicating that at least eighty eggs, and probably more, are laid by one female. From the records of this and other cage experi-

ments the egg stage under cage conditions appeared to be from thirteen to fifteen days, and the larvæ developed in from sixteen to twenty-two days more, making the total time from egg to adult from twenty-nine to thirty-seven days, under cage conditions.

In dissecting females during the egg-laying period only from four to nine fully developed eggs could be found at one time, indicating that the eggs are developed as laying proceeds and that probably each female deposits eggs through a period of several weeks.

This species is apparently single-brooded and, like most single-brooded species, that brood extends through a long period of time, some of the earlier larvæ often maturing before the later eggs are laid.

This long egg-laying period in single-brooded species has often deceived observers unacquainted with the habit and led them to the conclusion that there were a succession of broods, and for this reason some of the observations necessary to determine these facts are given. The discovery of adults soon after the vegetation had started in the spring, indicated that they had hibernated in that condition, as it was too early for them to have developed. The presence of fairly equal numbers of females and males would of itself indicate that eggs had not been laid and the female showed no signs of eggs. When examined on the beets, June 23d, there were more females than males and the females all had large eggs in the abdomens. There had not been either time or favorable weather sufficient for a brood to have developed before this, so this was near the beginning of egg-laying for the brood of larvæ appearing in July. Just as soon as adults began to appear again a number of fresh males and females, together with a number of large larvæ, were caged and kept until frost, but no eggs were deposited. On September 12th, no eggs having been laid in the cages or in the field, and the dissection of a number of females showing that none had developed as yet, a number of insects were swept from the field and placed in a cage and kept until the beets were harvested. No eggs were found in any of the cages and the insects were still alive, indicating that they hibernate without laying eggs.

The original food plant of this species is still in doubt. In the spring it occurred on *Sarcobatus*, *Dondia*, several species of *Atri-*

plex, russian thistle, and rarely on most species of these two families of plants occurring in the waste places. Later in the season most of these insects had migrated to the beets; in one place, however, they were found in some numbers on greasewood (*Sarcobatus*) during egg-laying time, which would indicate that plant as its original host, and its known distribution also agrees well with that of the greasewood.

Eutettix strobi—The larvæ of this species were found on *Chenopodium album* early in June and continued to appear until the latter part of the month. The first males appeared by the twentieth, the females several days later, the greatest number of adults appearing the latter part of June and the first week of July, while by the middle of July the last larvæ had transformed. A number of adults were placed in a cage for the purpose of getting eggs, but no eggs were found and the adults soon died. The field on which these observations were made was pastured soon after and the pig-weed was destroyed.

Three years' records in Colorado previous to this gave about the same dates for the first brood and for one season second brood larvæ were found, appearing the first of August and running on nearly through the month. Adults have been taken most commonly in September, males having been taken as late as September in Colorado and Texas and to October 24th in Iowa and Pennsylvania. A male from College Station, Texas, is labeled March 24th, indicating adult hibernation or a much earlier season there. Osborn ('87) records the last of the first brood for Iowa on July 25th.

This species seems to be confined very strictly to lamb's quarter in the larval stage at least, but where this plant occurs alongside of beet fields some larvæ are often found on the beets. The first record of the peculiar reddening of the leaves by this insect was by Osborn ('87). Since then it has been noted a number of times. It is quite characteristic and will be considered further under economic discussion.

LIFE HISTORY CHART OF THE SPECIES.

(See Chart on opposite page.)

The heavy line (—) shows observed occurrence of adults. The light line (—) above shows observed occurrence of larvæ of the same species. The arrow heads (<>) show beginning or end of a brood. The dotted lines (....) show known extensions but not observed.

Eutettix scitula.—Full-grown larvæ of this species were found, just before the middle of June, two different seasons in Colorado. With them were found adult males and a few females. From these and other records it appears that the larvæ hatch out late in May and may be found nearly through June. The adults appear by June 10th and continue through July. Adults have been collected sparingly in August and quite commonly in September, while a few have been taken into October, indicating that there is another brood of larvæ in August, but none has been found.

The larvæ have been taken in a number of places and always from *Chenopodium*, while the adults are almost always taken from cottonwood trees. The larvæ produce a small amount of reddening and curling of the *Chenopodium* leaves, but not as much as in the case of *strobi*. The powdery, pinkish color of the larvæ matches the under surface of the affected leaves so well that there is little question that their color is an adaptation to that situation. The adults are, however, rarely found on the pigweed except when freshly transformed; instead, they are found only on the cottonwood (*Populus monilifera* and *angustifolia*). This suggests that possibly the color of the pattern in the adults is an adaptation to the light bark of those trees and that the eggs are laid in the twigs. This may also explain the tree-inhabiting records of *strobi* and *seminuda*, and the failure to get eggs in the *strobi* cages. With this idea in mind all *strobi* and *scitula* records were examined and it was found that all records of larvæ being found in numbers were from locations within a few rods, at most, of trees, the *scitula* larvæ in every case being found near cottonwoods while the two worst cases of *strobi* infestation were close to rows of apple trees.

Eutettix seminuda.—A full-grown larva from District of Columbia (Heidemann), May 20th, and another taken in Iowa (Ball) October 1st, are the only larval records for this species. The adults have been taken most freely about the middle of June and again in early September, with extremes a month on each side of either date. These indicate two broods as in *strobi* and *scitula*, and from the close relationship it seems likely that the larvæ will be found to feed upon a *Chenopodium*. Wirtner ('04) gives similar dates for adults in Pennsylvania.

Eutettix insana.—Adults and larvæ were found together in abundance at Pueblo, Colorado, June 15th, and again September 15th. Collections made the latter half of July and early in August gave adults in small numbers. These dates are too far apart for a normal brood and it seems probable that they represent the beginning of the first brood and near the close of the second, but it was not possible to follow up the investigation and determine this.

This species, *clarivida* and *albida* are all very strictly confined to three or four species of the salt bushes, and all occur in the arid district where these plants abound. *Insana* and *albida* occur most abundantly on the "shad-scale" (*Atriplex confertifolia*) while *clarivida* is most widely distributed on a large spreading species (*A. canescens*), although it is often abundant on the "shad-scale." All three species occur on a smaller, yellow, and rather tomentose species that grows with the others. From these *clarivida* occasionally spreads to the russian thistle and sugar-beet.

Eutettix bicolorata is the only other species of this subgenus on which definite life history observations have been made. It seems to be strictly confined, both larvæ and adult, to the joint fir (*Ephedra trifurca*). Observations have been made only late in the season: on August 7th, at Richfield, Utah, larvæ and adults were found, the larvæ most abundant and most of the adults fresh and soft. Later in the month only adults were found.

Eutettix (Mesamia) nigradorsum.—Larvæ and adults of this species were first found making black spots on the leaves of *Helianthus* at Ames, Iowa, on July 1st, 1895. During the five years' work in Colorado numerous observations were made and a second brood established. Larvæ of this species were found early in June, 1906, on sunflower at Logan, Utah, and the locality was under observation throughout the rest of the season. The first brood of larvæ appeared late in May and the last of them transformed to adults late in June or early July. The first adults appear before June 10th and the majority of them are out before the 20th. The second brood of larvæ appeared the last week in July and continued through August. The adults began appearing a little before the middle of August, the greater number appearing about the 20th.

Both larvæ and adults appear to be very strictly confined to a few species of the genus *Helianthus*, the black spots and curling of the leaves caused by their punctures affording an admirable protection. In central Iowa it occurred more commonly on the tall long-leaved species (*H. grosseserratus*) while in northwestern Iowa, Colorado and Utah it is more commonly found on the wild sunflower (*H. annuus*). Specimens from the *H. grosseserratus* in Utah were uniformly darker than those from *H. annuus* and the effect on the leaves was most marked in the former species. Wirtner records this species in numbers June 4th, indicating an earlier appearance in Pennsylvania.

Eutettix (Mesamia) straminea.—This species was found with *nigridorsum* on the wild sunflower at Logan and its life history followed through with that species. The adults of the first brood appeared a few days later, and those of the second brood a few days earlier, than in the former species. This may have been accidental or may indicate a slightly shorter life cycle. The Colorado records indicate about the same dates as for *nigridorsum*.

This species occurs on *H. annuus* and also on a low clump-like perennial species (*H. pumilus*) that grows on the sides of the hills in Colorado, and on this form there is less discoloration than on the annual species. Both *nigridorsum* and *straminea* apparently prefer sunflowers growing in very hot dry situations, where they are often stunted and only a few inches to a foot or more in height.

Eutettix (Mesamia) coloradensis.—This species is apparently very strictly confined to one species of sage brush (*Artemisia dracunculoides*) to which its pale green and fuscous markings well adapt it. It has been observed for several years, and in one case, through an entire season on a single pasture at Fort Collins, Colorado, and its entire life history determined. The life history is very similar to that of the preceding species, the larval period being a little shorter, so that the second brood of adults begin to appear about the 5th of August.

Eutettix (Mesamia) johnsoni.—The only larval record of this species is a full-grown specimen from Fairfax, taken June 24th, 1889, by Prof. Osborn. Records of adults captured show females

taken from this time on through July, and about an equal number of males and females taken from the middle to the last of August, indicating another brood coming on at that time. These records would indicate that this larva was one of the last of the first brood, the greater number of adults having appeared before that time. Nothing is known of its food plant.

Eutettix (Mecania) vitellina.—The larvæ of this species have been found but once, and that was on July 27th, 1897, at Ames, Iowa, when full-grown larvæ in company with a number of adults, some still fresh, were found on the undersides of the leaves of wild roses on a grassy hillside. They were found on several different plants and always on the under side of the lower leaves, close to the ground. The leaves were more or less folded and distorted and seem to protect the insects beneath. Adult males were taken from this locality as early as June 21st and adults have been taken late in August, but only stragglers, and it seems doubtful whether there is more than one brood in a season.

Of the remaining species only very fragmentary records or simply dates of collecting specimens are at hand, and these can only be used with great caution. For the *lurida* group the record is not complete on a single variety. One female of var. *lurida* was taken in Iowa late in May, and a female of var. *marmorata* in Ohio at the same time. These two records strongly suggest adult hibernation. A large number of *marmorata* and *tristis* taken in Maryland late in October would also suggest it, while the remainder of the records on these varieties rather contradict it. *Subaenea* and *querci* have been studied in Colorado, where the former has only been taken after the middle of August, the males appearing first. *Querci* occurs in the southern portion, where little early collecting has been done. Males and females have been taken about equally in late August and September. A male taken June 18th might have been a late survivor of a hibernating brood or an early one of a summer brood.

Var. *querci* is strictly confined to the scrub-oaks in Colorado and Utah, from which both adults and larvæ have been taken. Var. *subaenea* was taken sparingly north of the oak districts, but no food plant was determined. Several specimens of *marmorata* from the Uhler collection were marked "Oak," and all of the

Colorado specimens were taken from the scrub-oaks. Of the other varieties nothing is known as to food plants.

For *cincta* records are at hand of females and males taken the last two days of July and into early August, with scattering ones later. A lot from Plummer's Island, Maryland (Heidemann), were taken August 12th, 15th and 23d, and scattering females in September. Wirtner records it in August and September from grass and weeds in open woods. The Iowa specimens were taken from weeds growing around rotten logs in a rather damp woods.

Of the subgenus *Aligia* the adults of *jucunda*, *munda* and *manitou* occur on the scrub-oaks in southern Colorado. Very little collecting has been done in these localities before July, so little is known of the early season. *jucunda* has been taken with both sexes common late in July and on into August, while scattering ones have been taken in October. In one collection, July 22d, only males were taken. *E. manitou* was found most abundant with the sexes about equal the first of August. *E. munda* has been taken but scatteringly, but all specimens were from oak. *Oculea* occurs at the same time as *jucunda* but seems to be strictly confined to the service berry (*Peraphyllum ramosissimum*) as a food plant. Where this plant and the scrub-oaks were in adjoining clumps, scattering specimens of *oculea* would be found on the oaks, but where there was no service berry near, only *jucunda* and *munda* could be taken. *Modesta* is apparently an oak-inhabiting species also; specimens from Maryland, from the Uhler collection, are labeled "Oak," and the Iowa types were swept from a patch of second-growth timber, largely oak. Records from Iowa and North Carolina are about the same as the Colorado ones for *jucunda*, but the Maryland and District of Columbia specimens were taken in October and one November 1st.

All specimens of *pullata* have been taken from pine trees growing in rather warm and sheltered situations, but no larvæ have been seen. *Perelegantis* and *mildredæ* have been taken from red cedar (*Sabina scopulorum*). *Perelegantis* has been found wherever the cedar grows at the lower elevations, and in warm situations higher up, while *mildredæ* has only been found in one sheltered spot in Colorado, and is probably more southern in distribution. *E. saucia* has only been taken in single specimens from widely separated but similar situations. In every case but one it has

been taken from thinly grass-covered transition areas between the sand and the sod. Few plants were common to all these localities, but among them was a small *Eriogonum* with reddish leaves, which would harmonize well with the color of the insects.

ECONOMIC RELATIONS.

It has only been within very recent years that this group of insects has been recognized as of any economic importance. Two or three of the species had occasionally been taken on sugar-beets, but only in small numbers, and no appreciable damage was recorded. Eight of the species are, however, known to feed on the wild relatives of the sugar-beet, and probably several more whose food plant are not known will be found to have similar habits. Most of these species occur in the arid region of the West, and with the rapid extension of the sugar-beet industry into that region it was not surprising that one of these species found in the sugar-beet fields a more favorable environment than on the desert, and that a rapid multiplication occurred.

In 1905 an immense number of *E. tenella* were found in the beet fields of Utah and the adjoining part of Colorado and Idaho. As a result of their attack the beet leaves soon began to curl up, the small veinlets thickened, and the whole under surface became rough and "warty." This condition was spoken of as "curly-leaf" or "blight," and at first was not attributed to the leaf hoppers. As this condition progressed the beets almost stopped growing and threw out a new and much more numerous set of fibrous roots, to which the dirt adhered when the beets were pulled.

The loss in Utah that season varied from nearly total in one section down to about ten per cent in another, with an average of over forty per cent for the state. The loss in tonnage, together with a further loss in sugar content and purity of the remainder of the crop, brought the total injury up to over \$500,000 in the one state.

In order to assist in determining whether the leaf hoppers were the cause of the "curly-leaf" condition a careful study was made of the effect of the attacks of other members of the group on their respective host plants and, in the case of *strobi*, on the sugar-beet itself. In the case of *strobi* and *scitula* the punctures of the larvæ

on the *Chenopodium* leaf first caused red spots to appear, and as these increased in number and size the leaf curled up and became distorted. The production of color is about the same whether on a large leaf or a small one, differing only in the two species, the work of *strobi* producing much the darker red. The distortion varies greatly, however, on small leaves, and especially on the young leaves of a starting plant the distortion is much greater than it is on the older ones. The distortion was also much greater on beets than it was on the wild plants in proportion to the size. One or two larvæ on small plants of either kind would often cause every leaf to curl up into a small closed knot and the plant would remain a stunted dwarf or wither and die. Most of the work of *strobi* on beets was near the margins of the fields, and in only one case were they numerous enough to do any real injury.

In the same way the attack of *nigridorsum* and *straminea* on the sunflowers produces a darkening and curling of the leaves which differs in amount according to the nature of the leaf attacked. The thin leaves of *H. grosseserratus* are often curled up into a roll by *nigridorsum*, while the stiff hairy leaves of *H. pumilus* are scarcely curled by *straminea* and less color is produced. On the true sunflower both species produce about the same amount of color and distortion, so that the difference in effect on the other two plants is apparently one of susceptibility of the plant.

In all of these cases the injury to the plant seemed to be in the nature of a gall formation, and like other galls, the specific nature of the process is still to be explained.

A careful watch was kept on the beet fields in 1906 for the first appearance of the "curly-leaf," and no sign of it was found until the larvæ of the leaf hoppers had appeared. The leaf hoppers appeared in very small numbers this year and but little "curly-leaf" developed. A number of the first plants affected were carefully examined and in almost every case the cast skins of the young larvæ could be found on the backs of the leaves while on the healthy plants they were very rare. In the case of *strobi* and *nigridorsum* but one or two larvæ would be found on a plant and on account of the protection of the color of the affected spot they remained almost stationary, while in *tenella* a number of larvæ would often be found on a plant and these were active and moving around. As a result the effect on the beet of the attack of

tenella was more general than that of *strobi*, the curly leaf appearing first on the medium-sized leaves and gradually working in to the smaller ones. The younger larvæ appeared to prefer the young leaves at the center, and it is possible that the altered condition develops with the leaves as the result of this early attack.

The leaf hoppers, as a group, are rather difficult to destroy, and this species was particularly so, kerosene emulsion at ordinary strength killing a very small number of them.

All of the species under consideration seem to thrive best in hot, dry situations, and to be able to produce the maximum effect on the plant under such conditions. The season of 1905, when so much damage was done, was an exceptionally favorable one in this respect, the early summer being excessively hot and dry.

Advantage has been taken of this fact to prevent their injuries. By keeping the ground damp, through frequent irrigations, until the beets are large enough to shade it and keep it cool, the injury has been prevented. Very early planting, in most sections, would accomplish the same results.

The leaf hoppers appeared on the beets at Grand Junction soon after they were introduced there and have apparently been fluctuating in numbers in that region ever since, as they have had much trouble with what they have called "blight" on their beets. In Sevier county, Utah, the insects have evidently been increasing in numbers for several years, as there was increasing loss each season from the curly-leaf. The winter preceding the season of 1905 was exceptionally favorable for the survival of most all injurious insects, and as a result the leaf hoppers, already increased in numbers, were so abundant that for the first time they were recognized as the cause of the trouble.

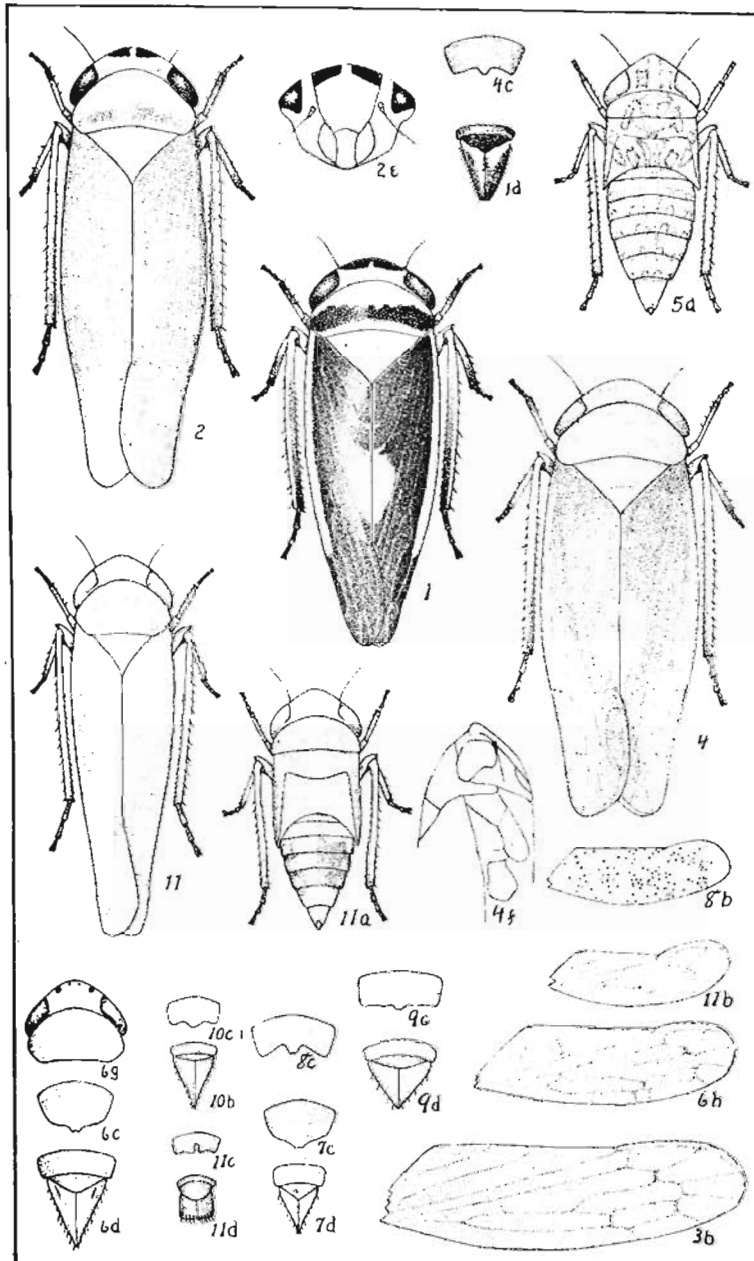
Besides the two already mentioned, *scitula*, *seminuda* and *clavivida* have been found on the beet at different times, but these latter species, like *strobi*, have not occurred in sufficient numbers to be considered injurious.

Many problems in connection with the new pest are still to be worked out. Just why one of the rarest leaf hoppers in its native environment should become the most abundant on the beets is still an open question. Possibly the fact that it is single-brooded while so far as known all the other species on the beets are two-brooded, may account for it. The adult hibernation would allow

of an early distribution on the beet fields; but probably more important than this is the fact that a single-brooded species may deposit eggs in the tissues of an annual plant, while a two-brooded one, where the winter is passed in the egg stage, must have woody tissue in which to deposit the over winter brood of eggs, and this could not be found in the beet fields.

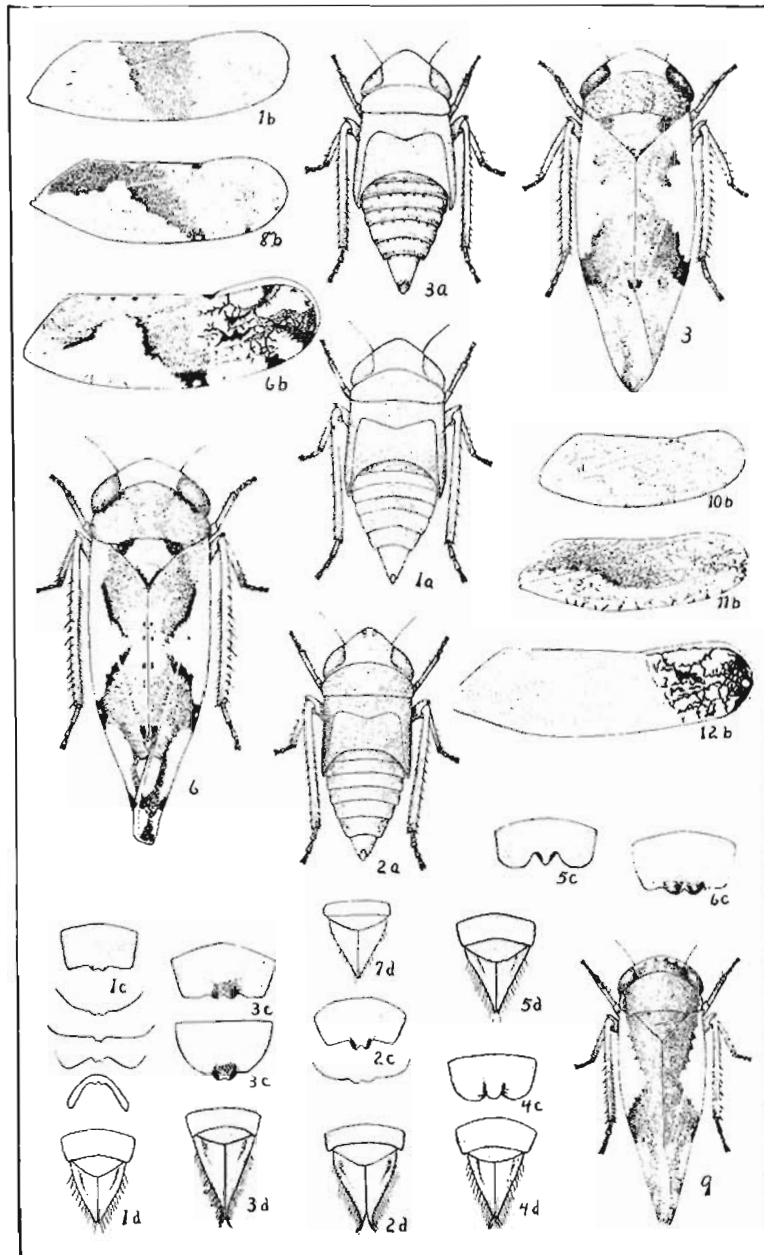
EXPLANATION OF PLATE I.

- Fig. 1. *Entellix subaenea* var. *picta*, adult; 1d ♂ genitalia.
 Fig. 2. " " var. *tristis*, adult; 2c face.
 Fig. 3b. " " var. *southwicki*, elytron. [profile.
 Fig. 4. " " var. *lurida*, adult; 4c ♀ genitalia; 4f
 Fig. 5a. " " var. *querci*, larva.
 Fig. 6b. " *clarivida*, wing; 6c ♀ genitalia; 6d ♂ genitalia;
 6g head and pronotum.
 Fig. 7c. " *osborni*, ♀ genitalia; 7d ♂ genitalia.
 Fig. 8b. " *insana*, wing; 8c ♀ genitalia.
 Fig. 9c. " *paupercula*, ♀ genitalia; 9d ♂ genitalia.
 Fig. 10c. " *stricta*, ♀ genitalia; 10d ♂ genitalia.
 Fig. 11. " *tenella*, adult; 11a larva; 11b wing; 11c ♀ genitalia; 11d ♂ genitalia.



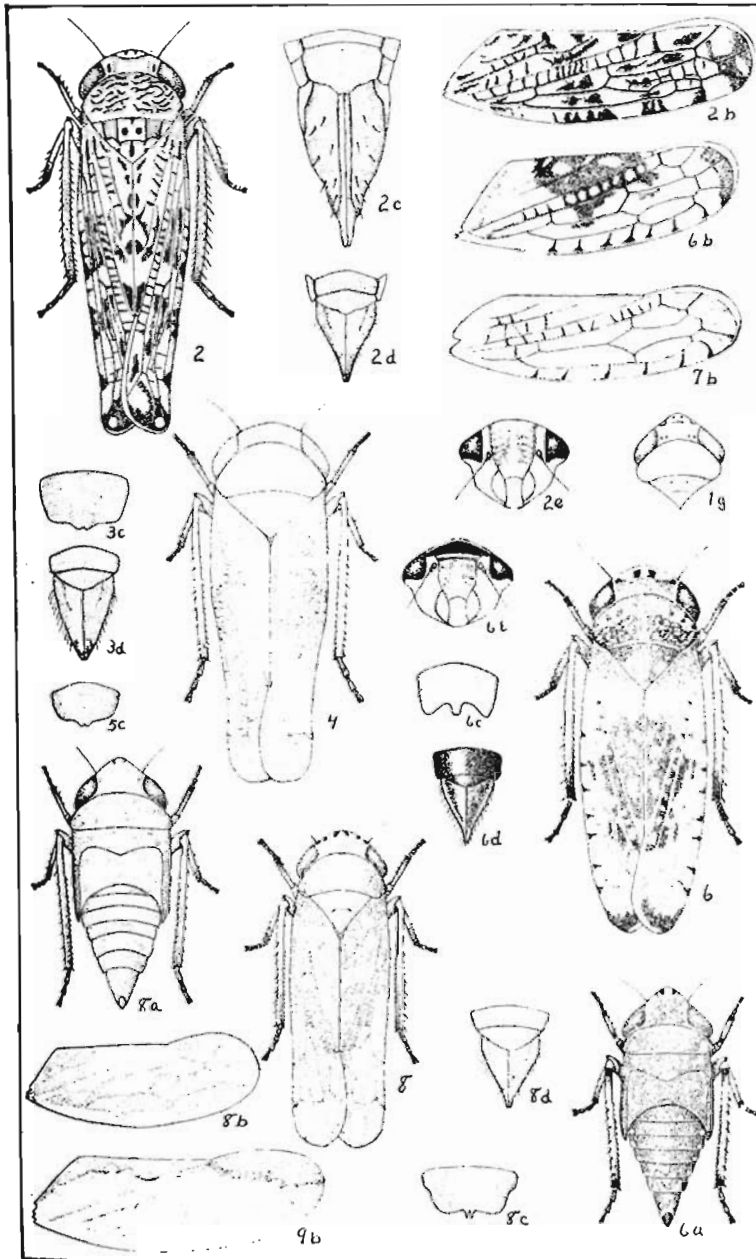
EXPLANATION OF PLATE II.

- Fig. 1*a*. *Eulettix seminuda*, larva; 1*b* wing; 1*c* ♀ genitalia; 1*d* ♂ genitalia.
- Fig. 2*a*. " *strobi*, larva; 2*c* ♀ genitalia; 2*d* ♂ genitalia.
- Fig. 3. " *scitula*, adult; 3*a* larva; 3*c* ♀ genitalia; 3*d* ♂ genitalia.
- Fig. 4*c*. " *pullata*, ♀ genitalia; 4*d* ♂ genitalia.
- Fig. 5*c*. " *perelegantis*, ♀ genitalia; 5*d* ♂ genitalia.
- Fig. 6. " *mildredae*, adult; 6*b* wing; 6*c* ♀ genitalia.
- Fig. 7*d*. " *snowi*, ♂ genitalia.
- Fig. 8*b*. " *saucia*, wing.
- Fig. 9. " *pulchella*, adult.
- Fig. 10*b*. " *albida*, wing.
- Fig. 11*b*. " *pannosa*, wing.
- Fig. 12*b*. " *bicolorata*, wing.



EXPLANATION OF PLATE III.

- Fig. 1g. *Eutettix (Aligia) inscripta*, head and pronotum.
 Fig. 2. " " *jucunda*, adult: 2b wing; 2c ♀ genitalia;
 2d ♂ genitalia; 2e face.
 Fig. 3c. " " *munda*, ♀ genitalia; 3d ♂ genitalia.
 Fig. 4. " " *modesta*, adult.
 Fig. 5c. " " *manitou*, ♀ genitalia.
 Fig. 6. " (*Mesamia*) *nigradorsum*, adult: 6a larva; 6b
 wing; 6c ♀ genitalia; 6d ♂ genitalia;
 6e face.
 Fig. 7b. " " *straminea*, wing.
 Fig. 8. " " *johnsoni*, adult: 8a larva; 8b wing; 8c
 ♀ genitalia; 8d ♂ genitalia.
 Fig. 9b. " " *palliolata*, wing.



EXPLANATION OF PLATE IV.

- Fig. 1. *Eutettix (Mesamia) cincta*, adult; 1*b* wing.
- Fig. 2. " " *vitellina*, adult; 2*b* wing; 2*c* ♀ genitalia; 2*d* ♂ genitalia; 2*f* profile.
- Fig. 3. A small plant of *Chenopodium album*, showing work of *E. strobil* larvæ; 3*b* a small leaf of a sugar beet, showing work of *strobil* larvæ.
- Fig. 4. A small leaf of sugar beet, showing curly-leaf condition caused by *E. tenella*; 4*b* a small section of the back of same leaf to show enlarged veinlets and "warty" condition of a bad case.
- Fig. 5*a*. Eggs of *E. tenella* (greatly enlarged); 5*b* section of beet stem showing how the eggs are placed; 5*c* beet stem with eggs ready to hatch; 5*d* beet stem showing old egg scars.
- Fig. 6. Leaf of *Helianthus grosseserratus* showing work of *E. (Mesamia) nigradorsum* larvæ.
- Fig. 7. Leaf of *Helianthus annuus* showing work of *E. (Mesamia) straminea* larvæ.

All drawings of insects are enlarged nine times except those of *E. tenella* adult and larvæ, which are sixteen times enlarged. The drawings have been made by Mrs. Ball, under supervision of the author.

