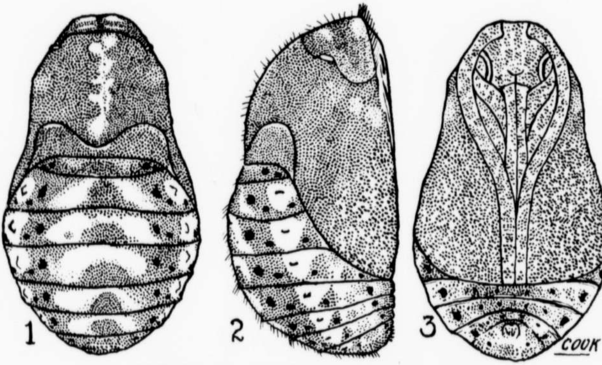
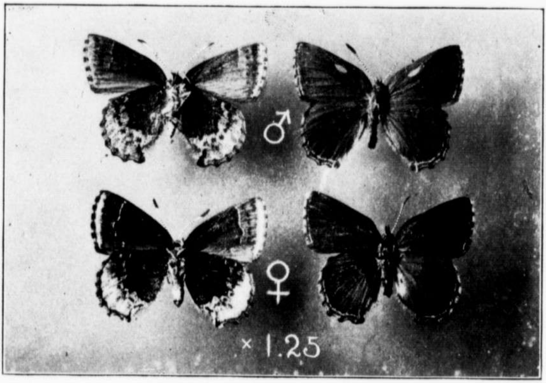


INCISALIA HENRICI—CHRYSALIS.
(Dorsal, lateral and ventral aspects.)



INCISALIA POLIOS, COOK AND WATSON.

The Canadian Entomologist.

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THE STRIDULATION OF THE SNOWY TREE-CRICKET (*ŒCANTHUS NIVEUS*).

BY A. FRANKLIN SHULL, ANN ARBOR, MICH.

I.—INTRODUCTION.*

Dolbear (1897), in writing of the chirping of a common cricket, which was probably the Snowy Tree-cricket (*Œcanthus niveus*), described the regularity of rate as "astonishing, for one may hear all the crickets in a field chirping synchronously, keeping time as if led by the wand of a conductor." In an adjoining field, he said, the rate was the same, but the beat was different; that is, the notes did not occur at the same instant. He expressed the relation of the rate to the temperature by the formula $T = 50 + \frac{N-40}{4}$, where T is the temperature Fahrenheit, and N is the number of chirps per minute. For convenience, the formula may be reduced to $T = 40 + \frac{N}{4}$. Dolbear does not say that the cricket referred to is *Œcanthus niveus*, though he has generally been so interpreted. Folsom (1906) conjectures that he refers to a species of *Gryllus*, but I see no reason for this assumption, except Dolbear's mention of daytime chirps, which are comparatively rare with *Œcanthus niveus*. It seems more probable, as Edes (1899) suggests, that the cricket found chirping in the daytime was another species which Dolbear confused with *Œcanthus*. Certainly his formula and statements agree more closely with *Œcanthus niveus* than with any species of *Gryllus*.

Carl A. and Edward A. Bessey (1898) derived from observations made on *Œcanthus niveus* previous to the publication of Dolbear's paper the formula $T = 60 + \frac{N-92}{4.7}$, which differs notably from Dolbear's in making the increase of rate 4.7 instead of 4 per degree rise in temperature. They stated, moreover, that below 60° the rate was higher than would be expected from the formula, thus making it evident that the curve of temperature could not be represented by a linear equation.

Edes (1899) found that while all the individuals of *Œcanthus niveus* performed in the same tempo, yet the chirps did not occur at the same instant. Using some observations of his own and those of Walter Faxon, he tested Dolbear's formula, and found that the increase of 4 per degree in the rate was nearly correct, but the different sets of data disagreed in

*Contribution from the Zoological Laboratory of the University of Michigan.

the constant term, one making the temperature two or three degrees lower than the other. Edes does not say that the temperatures were read from a standard tested thermometer, and the discrepancy noted was just such as might be expected from the use of incorrect thermometers.

II.—Statement of Problem and Method.

To test the formulas of Dolbear and Bessey, I counted the chirps of several crickets, and from them computed the temperatures. Finding that the computed temperatures were sometimes considerably in error, I undertook a series of observations to determine (1) whether the discrepancy was to be found in any very large proportion of the crickets, and if so, (2) to discover, if possible, the cause of the discrepancy.

These observations were made on *Œcanthus niveus* in Ann Arbor, Mich., in the level country near New Carlisle, Ohio, and on the hillsides of Ithaca, N. Y., in the summers of 1905 and 1906. At first all observations were made with the insect in view. Lantern in hand, I cautiously approached the point in the bushes from which the sound issued until the chirping insect was discovered and the chirps found to coincide with the motion of the wings. The crickets were not at all disconcerted by this procedure, and often permitted me to approach within two feet.

After having observed some 75 specimens by means of a lantern, I found that chirping crickets were rarely closer together than three or four feet, and hence that an individual could easily be picked out by sound. Thereafter I relied upon sound alone for the determination of rates. Of the observations made with a lantern, the only one recorded in the following pages is the one mentioned in the discussion as having chirped 2,228 times in succession. An ordinary watch was used in timing, and to minimize the error, each count was continued through several minutes. Temperature readings were taken within a few minutes of making the count, and all readings were made from the same thermometer. This thermometer was afterward compared with a tested thermometer, by immersing them simultaneously in vessels of water at various temperatures, and was found to have a constant error of about half a degree within the range of temperatures recorded below. Corrections have accordingly been made in these readings before entering them in the tables. The thermometer read to degrees, and fractions of degrees were estimated. The length of one degree on the scale was such that for an eye trained in estimating fractions of lengths the error should in any case have been less than one-tenth of a degree.

I am indebted to Prof. Jacob Reighard for much assistance in discussing my data and in preparing this paper for publication.

III.—Rate of Chirping.

In producing the sound the wings are raised nearly at a right angle with the body, and then scraped firmly across each other. The sound is either a single chirp, or much more commonly a succession of chirps, which follow one another at regular intervals, and vary in number, in the cases observed by me, from 5 or 6 to 2,640. Six hundred to a thousand is the more usual number. The term "chirp," as used in the following pages, refers to a single element of such a series. If the rate of chirping is 120 per minute, the chirps occur at intervals of half a second. I have estimated that one-third of this time, or one-sixth of a second, is occupied in producing the sound, while the remainder is the period of silence between chirps. If the rate is only 60 per minute, the time occupied by the sound is one-third of a second. The rate of sound vibration in this case is much slower, and the pitch is correspondingly lower.

a.—Effect of Temperature on Rate.

From the hundreds of observations made, a representative group is shown in Table I. The temperatures are those at an elevation of six feet, the average elevation of the insects. The temperature at two feet elevation was generally about half a degree lower, that at ten feet half a degree higher than that at six feet elevation. The temperatures computed from Dolbear's and Bessey's formulas are added for comparison.

Table I.—Showing rates of chirping of various individuals of *Œcanthus niveus* at different temperatures and elevations :

Date.	Number of chirps per minute, individuals of *Œcanthus niveus*.	Elevation of individual above ground, in feet.	Temperature in degrees Fahrenheit.		
			Computed from Dolbear's formula.	Observed at elevation of six feet.	Computed from Bessey's formula.
Aug. 22...	144	—	76.0	75.8	71.06
Aug. 23..	156	6	79.0	74.9	73.62
Aug. 24..	174	6	83.5	78.8	77.45
Aug. 27..	93	6	63.25	60.4	60.21
Aug. 28..	82	4	60.5	61.5	57.87
Sept 7....	93	2	63.25	69.9	60.21
	96	2	64.0		60.85
	100	3	65.0		61.70
	102	8	65.5		62.13
	110	10	67.5		63.83

It is seen that there is a general correspondence between rate and temperature. But that the rate does not follow any law based on temperature is apparent from the observations for Aug. 27 and Sept. 7 (first record), where the rates are the same with a difference of temperature of over nine degrees. Furthermore, comparison of Aug. 27 and Aug. 28 shows that of two records the higher rate may accompany the lower temperature. The five records for Sept. 7 were made within an area of two square rods in the same blackberry patch. The crickets were chirping simultaneously, and the observations were made within a period of 15 minutes; the temperature did not change perceptibly, yet the rate in different individuals is from 93 to 110. Other records made outside of this area on the same evening showed even greater extremes, the lowest rate being 84 per minute, the highest 126. These observations are of interest in the light of Dolbear's observation of accurate synchronism.

It will be noted that the crickets of Sept. 7 were at different elevations, and that those at the greater height chirped the more rapidly. While there were numerous exceptions to this correlation of rate with elevation, the higher crickets chirped at rates which on the average were markedly higher than the average of individuals nearer the ground. Dolbear might have explained this difference of rate at different elevations by the fact that the greater elevations have the higher temperatures. Even if temperature is the cause of the variations at different altitudes, the synchronism existing among "all the crickets in a field" would be destroyed, for to produce such synchronism it would be necessary to have, not merely a level field, but all the crickets in the same horizontal plane over the field. Granting for the moment that temperature alone is responsible for these differences in rate, Dolbear's formula, which is not much in error in making the rate increase by 4 per degree rise in temperature, does not state the proper relation between the difference of temperature and the difference of rate. The observed difference of temperature between elevations of 2 ft. and 10 ft. was usually about 1° at the time of making these observations, 7.30 to 8 p.m. Hence, according to Dolbear's formula, or any formula based on crickets at the same elevation, the difference in rate between elevations of 2 ft. and 10 ft. should have been about 4, whereas it will be seen from the table that the difference was 17.

Evidently individual rates are not closely correlated with temperature. If any accurate correlation exists, it ought to be apparent from average rates. A few averages, covering, with some additions, the same period as in Table I, have been calculated, and are given, together with the temperatures computed from Dolbear's and Bessey's formulas, in Table II.

Table II.—Showing averages of the rates of ten to fifteen individuals of *Œcanthus niveus* at different temperatures :

Date.	Average number of chirps per minute of 10 to 15 individuals of *Œcanthus niveus*.	Temperature in degrees Fahrenheit.		
		Computed from Dolbear's formula	Observed, taken at 6 ft. elevation, in middle of series.	Computed from Bessey's formula.
Aug. 22...	147 20	76.80	75 8	71.74
Aug. 23.	148.75	77.19	74.9	72.07
Aug. 24.	168.60	82.15	78.8	76.30
Aug. 27...	85 71	61.43	60.4	58.66
Aug. 28.	84 20	61.05	61.5	58.34
Aug. 29.	119.16	69.79	68.2	65.78
Sept. 1....	104.40	66.10	67.0	62.64
Sept. 7 ..	102.30	65 58	69 9	62.19
Sept. 8....	104.68	66.17	70.9	62.70

Here it appears again that, even when averages are taken, approximately equal rates may accompany widely-differing temperatures (cf. Sept. 1 and Sept. 8), and that the higher rate may occur with the lower temperature (cf. Aug. 27 and 28), though in both cases the discrepancy is less marked than in Table I.

It seems that while there is a general agreement between temperature and rate of chirping, yet it is not possible to express this agreement by any formula. Any temperature calculated from the rate by Dolbear's formula may be over six degrees in error, and over nine degrees when Bessey's formula is used. It follows also from these observations that there can be no accurate synchronism.

b.—Effect of Wing Length on Rate.

In attempting to explain the discrepancies noted above, wing length suggested itself as a possible factor. The effect of wing length was determined as follows : The rates of a number of individuals, say ten or fifteen, were determined, usually within a period of 40 minutes, and the average was computed. One member of the series, whose rate was of course known, was captured, and its wings were measured. Measurement was made by laying the wing, after removal from the body, on a scale graduated to fifths of millimeters. By use of a lens these divisions could easily be divided to fourths, that is, to twentieths of a millimeter, so that the error in any case should have been within half this amount, or less than 0.025 mm. The captured specimen was taken from the middle of the series, in order to obviate any error due to a fall of temperature while the observations were being made. Sixteen such series were recorded, and consequently sixteen wing measurements were made. The results of these measurements are given in Table III. The quantities in the fifth column are found by dividing those in the third column by those in the fourth.

Table III.—Showing the length of wing of individuals of *Œcanthus niveus*, the rates of chirping of these individuals, and the average rates of other individuals at the same time :

No.	Length of right wing in millimeters.	Number of chirps per minute.		Ratio of individual rate to average rate.
		Of individual in middle of series.	Average of entire series.	
1	12.93	109	111	.982
2	13.18	136	135	1.007
3	13.25	111	112	.991
4	13.13	151	153	.987
5	13.10	111	111	1.000
6	13.02	67	68	.985
7	13.84	140	139	1.007
8	12.28	137	138	.993
9	13.05	114	111	1.027
10	13.27	132	134	.985
11	12.65	112	111	1.009
12	12.91	149	150	.993
13	13.48	112	111	1.009
14	12.70	134	137	.978
15	13.24	131	131	1.000
16	13.22	157	153	1.026
Average . . .	13.08			

If, now the wing-lengths and the ratios of the individual rates to the average rates be plotted as ordinates and abscissæ, respectively, they should group themselves in some noticeable fashion about an oblique line, provided there is any correlation between wing-length and rate of stridulation. But no such grouping is apparent (fig. 14). Particularly

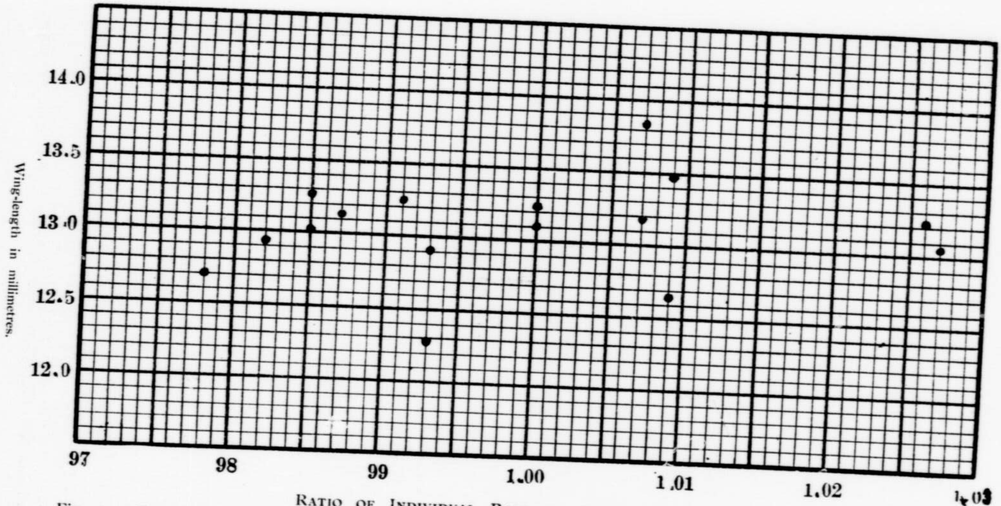


Fig. 14.—Graphical representation of the wing-length and ratio of individual rate to average rate for sixteen individuals of *Œcanthus niveus*. Data from Table III.

instructive should be Nos. 7 and 8, representing the extremes of wing-length. In neither case is the deviation from the average rate as marked as in some cases where the wing-length is more nearly the average, for example, Nos. 4 and 9.

c.—Effect of Humidity on Rate.

As I was not properly equipped with apparatus, I have no conclusive evidence of the effect of humidity. But the results of two sets of observations made on the same evening, under different conditions, point to a probable influence of humidity. The first observations were made under a clear sky, and with no perceptible air currents. Dew was forming near the ground, showing that the vapour was saturated there, while higher up the bushes were dry. The second set of observations was made nearly two hours later, when there were light winds and it was beginning to rain. At this time the vapour must have been saturated at all elevations. Hence the humidity had remained constant near the ground, but had risen noticeably at greater elevations. During the two hours the temperature at an elevation of 6 ft. had fallen 1°.6. The decrease at 12 ft. was probably about 2°.2. The crickets observed were in precisely the same locations in both sets of observations, and were probably the same crickets. The rate of chirping of those near the ground had decreased 5 or 6 per minute, that at 12 ft. had decreased 20 per minute. Change in temperature alone accounts, according to Dolbear's formula, for a decrease of but 9 in rate. It is possible to explain the further decrease at the higher elevation by supposing that increase of humidity diminishes the rate of stridulation. This supposition will also explain part of the difference in rate noted between crickets at elevations of 2 ft. and 10 ft. on Sept. 7 (Table I), since the humidity is greater near the ground.

d.—Effect of Individuality on Rate.

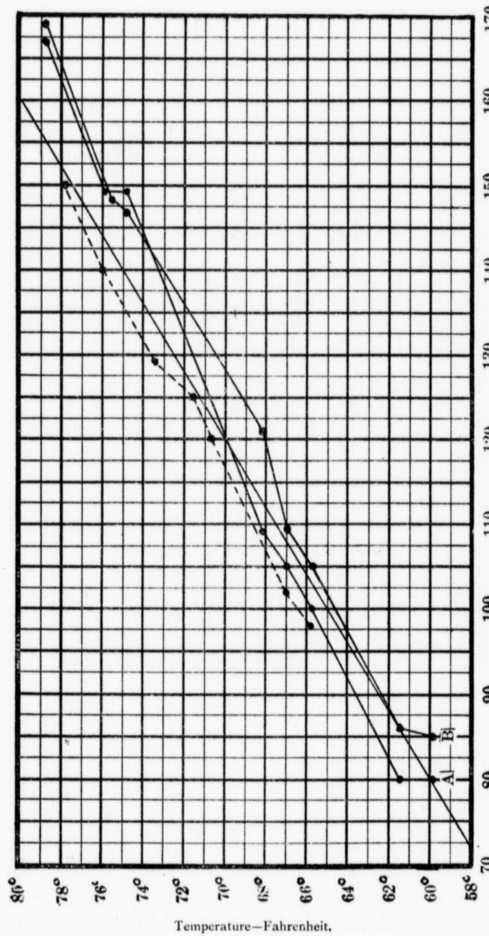
As I did not find external factors to explain satisfactorily all the observed facts, I was led to look for internal factors. Of these internal factors, individuality and physiological state suggested themselves. By individuality is meant that constitutional peculiarity which results in a constant difference between one cricket and its fellows. The constant difference was frequently one of pitch. Certain crickets, while maintaining approximately the same rate, were found to chirp at a constantly lower pitch than other crickets in similar locations. Again, some crickets possessed a peculiar variety of chirp, one of which is later to be mentioned specifically, and this peculiarity was present in every chirp. If it should be found that each individual, while varying its rate with the temperature or other external conditions, at the same time shows individual peculiarity in rate, so that under the same conditions the rate is constantly higher or lower than that of other crickets, this constant peculiarity might be referred to as "rate individuality."

To determine whether individuality affects rate as I found it to affect pitch and quality of chirp, several crickets were confined in the house. But they rarely chirped, and then for but a short time. Outside in the yard and fields it was found that chirps issued from the same point in the bushes evening after evening. Sometimes these chirps possessed peculiarities of pitch or unsteadiness which were different from those of almost any other cricket. When these peculiarities occurred in the same place for several successive evenings, I assumed that they were produced by the same cricket. The data given in Table IV are from one such cricket, whose distinguishing peculiarity was an interrupted chirp, accentuated at the beginning and end as if the wings were then pressed more firmly together, so that the chirp sounded almost as if divided in the middle.

Table IV.—Showing rates of chirping of same individual of *Œcanthus niveus* over a period of thirteen days :

Date.	Number of chirps per minute of the same individual of *Œcanthus niveus* on different days.	Temperature in degrees Fahrenheit.	
		Observed.	Computed from Dolbear's formula.
Aug. 23....	149	74.9	77.25
Aug. 24....	167	78.8	81.75
Aug. 27....	80	59.9	60.00
Aug. 28....	80	61.5	60.00
Aug. 29....	109	68.2	67.25
Sept. 1.....	105	67.0	66.25
Sept. 2.....	149	76.0	77.25
Sept. 4.....	100	65.8	65.00

These data, together with data secured in like manner from two other crickets, are graphically represented in fig. 15. The straight solid line is the representation of Dolbear's formula. The other solid lines, A and B, are from two crickets that were observed over nearly the same period of days, one cricket being that referred to in Table IV. The two crickets were at nearly the same elevation and in similar locations, so that external conditions were practically identical. The dotted line is the curve for a cricket observed over a different period of time.



RATE OF STRIDULATION.

Fig. 15.—Graphical representation of temperature and rate of chirping of three individuals of *Œcanthus niveus*. The curve A is that of the cricket referred to in Table IV, observed from Aug. 23 to Sept. 4, 1906; B an individual observed from Aug. 22 to Sept. 4, and the dotted curve, one observed from Sept. 1 to 11, 1906.

The table of the rate of chirping of the individual cricket shows that the rates of even an individual are not closely correlated with temperature. In fig. 15, the fact that one of the solid lines lies, throughout the greater part of its length, above the other shows that the rate of one cricket is almost constantly higher than that of the other. This can hardly be explained except by individuality. The crossing and recrossing of the two lines must then be explained by another factor (physiological state) which I discuss in another place.

IV.—Synchronism.

I found exact synchronism to be comparatively rare, and to exist only between neighbouring crickets. When accurate synchronism did occur, it affected usually only two individuals, sometimes three. One evening I discovered two crickets about five feet apart chirping in such accurate unison that I did not at once realize that there were two crickets. One soon stopped; the second hesitated, its chirp became weak, and it even lost a beat. After an irregular solo of several minutes, the second cricket recommenced. At the first chirp the first cricket struck a note out of time, then lost a beat, as if startled. It next voiced a half-dozen weak, uncertain chirps, then the call gradually grew in intensity, until the two crickets were again chirping in exact unison.

V.—Summary.

1. While there is a general correspondence between temperature and rate of stridulation, there are numerous variations of rate that cannot be accounted for by differences of temperature. Dolbear's formula cannot be applied to my observations without a possible error of $6^\circ.65$.

2. Rate of stridulation is in no way correlated with wing-length.

3. Humidity seems to affect rate of chirping, but the evidence is not conclusive.

4. The rate of chirping of different crickets under the same external conditions depends on their individuality.

5. Synchronism is rare, and is observable in only two or three individuals near one another.

VI.—Discussion.

It is clear that Dolbear's and Bessey's laws are only approximately accurate. Temperatures computed from them may be expected to vary from observed temperatures as much as $6^\circ.65$ with the first formula, and $9^\circ.69$ with the second. Any expression for the rate of chirping must be a function of several independent variables, of which temperature is only one. Hence, its graphical representation is not a line, nor even a surface. Of the other possible factors in addition to temperature, it has been shown that wing-length is of no effect in determining the rate of chirping. The remaining two factors which have been studied, namely, humidity and individuality, are, with temperature, sufficient to explain most of the observed facts. However, in fig. 15 there remains still one point to be explained. That point is the crossing of the curves of the individual crickets. The external factors of temperature and humidity have been eliminated by having them practically the same for both crickets. Individuality has not served to keep the curves separate throughout their length. Here some other factor, either external or internal, must enter. The most plausible explanation seems to be that based on differences of physiological state, which, of course, could not be determined from my observations. It is quite possible that physiological condition (age, hunger, sexual condition, etc.), plays an important role. It may well so have affected "rate individuality" as to have caused the crossing of the two curves plotted in fig. 15.

The synchronism found by Dolbear does not appear in my observations. As a rule, even neighbouring crickets chirp at rates that are very noticeably different. The instance of synchronism recounted above throws some light on the question, which by implication Edes (1899) raises, as to whether synchronism is due to the effect upon various individuals of equal temperatures or other conditions. It seems from my observation that synchronism may possibly be due rather to the effect of each cricket's chirp upon the other cricket.

Dolbear may have gained his impression of universal synchronism by observing a sporadic case of it or by actually listening to but one cricket and mistaking it for a full chorus. The intensity of sound diminishes so rapidly with increasing distance from the source, that with but one cricket chirping several feet away and the others at a greater distance an observer could easily overlook those at the greater distance. One cricket, if undisturbed, will usually perform six to eight hundred chirps without missing one, except on cool nights. Not infrequently it will perform 1,500 in succession; while one "long-winded" individual which I observed continued through 2,640, another 2,425, a third 2,228. From these figures it will be seen that breaks in the series of chirps might escape observation, and that the continuous chirping of one performer might be mistaken for a chorus in which the single crickets were not missed when they dropped out. It would thus happen that a single cricket may have been mistaken for several in unison, each performing less continuously.

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TWO UNDESCRIBED WATER BUGS FROM THE UNITED STATES.

BY J. R. DE LA TORRE BUENO, NEW YORK.

If one takes up any of the authoritative text-books of entomology, especially such as refer to the Eastern United States, one will find that in certain of the families of the so-called Cryptocerata the Eastern American species rarely exceed two or three in as many genera. Such, for instance, is the case with the *Nepidæ*, for which only two species are given; the *Gelastocoridæ*, which is stated to have but two or (counting Ochterus as in the family) three species in as many genera. A more pertinent example is the family *Naucoridæ*, of which there is only one species known on this side of the continent; to this I add another, *Pelocoris Carolinensis*, mihi, described hereafter. The *Notonectidæ* have fared better, and the five thus far known are increased to six for the Eastern United States. Both these additions are due to the assiduous labours of Mr. C. S. Brimley, to whom I am grateful for many very interesting things noted elsewhere.

Family NOTONECTIDÆ, Genus NOTONECTA, Linné.

Notonecta Raleighi, nov. sp. = *N. variabilis*, partim, Bueno. J. N. Y. Ent. Soc., xiii, p. 155.

Head.—Notocephalic lateral margins nearly straight; vertex more than six times as wide as synthlipsis; base of eyes over four times as wide as synthlipsis.

Pronotum two-thirds broader than long; base and lateral margins nearly straight, humeral margin sinuate. Scutellum one-quarter broader than long, sides pronouncedly sinuate, caudal angle long. Hemelytra little longer than the body, moderately clothed with a silvery pubescence on the clavus and corium; membrane lobes unequal. Abdomen luteous, fringing ciliæ black, sparse. Pedes luteous; intermediate femoral spur concolorous, long, thin and sharp.

Coloration.—Eyes dark reddish-brown. Cranium and prothorax whitish. Scutellum ranges from pure light yellowish to black, disk margined with smoky orange-yellow on the hemelytral margins. Hemelytra ranging from white with vague beginnings of the corial fasciæ and black humeri with white membrane, through all intergrades to a form with a blackish stripe along the anterior margin of the corium; black margins to the clavus along the scutellar edges; a blackish streak along the corium near to and parallel to the claval suture; black corial fasciæ merging into the black membrane, which shades off into smoky and then white at the apex. One of the types is the most pronouncedly melanic specimen of the species in a series of 60 or so specimens. In this the extreme of scutellar darkness with orange-red edges obtains. The external edges of the clavus are broadly black, shading into smoky to the corial suture; the dark band on the corium parallel to this suture is broad; the humerus has a black streak running into the corium, which is dark luteous, except for the black fasciæ which coalesce with the black membrane, which in turn lightens to smoky at the apex. The structural characters are the same as in the others.

Measurements.—Vertex, 1 mm.; synthlipsis, .15 mm. Pronotum, long., 1.5 mm. to 1.8 mm.; pronotum, lat. (at humeral angle), 2.5 mm. to 2.9 mm., (at base) 2 mm. Scutellum, long., 1.6 mm.; scutellum, lat., 2 mm. Insect., long., 8 mm to 8.8 mm.; insect, lat. (at humeral angle of pronotum), 2.5 to 2.9 mm.

Described from sixteen specimens from Raleigh, N. C. Types: Collections U. S. National Museum, American Museum of Natural History, C. S. Brimley, and mine.

This species very much resembles a dwarf *variabilis*, but it is easily distinguishable by the cephalic structure. It comes in section 7 of my table for the separation of species,* which may be varied as follows to include it:

7. (1 and 10) Small slender species.
8. (9) Vertex three times the synthlipsis, etc, etc. . . *variabilis*, Fieber.
9. (8) Vertex more than three times the synthlipsis.

*See Journal N. Y. Ent. Soc., xiii, p. 149.

10a. (11a) Vertex six times the synthlipsis ; width of pronotum one and two-thirds times the length ; width of scutellum one and one-quarter times the length ; length of insect, 8 to 8.8 mm. . . . . *Raleighi*, n. sp.

11a. (10a) Vertex six to eight times synthlipsis, etc., etc. *Uhleri*, Kirkaldy.

This species is locally abundant at Raleigh, N. C., and I also have it from Delair, N. J. (W. P. Seal) ; Chicago, Ills. (V. E. Shelford); Running Lake, Mississippi River Bottoms, Ills. (Prof. C. A. Hart) ; Bladensburg, Md., and Washington, D. C. (O. Heidemann). The Washington and Bladensburg specimens I had placed in *N. variabilis* in my revision of the genus cited above, taking them, as noted, for dwarf specimens of the latter species, but a larger series showed unmistakably that it was a different species.

Family NAUCORIDÆ, Genus PELOCORIS, Stal.

Pelocoris Carolinensis, n. sp..

Head.—Broader, including eyes, than long ; front more or less remotely punctuated and furrowed ; width at base and at widest part subequal ; eyes longer than wide, greatest width about one-third from the distal end ; sinuate in the inner margin, converging toward the distal end more than toward the proximal end. Labrum broader at base than long ; triangular in shape, with rounded apex attaining the middle of the third segment of the rostrum. Rostrum short, stout.

Pronotum about 2⅓ times as broad at base as long along the median line ; broader at base than at distal margin; both basal and distal margins more or less sinuate ; edges curved regularly from the eyes to the humeral angles, which are rounded ; disk with indented lines behind the head, parallel to the anterior margin, the first line as long as the distance between the eyes, and diminishing in length posteriorly, giving an obtusely triangular shape to the lined area, the remainder of the disk coarsely punctuated, caudad of the pronotal suture it is shagreened in wavy lines.

Scutellum about twice as broad as long along the medial line ; apex blunt ; sides sinuate, shagreened.

Hemelytra narrower than abdomen, but extending to end of same. Membrane distinct, but merging insensibly into the corium. Embolium flattened and broadened marginally, extending beyond the abdomen. The three last connexival segments have prominent posterior angles. Entire hemelytra, including the membrane, covered with very short, sparse golden hairs. Mesosternal keel slightly raised, grooved longitudinally with hairs arising on either side, and nearly covering the groove.

Abdomen.—Genital segments prominent in male, flattened and cleft in female. These segments are somewhat complicated, and no adequate description can be made without a dissection.

Pedes.—First pair raptorial with incrassate femora grooved for the reception of the tibiæ, which are curved and furnished with a one-jointed tarsus, destitute of claws. Second and third pair cursorial, with normal femora and tibiæ, with two-jointed tarsi, armed with moderately long, slender claws. The tibiæ are furnished with moderately long spines in two rows.

Coloration.—Head flavous, with a dark median line of varying width, sometimes reduced to a triangle at the vertex, and at others entirely absent or very faint. Prothorax also flavous, the punctuations of the disk brown, the flattened outer margin much lighter in colour; the area caudad of the suture, more or less variegated with perpendicular black lines of varying widths. Scutellum brown, the apex sometimes lighter in colour, approaching to flavous; some individuals have lighter vermiculations in the disk. Hemelytra also brown, with lighter vermiculations, the ground colour of varying shades; the darker forms have two flavous spots on the corium at the edge next to the membrane, which disappear in the lighter forms. The embolium is testaceous, darkening caudad. The connexival segments are black posteriorly. The abdomen varies from testaceous to dark brown. The legs are concolorous except the spines, which are darker and black-tipped; the anterior legs are flavous, except the apex of the tarsus, which is dark. Labrum flavous; terminal segment of rostrum darker at the lip.

Measurements.—Head, ♂, long., 1.5 to 1.7 mm.; lat., 2.6 to 2.9 mm. ♀, long., 1.8 to 1.9 mm.; lat., 2.8 to 3 mm. Pronotum.—♂, long., 1.7 to 2 mm.; lat., 4 to 4.6 mm. ♀, long., 1.9 to 2 mm.; lat., 4.5 to 4.7 mm. Scutellum.—♂, long. (measured from prothoracic groove), 1.3 to 1.4 mm.; lat., 2.3 to 2.7 mm. ♀, long., 1 4 to 1.5 mm.; lat., 2.7 to 2.9 mm. Insect.—♂, long., 8.2 to 9.3 mm; lat., 5 to 5.5 mm. ♀, long., 9.3 to 9.6; lat., 5 6 to 6.1 mm.

Described from 8 males and 8 females taken by Mr. C. S. Brimley, at Lake Ellis, Havelock, N. C., and two carded specimens from Blanfort, S. C., in the American Museum of Natural History collections. Types in U. S. National Museum (♂ and ♀), American Museum of Natural History (two carded specimens mentioned above), collection C. S. Brimley (♂ and ♀), and my collection.

This bug differs from the species recognized as *Pelocoris femoratus*, Pal., Beauv., in its smaller size, more slender shape, the cleft female genital segment, the more densely punctate and stouter prothorax, and the more noticeably flattened prothoracic margins. Mr. Brimley says of this water-bug*: "Among the Hemiptera the only form of note was a Naucorid, which fairly swarmed in the lake among the water-weeds." The lake referred to is Lake Ellis.

*Ent. News, xvii, No. 3, p. 85, March, 1906,

ON THE GENUS *RULANDUS*, DISTANT, (HEMIPTERA).

BY G. W. KIRKALDY, HONOLULU, HAWAIIAN ISLANDS.

Rulandus, Distant (1904, Faun. Ind. Rh., II, 391), is described as a Nabid, but it is most certainly not, as it has neither the facies nor the characters of that family. It is a Reduviid, and judging from the figure and description is probably a Reduviine proper (Acanthaspidine).

STUDIES IN THE GENUS INCISALIA.

BY JOHN H. COOK, ALBANY, N. Y.

III.—INCISALIA HENRICI.

(Continued from page 187.)

Incubation.—Of the thirteen eggs secured from the female confined over *Vaccinium*, seven were left on the growing plant and in the open air to develop under natural conditions; the other six were brought into the laboratory. When first laid the egg is pale green, showing under a low power of the microscope the large white bosses studding the surface except on the flattened top and bottom. As the larva develops within the shell the latter becomes glistening white, the caterpillar appearing but faintly through the nearly opaque pellicle.

On May 19th, between 7.30 p.m. and the next observation, the first egg (No. 1) hatched. When found at 10.30 p.m. the larva had deserted the empty shell and was feeding on a bud, the food showing through the dorsum as a dark green line. A small hole was visible at the edge of the circum-micropylar area of egg No. 3 (laid on *V. corymbosum*), and at 11.12 p.m. the caterpillar, having eaten away the whole top of the shell, emerged. Shortly afterward Nos. 2, 4 and 5 were punctured, and the larvæ emerged almost simultaneously at midnight. No. 6 did not hatch until 9.30 the next morning.

The eggs left out of doors did not develop so rapidly; Nos. 7, 8, 9 and 10 hatched during the early morning, and No. 11 about 5 p.m. on May 21st. The larvæ in Nos. 12 and 13 developed normally, but died within the shell.

The period of incubation, therefore, varies from 4 days 7 hours to 6 days 4 hours. Edwards gives as the "duration of this stage five or six days."

The Larval Stages.—Following are the tabulated records of the larvæ which lived long enough to make the determined facts of any value. The terms and the use of the asterisk are the same as I employed in outlining the life-history of *I. angustus* (see CAN. ENT. for July, 1906).

EGG.	No. 2.	No. 3.	No. 5.	No. 6.
laid	*2.05 p.m. May 15	*2.12 p.m. May 15	*2.16 p.m. May 15	12.40 p.m. May 15
hatch'd	*12.01 a.m. May 20	*11.12 p.m. May 19	*12.01 a.m. May 20	*9.30 a.m. May 21
FIRST MOULT—				
UP	7.30 p.m. May 22	7 p.m. May 25	2 p.m. May 23	4 a.m. May 25
OFF	*8.30 p.m. May 24	4 a.m. May 26	*noon May 25	4 a.m. May 26
SECOND MOULT—				
UP	10 a.m. May 27	1 p.m. May 29	*8 a.m. May 28	9 p.m. May 29
OFF	4 a. m. May 29	*6.05 p.m. May 30	4 a.m. May 31	*11 p.m. May 31
THIRD MOULT—				
UP	6 p.m. June 1	4 a.m. June 2	not	*5.32 p.m. June 3
OFF	5.30 p.m. June 3	9 p.m. June 4	observed	11 p.m. June 4
PUPATION—				
FINAL	8 a.m. June 10	killed	2 p.m. June 9	noon June 10
PUPA	*9.34 p.m June 11	for study	*11.10 p.m. June 10	*10.22 p.m. June 11

The larval stages of this species were worked out by William Henry Edwards with such careful accuracy that little remains for me to do beyond paying tribute to the character and quality of his work and verifying the facts published in Papilio (Vol. I, p. 150-152), a quarter of a century ago. However, since I have had the exceptional good fortune of breeding the larvæ side by side with those of *irus*, *augustus* and *niphon*, I venture to hope that my observations will be of added value by reason of the comparisons thus made possible.

First Stage.—The caterpillar begins life in the generalized form described by Edwards thus: "Length, 4-100 inch; shape, oval; broadest anteriorly, the base flattened; dorsum high and sloping posteriorly; the summit of dorsum flattened for a little space, and on either side there is a row of long recurved white hairs; along edge of base is another row of similar hairs bent down; colour brownish-yellow; head obovoid and smooth." I may add that the head is brownish-yellow, with rich brown mandibles and labrum, and the short dusky bristles associated with the laterodorsal series of hairs are present. Without careful examination with a microscope the new-born larvæ are indistinguishable from those of ***irus*** or ***augustus***.

The Succeeding Stages.—As Edwards has pointed out, the coloration has altered considerably by the time the first moult is passed. The general colour is light green, with markings distributed as in *irus* and *augustus* (when mature), these markings of a yellow-green, not the intense yellow-green of *augustus*, but of a tint that may properly be described as "flat," and lacking in brilliancy. On either side of the faint (and not always present) mediodorsal yellow-green stripe the dorsal blood-vessel shows *dull red-brown*. Moreover, all the body-green (*i.e.*, all excepting the mediodorsal stripe, the summits of the laterodorsal ridge, the oblique lateral dashes—in *Henrici* run in with the laterodorsal marks and not distinguishable from them—the spots which represent the vestige of a spiracular line, and the stripe on the substigmatal fold, all of which are markings due to modification of the tissues)—with the exception then of these markings *the whole upper part of the larva may be a deep red-brown*. There are all degrees of intergrading between the two extremes, *but the dorsal stripe was red-brown in all of the larvæ carried through to the second stage.* As no such colour appeared in any of the hundred-odd *irus* or in any of the six *augustus* examined, it is probably a reliable diagnostic character for this stage, and as it persists throughout larval life, for the subsequent stages also.*

The more elongate shape and the *prominent* ridge on each of the first eight abdominal segments differentiate the larva of *Henrici* from the congeneric caterpillars without reference to coloration, though the differences in the latter respect are more striking, *irus* being *pale pea-pod-green*, with faint white or very light green markings, *augustus vivid* yellow-green, with (or without) *bright* yellow markings, and *Henrici* dark green or "*port-wine-red*," with broad, prominent markings of a *dull, flat* yellow-green. These points will be discussed and illustrated later.

Larval Variation.—In the spring of 1881 Mr. Edwards found his first caterpillar of this species feeding on a wild plum. It was nearly full-grown, and eventually became a chrysalis which did not disclose the imago. It was described as having been "entirely green in shades, *except for two subdorsal red-brown stripes.*" The following year eggs were secured from an imprisoned butterfly, and one larva was bred to maturity on plum; when full-grown it differed from the other caterpillar in that the

*The dorsum is red in *I. polios* during the second larval instar, but other characters make the separation of *Henrici* and *polios* a simple matter.

darker green (the ground colour) was almost completely replaced by "port-wine-red," leaving the lighter yellow-green in strong contrast. Because the larvæ were of the same size and shape, fed upon the same plant and yielded similar pupæ, Mr. Edwards was led to believe that they were varietal forms of the same species. His suggestion that "possibly, in raising a brood of these caterpillars at some future time, both red and green ones will be found among them," is tantamount to a prediction. Such proved to be the case. Of the four larvæ which were raised by me, one fitted the description of "the caterpillar of 1881" (green) to a nicety; a second corresponded in every detail to the "port-wine-red" caterpillar (of 1882), and of the two others one was intermediate between these, and one became eventually even more completely red than the red one of Edwards.

Feeding Habits.—The habits of the caterpillar when feeding on plum have been described; they do not differ essentially when *Vaccinium* is the food. When young the larvæ will eat the floral organs, but by the time the second moult is reached these have disappeared and the green fruit is eaten. A tunnel just large enough to accommodate the head is made in the side of a berry, and as the mandibles work this deeper and deeper the "collar" is brought up flush with the surface of the fruit, much as a man's sleeve would come against a fence if he attempted to force his arm through a small hole therein. This gives the caterpillar the appearance of being half-way into a berry not large enough to hold the half.

The larvæ will often remain motionless (apparently) for many hours at a time, and do not evince any great desire to wander from a fruit-cluster until all the edible pulp has disappeared. My "very red one" (No. 5), when nearly mature spun a little silk on a pedicel, and after firmly fixing his anal prolegs to the mat proceeded to clean out all the food within reach. It devoured the interiors of five berries in about eight hours without releasing its hold on the mat. In order to do this it was twice necessary to maintain an exceedingly awkard position. Having finished up these five it moved the fore part of its body in all directions, until it came in contact with the lowest fruit on a cluster above, and into this it promptly bored. As long as watched (about 25 minutes) it fed in this unusual position, stretched to its full length, with only the anal prolegs and the true legs touching the plant. When next observed it had released its hold on the lower cluster.

Food-plants.—Though we have every reason to believe from the facts as given that *Vaccinium vacillans* is a natural food-plant, I am not satisfied that it is the only local food-plant. I have spent many hours, both of daylight and at night, in the search for *augustus* larvæ on the same plant, and have never yet found a caterpillar of *Henrici.* Mr. Edwards's discovery of a full-grown larva on wild plum suggests that other species of *Prunus* may be the food, and this is borne out by the coloration of the insect, which renders it very conspicuous on a green surface, and the rosy tints here and there on *vacillans* are altogether too ill-defined to make it any the less so on that plant. Although wild plum is not found hereabout, *Prunus pennsylvanica* and *P. cuneata** are common, and are likely to prove the usual food-plant locally.

I was unable to secure any wild plum, or I should have tried my larvæ with it; they would not touch cultivated varieties when *Vaccinium* was to be had, and I did not risk losing them by removing the latter from the breeding-glasses.

Pupation.—When ready to pupate the caterpillar descends from the plant and turns to chrysalis among the twigs and dried leaves on the ground. When from their actions it became evident that my larvæ had finished eating, they were placed in a box with a plentiful supply of rubbish, among which there chanced to be an old alder leaf caked over and nearly black with dried "honey-dew." This was found by all three caterpillars, and on the lower surface (as it lay) they took their stations preparatory to casting the last larval skin.

The Change to Chrysalis.—I witnessed the ecdysis of the chrysalis of all of the three insects which pupated, though the greater part of the precursory peristalsis took place during my absence. The skin split first along the thoracic dorsimeson, and was more or less torn as the soft pupa worked its way out. The latter was dingy gray-green on the wing-cases and abdomen ventrally, dusky orange-brown on the dorsum. The series of pits (distributed as in *augustus*) were not as marked as would have been expected from the deep foveæ of the larva, the pigment in them was dark brown instead of black, and appeared to be absent in some. By morning the chrysalids were brownish-yellow, sprinkled with pitchy spots, the pits scarcely noticeable, the straw-coloured spiracles standing out in sharp contrast. During the succeeding 24 hours the skin became steadily darker, the spiracles remaining light until the final coloration was attained.

*Recently separated from *P. pumila* according to Britton and Brown.

The Chrysalis.—Distinguished at once from the chrysalids of *irus*, *augustus* and *niphon* by its squat, compressed appearance, the abdomen being relatively stouter. This may be readily seen by comparing the figures (1, 2 and 3) in plate 5 with the figures of *irus* and *augustus* pupæ given in Vol. XXXVIII, No. 6 (June, 1906) and plate 3 of the current volume (May).

Ground colour warm orange-brown, marked with very dark brown, as follows: Each abdominal segment with a moderately large medio dorsal blotch crowded toward the posterior incisure; a larger supra-lateral area from just above the spiracle to a point somewhat dorsad of the lateral pit, extending the entire width of the segment and including the lateral and infra-lateral pits, which are black; a rudely-triangular infra-stigmatal spot, largest near the posterior incisure, tapering forward; on the ventral surface of those segments not covered by the wing-cases a few scattered, minute spots. The metathorax and sides of the mesothorax are of the same deep brown (in a strong light burnt-sienna), leaving the orange-brown as an irregular mediodorsal streak. Prothorax with an obscure dark transverse stripe near the posterior incisure, and a medio-dorsal slender line of the same colour. Face and wing-covers very dark from the many crowded small spots. Spiracles very noticeable, each bright yellow, set in an orange-brown area, except the thoracic. Prothorax with a delicate medial "ridge." Described from three specimens showing scarcely any variation.

Were it not for the fact that the darker colour covering most of the surface has been determined to be due to the presence of pigment I should have spoken of this as the ground colour, and the smaller orange-brown areas as markings. Such a description would have been, perhaps, easier to apply in identifying the pupæ, but would not have been accurate in the use of terms.

Possible Correlation between Larval Characters and Sex.—Unfortunately the numbers affixed to the leaf beside each chrysalis became detached, and the suggestion offered here is based upon my memory of where the three caterpillars spun their final mats and the position of the numbers as they lay after having fallen off. I regret that it did not occur to me to sketch the larvæ as they rested upon the leaf. To the best of my knowledge and belief the *green* caterpillar yielded a larger pupa containing a female; the two *red* larvæ yielding smaller pupæ containing males. I shall endeavour to verify this with others now being bred.

NOTE ON I. POLIOS.

In the lower part of the plate are represented paratypes No. 23 (♂ under surface), No. 24 (♂ upper surface), No. 25 (♀ under surface), and No. 26 (♀ upper surface), of *I. polios*, described in the CANADIAN ENTOMOLOGIST for June, p. 202. It may be pertinent to state that the food-plant of *polios* has been discovered, eggs secured, and the larvæ now being raised have already passed the first moult. The specific validity of the form is no longer open to question.

NEW COLEOPTERA FROM THE SOUTHWEST.—III.

BY H. C. FALL, PASADENA, CALIF.

Pteroloma caraboides, n. sp.—Blackish-brown, moderately shining, legs and antennæ somewhat paler. Antennæ as usual. Head sparsely finely punctate. Prothorax 2/5 (♂) to 1/2 (♀) wider than long, widest at or slightly in advance of the middle, base a little wider than the apex, sides moderately rounded, oblique and just perceptibly sinuate posteriorly, hind angles sharply defined, but slightly obtuse; disk evenly, rather feebly, convex, median line not at all impressed, side margin acute and slightly reflexed, a feeble impression within the hind angles; surface finely, sparsely punctate, the punctures somewhat unequal in size, and becoming more numerous near the basal and lateral margins. Elytra elongate oval, a little wider at base than the prothorax, more than three times as long as the latter, and more than one-half longer than wide ; sides arcuate, feebly sinuate before the apex, which is narrowly rounded ; striæ strongly impressed, distinctly but not coarsely punctate ; intervals very finely and sparsely punctulate, the alternate ones with a series of distinct and feeble larger punctures. Body beneath distinctly alutaceous, but shining and very finely, sparsely punctate. Epipleura minutely and sparsely punctate. Length, 6½–7 mm.

Wenatchee, Washington, collected by Prof. H. F. Wickham; Mt. San Antonio, So. California, a single example taken at an altitude of about 9,000 ft. by Mr. C. A. Richmond.

The male has the front tarsi quite strongly dilated, the first two joints of middle tarsi moderately so.

This species has the general form of *Forstræmei*, but differs—judging from the description—in the more finely punctate thorax, with median line unimpressed, the much less distinct serial punctures of the alternate elytral intervals, the nearly impunctate epipleura, and the more widely dilated male tarsi. According to Horn's description the sixth ventral segment is deeply longitudinally impressed in the female of *Forstræmei*. There is no sign of such impression in the female of the present species, though in the male of both this and *tenuicornis* the sixth ventral has a fine median impressed line. The resemblance of this species to *Bembidium spectabile* is quite striking.

Chrysobothris carmelita, n. sp.—Moderately elongate, feebly convex, piceous-bronzed ; front (♂) green ; occiput, front margin of pronotum narrowly, the front angles broadly, brilliant æneo-cupreous ; elytral impressions more or less cupreous ; beneath blackish, with faint green-bronze lustre, hind thighs æneo-cupreous in apical half. Front nearly flat, rather densely pubescent, uniformly densely punctate, occipital impressed line a little elevated anteriorly ; clypeus with deep oval emargination, arcuato-truncate each side. Antennæ bronzed, greenish at base, narrowed externally, third joint barely as long as the two following. Prothorax one-half wider than long, widest close to front angles, sides thence convergent and straight except for a feeble median sinuation, nearly to base, becoming slightly inflexed at the hind angles ; disk faintly impressed along the median line, and with a slight impression each side of the middle posteriorly ; punctuation dense, with a tendency to form transverse strigæ laterally, especially near the angles. Elytra ¼ wider than the prothorax, and about 3½ times as long, very nearly twice as long as wide, basal and intra-humeral impressions well marked, a shallow rounded fovea just before the middle, and two others at apical third ; inner costa distinct in apical half; second costa shorter, extending backward from the antemedian fovea ; surface densely punctate throughout ; side margin serrulate posteriorly, tips conjointly rounded with slight sectional sinuation. Prosternum lobed in front, densely punctate, and with rather long and dense white pubescence. Metasternum and ventral segments densely punctate at sides, less densely so at middle ; pubescence abundant, and in well-preserved examples made more conspicuous by the presence of a white efflorescence. Length, 7¼–8¼ mm.

Arizona. Two examples are before me, one without definite locality, the other from Hot Springs, collected by Barber and Schwarz. Both examples are males, having the anterior tibiæ arcuate, and with a rather strong apical dilatation, above which the inner margin is distinctly notched or impressed; middle tibiæ sinuate within and mucronate at tips, hind tibiæ straight; apical ventral segment broadly arcuately emarginate. One of the above examples has been in my collection many years, and was once submitted to Dr. Horn, who referred it doubtfully to *debilis*. It is, however, abundantly distinct from the latter by the dense punctuation of the entire upper surface, deeper clypeal emargination, brilliant colour of head and anterior margin of pronotum, form of prothorax, and other details. The front tibiæ of the ♂ in *debilis* are not emarginate above the dilatation.

Chrysobothris micromorpha, n. sp.—Elongate, not depressed, dark brown bronzed with traces of violaceous lustre on the anterior part of the pronotum and on parts of the elytra; front green (♂), vertex and occiput bright coppery-red; beneath piceous, faintly bronzed, tips of middle thighs and apical half or more of hind thighs brilliant coppery-red. Antennæ piceous, becoming bronzed at base, third joint much shorter than the next two united; outer joints gradually narrower. Front moderately convex, with conspicuous though not very dense white pubescence; punctuation moderately close and a little irregular, having a small smoother area each side of the median line, above which is a well-defined vertical chevron; clypeus broadly arcuately emarginate, sides subtruncate. Prothorax slightly less than twice as wide as long, sides subangulate at 2/5 from base, before which they are nearly straight and parallel, posteriorly straight and strongly convergent to base, which is narrower than the apex, and about 3/5 as wide as the base of the elytra; surface uniformly convex, without distinct impressions; punctures uniformly distributed, distant by rather more than their own diameter, and without tendency toward strigosity except very feebly near the hind angles. Elytra ⅔ wider than the prothorax, sides parallel and straight to about apical third, apex serrulate, surface without distinct foveæ except the basal ones; the inner costa feeble but evident toward the apex; punctuation similar to that of the pronotum. Prosternum rather strongly lobed in front, closely punctate anteriorly, a little less so posteriorly. Abdomen moderately punctate and pubescent, without lateral callosities. Length, 4½ mm.

Arizona. As in the preceding species, two examples are at hand, one without definite locality, the other taken at Hot Springs by Barber and Schwarz.

Both specimens are ♂'s, and have the front tibiæ slightly arcuate and dilated within at apex, middle tibiæ less arcuate, hind tibiæ straight; last ventral truncate and broadly feebly emarginate, the outer angles of the emargination not dentiform. The side margins of the last ventral segment are evidently though feebly serrulate, and this, together with the absence of pronotal foveæ or callosities, places this species in Horn's Group I. It is most nearly allied to *piuta*, Wick., which should evidently be referred to the same group instead of Group IV, as stated by its author, but is still smaller—in fact, the smallest species of the genus known to me—and lacks the elytral foveæ, which are well defined in *piuta*. In this latter the coloration of the upper surface is more brilliant, the sides of the prothorax less narrowed posteriorly, and scarcely at all angulate, the third antennal joint longer and relatively narrower.

Chrysobothris pubescens, n. sp.—Moderately robust, dark bronze, shining, distinctly but sparsely pubescent throughout. Head coppery (♀), front green (♂). Antennæ narrowed externally, bronzed in ♀, greenish in ♂, third joint much shorter than the next two together. Front closely punctate, without or with but a small feeble callosity each side of the median line; clypeus with broad triangular emargination, lateral lobes rounded. Prothorax one-half wider than long, sides rounded in front and behind, parallel and slightly sinuate at middle; disk nearly uniformly convex except for a shallow impression on the median line anteriorly, callosities wanting, punctuation moderately close. Elytra one-third wider than the prothorax, not quite twice as long as wide, basal foveæ broad, not very deep; discal foveæ three in number, one before the middle, the other two at apical third, the outer one a little in advance of the inner, and sometimes connected with it, all the foveæ more or less cupreous or rarely greenish; costæ somewhat variable, the inner one usually distinct from basal third to apex; the second feebler, scarcely elevated, interrupted by the foveæ; punctures rather fine and well separated, at least at the middle of the disk; apices rounded and feebly serrulate. Prosternum lobed in front, closely and rather coarsely punctate, pubescent, scarcely differing in the sexes; ventral segments brightly bronzed, rather sparsely punctured at middle, more closely so laterally, and with more or less evident callosities. Front thighs with moderate acute tooth, which is denticulate externally. Length, 7½–9 mm.

California. Not rare in the Southern Sierras at altitudes of 3,000 to 6,000 ft., occurring most commonly on scrub oak.

In the male the tibial characters are the same as in the allied *deleta*, and the last ventral is very similarly subsemicircularly emarginate. In the female of *pubescens* the last ventral has a much smaller emargination of nearly same shape as in the male, while in *deleta* (♀) the emargination is bisinuate. *Pubescens* is evidently broader and a little less convex than *deleta*, and—so far as my experience goes—may always be distinguished from the allied *deleta*, *deserta* and *lixa* by the anterior discal impression of the pronotum, which though slight is very constant, but is entirely lacking in the others. *Deleta* has a transverse series of four small callosities on the pronotum, the outer two often ill-defined. In *pubescens* these callosities are lacking, while in *deserta* they are larger and all four distinct. *Deserta* and *deleta* are very closely related; in fact, one of the two examples of the former in the Horn collection is really *deleta*. This specimen is from the vicinity of San Diego, in which region *deleta* seems to occur more frequently than elsewhere, while the type of *deserta*—the specimen bearing the label—is from the Mojave Desert. In this latter the eyes are separated on the vertex by a distance subequal to half the length of the pronotum on the median line, and the third antennal joint is fully twice as long as wide, while in *deleta* the eyes are separated by a distance equal to two-thirds the length of the pronotum, and the third antennal joint is less slender, never quite twice as long as wide. There is virtually no difference in the form of the anterior tibiæ of the male in these two species, notwithstanding Horn's remark, nor do I believe the elytral costæ can be depended on as a mark of distinction.

There is a manifest inconsistency in the Horn tabulation of groups in this genus, in which it is stated that the species of Groups II–V have the "disk of the thorax irregular, median line more or less sulcate." This character completely fails in Group V, which includes the species we are now considering. A better character for the separation of this group would be the pubescence of the entire upper surface, which is always very obvious in even fairly well preserved specimens, and which does not exist elsewhere in our species.

Chrysobothris smaragdula, n. sp.—Moderately elongate, bright green above, dark green, with slight violaceous tint, below, surface moderately shining, glabrous. Antennæ with first three joints green, outer joints piceous, feebly metallic, gradually decreasing in width, third joint nearly as long as the next three. Front feebly convex, strongly, closely punctate; clypeus broadly triangularly emarginate, arcuate each side. Prothorax nearly twice as wide as long, sides straight and parallel almost throughout, disk feebly, evenly convex, punctuation moderately coarse and close, with slight tendency to transverse strigosity. Elytra a little wider than the prothorax, sides parallel for three-fifths their length, then arcuately narrowed to apex, the tips separately rounded and serrulate; surface somewhat uneven, but without costæ or foveæ except the basal impressions; punctuation similar to that of the prothorax. Prosternum coarsely, densely punctate, the flanks more sparsely so; abdomen sparsely punctate and polished; ventral segments without callosities, the last segment with submarginal serrate ridge, the lateral margin interrupted but not serrulate. Prosternum lobed in front, anterior femora toothed as usual. Length, 6 mm.

Oak Creek Canon, Arizona (Prof. Snow).

Described from a single female (?) specimen.

This species must be referred to Horn's Group VIII, and is most nearly related to ***prasina;*** this latter, however, has the prothorax narrowed anteriorly, the punctuation sparser, the last ventral without submarginal ridge.

Acmæodera robusta, var. ***rubrosuffusa***, n. var.—In a series of specimens taken by Dr. Fenyes at Mojave, Cal., the basal portion of the disk of the elytra is broadly suffused with red. The prothorax is also brightly bronzed, and the abdomen violaceous-bronzed, instead of black as in the typical form. In this latter respect it approaches ***tuta***, of which, indeed, it might be considered a variety with about equal propriety.

Acmæodera Hepburnii, var. ***latiflava***, n. var.—This name is proposed for a form of *Hepburnii* in which the elytra are entirely yellow except the tip of the humeral umbone, a narrow sutural stripe, and one or two small spots at apical third. It looks so different from the typical form that it would naturally be separated in a cabinet arrangement, and has, indeed, been mistaken by collectors for a distinct species. It is known to me from the Yosemite region and from various points in So. California.

Acmæodera Bishopiana, n. sp.—Moderately stout, black, shining, not at all bronzed, prothorax with or without a very small yellow spot at sides near the base, elytra with numerous small irregular yellow spots, pubescence long, fine, erect, fuscous and cinereous, the latter colour predominating. Head densely punctate as usual, vertex finely carinate, clypeal emargination rather deep, nearly as in *labyrinthica*. Prothorax not wider than the elytra, twice as wide as long, widest a little before the base, surface coarsely, deeply punctate, the punctures well separated toward the middle, the interstices polished. Elytra with coarsely punctate striæ ; intervals narrow, nearly flat on the disk. Beneath rather strongly, closely punctate ; apical ventral plate small and feeble, the free edge thin and evenly arcuato-truncate. Length, 6.5–8 mm.

Bishop, Big Pine and Independence, Inyo Co., California. Collected by Dr. Fenyes, June 7–12.

This species belongs to the "Emarginatæ," and is most nearly related to *labyrinthica*, which is, however, on the average a larger species, always distinctly bronzed, the form slightly flatter, the prothorax more closely and relatively a little more finely punctate, the elytra with more numerous and intricate markings. *Bishopiana* resembles quite closely a form which I hold to be a variety of *dolorosa*, taken by Dr. Fenyes in the same region ; this latter is somewhat flatter, more pointed behind, and with distinctly more broadly, less deeply emarginate clypeus.

Acmæodera faceta, n. sp.—Parallel, subcylindrical, dorsum a little depressed. Head and thorax black, elytra dark blue, with a small orange-red marginal spot near the posterior fourth ; beneath blue-black. Head not densely punctate, front moderately impressed at middle. Prothorax slightly narrower than the elytra, gradually narrowed in front, sides subparallel in basal third or half, punctuation sparse at middle, closer at sides, surface polished, basal impressions feeble. Elytra parallel for two-thirds their length or more, post-humeral sinuation feeble ; striæ moderate, intervals rather narrow, nearly flat on the disk, more convex laterally. Pubescence fine, sparse, whitish throughout. Front margin of prosternum with two distant obtuse but rather prominent lobe-like teeth. Ventral segments rather finely and densely punctate at sides, more sparsely at middle ; last ventral with feeble apical crest. Length, 5¾–7 mm.

Santa Rosa, Lower California (Beyer).

This species resembles *stigmata* and *bivulnera* quite closely. The prosternal characters are nearly as in *stigmata*, which species is, however, a little more gradually narrowed behind, lateral red spot more anterior in position, the prothorax green-bronzed rather than black, the abdomen more evenly punctate. In *bivulnera* the front of the prosternum is quite different in outline, having a rather strong sinuate lobe at middle.

Acmæodera larreæ, n. sp.—Strongly convex, subcylindrical, head, prothorax and under surface distinctly æneous, elytra yellow, with four or five irregular pale brown fasciæ; pubescence sparse, fine, short, suberect and entirely whitish in colour. Antennæ very strongly serrate (♂) or moderately so (♀), the serration beginning with the fourth joint, which is as wide as the fifth; joints 4–10 all much broader and long. Head densely punctate, very feebly impressed. Prothorax one-half wider than long, sides not very strongly rounded, apex four-fifths as wide as the base, surface densely, almost cribrately punctate, median impression feeble, lateral basal foveæ moderately deep. Elytra barely as wide as the prothorax, sides feebly sinuate basally, gradually narrowed behind, striæ impressed, closely, moderately punctate, intervals narrow and more or less convex. Beneath with sparse white recumbent pubescence, prosternum truncate in front; abdomen rather sparsely, not coarsely, punctate, and polished; last ventral without apical plate. Length, 7½–9 mm.

The type is one of three examples taken by Dr. Fenyes at Mojave, Cal., on Larrea. In one specimen the brown bands are darker and wider, and the elytra might more properly be described as brown, with irregular yellow fasciæ. In this species the sexual differences in the antennæ are remarkable. Joints 4–10 are not only very broad in the male, but they are very densely minutely punctulate and clothed with an exceedingly short, erect blackish pile. In the female the surface of the joints is moderately punctulate and shining, and clothed as usual. By the broad fourth joint of the antennæ this species is related to *cribricollis*, *gemina* and *insignis*. By some mischance, *cribricollis* is, in my Synopsis of this genus, erroneously tabulated with those species having the fifth antennal joint abruptly wider than the fourth. The species is really very close to the one here described, but differs in having the elytral markings black instead of brown (perhaps not constant), the punctuation of the ventral segments coarser, especially apically, the last ventral with evident thick marginal crest. Males of *cribricollis* are as yet unknown, so it is not possible to say if a similar sexual disparity in the form of the antennæ exists.

Trirhabda labrata, n. sp.—Form and size of *flavolimbata*. Elytra brilliant green, with narrow pale margin, pubescence unusually sparse and short, the surface quite strongly shining, punctuation dense and rather coarse. Prothorax about twice as wide as long, more or less strongly transversely impressed, and with the usual three spots, these being large, sometimes confluent, metallic-green; surface highly polished and sparsely punctured, the pubescence nearly wanting. Head testaceous in front, labrum blackish; occiput entirely green, sparsely, finely punctured and shining. Antennæ in great part piceous; under side of body and legs testaceous, varied with dark green or piceous. In the male the last ventral is rather strongly and broadly emarginate at apex; in the female there is a small subcircular emargination, the sides of which nearly meet behind. The inner division of the claws is as usual a little shorter and more divergent in the female. Length, 6¼–7½ mm.

Monterey, California (Fenyes).

The brilliant green colour, sparse pubescence, shining surface and dark labrum are the distinguishing characteristics of this species. The punctuation of the elytra is also evidently coarser than in *flavolimbata*, and much coarser than in *luteocincta*, in both of which species the labrum is pale, or at most slightly dusky, the head more densely punctate and dull, the occipital plaga less extended, not as a rule involving the upper inner margin of the eye.

Trirhabda eriodictyonis, n. sp.—Oblong, rather robust, not broader behind, testaceous throughout, antennæ dusky except at base, head with a very small occipital plaga, which becomes linear in the female, and is rarely entirely wanting. Prothorax with the three spots small, black; elytra with greenish elongate humeral spot, which may extend the entire length of the elytra, or may become almost obsolete. Head densely, rather coarsely punctate, feebly shining; prothorax sparsely, feebly punctate or nearly smooth, polished; elytra densely, finely punctate.

Male with broad but distinct apical ventral emargination; female with much narrower but relatively deeper emargination. Length, 7½–9 mm.

This species occurs rather abundantly on a species of Eriodictyon ("Yerba Santa") at Pasadena, San Bernardino and elsewhere in Southern California.

It has been distributed quite generally as *caduca*, on the basis of an erroneons identification made years ago for the writer. The latter species is much smaller, very sparsely pubescent, more shining, less densely punctate, the dark markings without metallic lustre, the occipital spot much larger. It is known only from Owens Valley. *Nigrohumeralis*, Schf., is still closer to the present species, but in it the punctuation is somewhat coarser, and, like *caduca*, it is smaller and the dark markings are not at all metallic.

ON SOME HAWAIIAN HEMIPTERA-HETEROPTERA.

BY G. W. KIRKALDY. HONOLULU, HAWAIIAN ISLANDS.

Fam. MYODOCHIDÆ.

In the "Fauna Hawaiiensis—Hemiptera," in dealing with White's species of "*Cymus*," I had specimens before me of *C. criniger* only; since then I have seen White's *C. calvus*, and another species allied thereto, but with substylate eyes; these three form three genera, distinguished as follows:

1. Eyes substylate, prominent, extending laterally well beyond the pronotum, which is distinctly longer than wide; tegmina scarcely punctured .... *Nesomartis*, gen. nov.

1a. Eyes sessile, not prominent, not extending laterally so far as the transverse pronotum; tegmina strongly punctured .... 2.

2. Ocelli as far from one another as from an eye. Pronotum with a distinct transverse impression basal of the middle .... *Nesocymus*, gen. nov.

2a. Ocelli much nearer to the eyes than to one another. Pronotum not transversely impressed .... *Sephora*, Kirkaldy.

The character of the nonpunctuation of the tegmina in *Nesomartis* would remove it from the Cyminæ in the usual acceptation of the subfamily, but it is obviously closely related to *Nesocymus* and *Sephora*. I cannot find any character to separate satisfactorily the Cyminæ from the Astacopinæ (Lygæinæ of some authors), and the amalgamated subfamily should be known as Cyminæ. Stal (Hem. Afr., ii, 120) relies on the tegmina being wider than the abdomen, and the exterior margin of the corium dilated, while his "Lygæida" have the tegmina not, or only partly, dilated and wider than the abdomen, but the latter is not the case in many forms. I think that *Nysius* is more closely allied to *Cymus* than it is to *Stalagmostethus* and its allies.

Sephora, Kirkaldy.

Sephora, Kirkaldy, 1902, Faun. Haw., iii, 161.

The rostrum barely reaches to the middle coxæ, first segment *not* extending quite so far as the base of the head. Collar feebly marked, pronotum scarcely constricted there, and not constricted again towards the base. Ocelli much nearer to the eye margins than to one another.

1. *criniger* (White).

Cymus criniger, F. B. White, 1881, A. M. N. H. (5), vii, 57.

Sephora criniger, Kirkaldy, 1902, Faun. Haw., iii, 161, Pl. v, f. 45.

The specimens before me agree fairly well with White's description, except as follows: the general colour of the head is paler; the membrane is almost always faintly marked longitudinally with a fuscous stripe, and the rostrum just reaches to the middle coxæ, instead of to the middle of the mesosternum, while the first segment does not reach as far as the base of the head, instead of to the middle of the prosternum. I feel sure White's description is incorrect in this.

Hab.—Lanai and Molokai, as detailed previously; White records it from Maui at 5,000 feet, under stones, but Dr. Perkins informs me that the specimens collected by him were beaten from the branches of trees, where they probably live under moss or lichens.

Nesocymus, gen. nov.

Allied to the last, but the distances between the ocelli, and from an ocellus to the nearest eye margin, are subequal. The rostrum reaches to the middle of the mesosternum, the first segment reaching to the base of the head. Vertex more convex, and eyes larger. Pronotal collar more marked, the pronotum exteriorly rounded after this, and divided into two parts by a median transverse very narrow impressed line.

1. *calvus* (White).

Cymus calvus, F. B. White, 1881, A. M. N. H. (5), vii, 56.

Sephora calvus, Kirkaldy, 1902, Faun. Haw., iii, 162.

Hab.—Oahu (as previously noted), at roots of herbage in the mountains, from 1,500–2,000 ft. Dr. Perkins has lately collected a series of forms agreeing with White's description, except as follows: there is always a dark, broad, fuscous longitudinal stripe on the membrane (not noted by White), and his rostral proportions do not agree.

Nesomartis, gen. nov.*

Differs from the two preceding genera by the very transverse vertex and substylated eyes, which extend laterally much further than the pronotum; by the ocelli as close to one another as to the eye margins, and being close to the anterior margin of the pronotum (they are somewhat distant in the other genera), by the elongate, collarless pronotum, whose lateral margins are straight and scarcely divergent. Tegmina scarcely punctured. Rostrum reaching middle coxæ, mesosternum rather deeply sulcate posteriorly.

N. psammophila, sp. nov.

Pale greenish, drying to testaceous, with sparse whitish-pubescence, a lævigate elongate spot on each side of the pronotum anteriorly.

**Nesos*, island, *martis*, maiden.

Scutellum with a percurrent fuscous longitudinal line extending to apex of clavus. Tegmina hyaline, each with a median longitudinal fuscous streak, which converge on the membrane when the tegmina overlap in repose. Fourth segment and apex of second segment of antennæ fuscous. Metanotum and tergites dark fuscous, margined laterally with testaceous. First segment of antennæ reaching just beyond head, second segment about 4½ times as long as the first, and about as long as the incrassate fourth, which is a little longer than the third. Length, 4¾ mm.

Hab : Oahu, on the coast on the ground amongst *Sida* and other plants (R. C. L. P.) ; Hawaii, Kona coast in similar situations (R. C. L. P.). The Hawaiian specimens have the second and fourth segments of the antennæ each five times as long as the first, but do not otherwise differ appreciably from the typical Oahuan.

1. *Orthœa nigriceps* (Dallas).
(= *Orthœa nigriceps*, Kirkaldy, olim.)

F. B. White, on Blackburn's authority, states that this species does not occur below about one thousand feet above sea level, but that was probably a mistake then, and certainly is so now, as it comes at night to light in houses from sea level upwards. It occurs also in Tahiti and the Philippine Isles. Mayr recorded it from New Zealand, but White, on the strength of an allied form (*Douglasi*) from the latter country, considered Mayr's record erroneous. Distant has now, however, considered *Rhyparochromus inornatus*, Walker, from New Zealand, to be a variety of *O. nigriceps*, and if Distant's identification be correct, it is probable that Mayr's New Zealand forms were actually *O. nigriceps*.

2. *O. periplanios*, sp. nov.

This pretty little species is much smaller and less robust than the preceding ; it does not fit into either of Stal's primary groups of "*Pamera*," being removed from "*a*" by the anterior lobe of the pronotum being very distinctly transverse, from "*aa*" by the said lobe being very slighly narrower than the head. It is probably allied to *vincta*, Say, but has unicolorous, dark ochraceous fore femora.

Black, with silvery-gray pubescence ; first three segments of antennæ, the rostrum and legs ochraceous, fore femora darker ochraceous, last segment of rostrum dark. Tegmina yellowish-testaceous, strongly punctured with dark brown, costal margin paler, immaculate, except the apical margin ; apical margin of corium broadly but unevenly blackish-brown, sometimes extending a little way along the inner margin, a white spot at the inner posterior angle. Membrane pale, with several longitudinal pale smoky streaks. Head distinctly longer and slightly wider than the anterior lobe of the pronotum; first segment of antennæ reaching beyond the head, fourth segment the longest, fusiform; rostrum reaching to the fore coxæ. The collar well marked, not as wide as the anterior lobe; the latter nearly twice as wide as its length, laterally rounded, basally very slightly wider than in front; posterior lobe finely but sparsely punctured, raised and rounded behind, scarcely shorter medially than the anterior lobe, very distinctly wider than the head, its lateral margins diverging at first obtuse-angularly, then turning sharply parallel with the long axis of the body; posterior margin very lightly emarginate. Scutellum medially carinate on the posterior two-thirds. Fore femora incrassate and spinose, tibiæ not toothed, but apically a little widened and subbifid.

Length, ♂, 3⅛ mm.; ♀, 4 mm.

Hab.: Hawaiian Archipelago (introduced), now spread over Kauai, Kekaha (F. W. T.); Oahu, from sea level to Mt. Tantalus, 1,500 feet (R. C. L. P., W. M. G., G. W. K.); Maui, Olowalu (O. H. S.); comes frequently to light.

In examples not fully matured the collar and posterior lobe of pronotum may be dark ferruginous, instead of black.

The types (♂ ♀) are in my collection.*

Fam. REDUVIIDÆ.

Triatoma rubrofasciatus, DeGeer.

Probably originally a native of Brazil, now widely distributed. It is found in these Islands near cottages of the poorer sort.

Zelus peregrinus, Kirkaldy.

Mr. O. Heidemann has (*in litt.*) identified this as identical with *Z. Renardii*, Kolenati (1856, Bull. Soc. Nat. Moscou, XXIX, 460, Pl. III, fig. 2), from California, but I am not disposed to admit it on present evidence. Kolenati's figure is useless, and he states that the apex of the femora and base of the tibiæ are intensely sanguineous, which I do not consider them to be, at least noticeably. The anterior lobe of the pronotum is also not very distinctly quadrituberculate, nor is the abdomen entirely lurid. *Z. Renardii* has not to my knowledge been redescribed since 1856.

Milu, gen. nov.†

Differs from *Reduviolus*, W. Kirby, by the incrassate first segment of the antennæ and the prominent blunt spine arising well in front of the antennal insertion from the side of the head, which I formerly overlooked, but which has been pointed out to me by Dr. Perkins.

*Since writing this I have seen specimens from Australia and Viti.

†*Milu* is the Hawaiian ruler of the dead.

1. *kerasphoron*, nom. nov.

= *Reduviolus rubritinctus*, Kirkaldy nec Blackburn. The latter has the incrassate antennæ, but as the head spines are not mentioned it cannot yet be included in *Milu*. *M. kerasphoron* is very much like *R. sharpianus*, Kirkaldy, in pattern.

SUMMARY :

Sephora criniger (White.)
Nesocymus (n.g.) *calvus* (White).
Nesomartis (n.g.) *psammophila*, n. sp.
Orthæa nigriceps (Dallas).
O. periplanios, sp. nov.
Triatoma rubrofasciatus (DeGeer).
Zelus peregrinus (Kirkaldy).
Milu (n.g.) *kerasphoron*, sp. n.

NOTES ON CENTRAL AMERICAN HEMIPTEROUS FAUNA.

BY G. W. KIRKALDY, HONOLULU, HAWAIIAN ISLANDS.

While preparing his account of the Homoptera of Central America (Biologia Centrali Americana, Rh. Hom. II), Mr. Distant must have neglected to refer to the third part of Stal's "Analecta hemipterologica" (1869, Berlin Ent. Zeit., XIII, 225–42), as he has omitted mention of four species therein described ; these are as follows :

Aphrodisias (=|| *Compsoptera*) *cacica*, Stal ; *Acmonia anceps*, Stal ; *Cyrpoptus nubeculosus*, Stal, and *C. ferruginosus*, Stal, all from Mexico.

In the Annals and Mag. Nat. Hist. (7), XVIII, 193 (1906), Mr. Distant twice quotes his genus "*Amilavaca*" (as a syn. of *Echetra*); this was, however, originally written *Amalivaca*.

In the same volume of the "Biologia" Dr. Fowler has redescribed *Scolops*, Germ., under the name of *Ornithissus*, incorrectly placing it in the Issidæ. *S. Cockerelli* seems to be a good species (p. 122).

I have not seen specimens, but the descriptions and figures, as well as comparison with *Mistharnophantia*, Kirkaldy, lead me to believe that *Hypancylus*, Fowler (p. 114), is a Poekillopterine, not an Issine.

Of the two Fulgoroids considered uncertain by Dr. Fowler, *Rhotala* is an Achiline, while *Syntames* is a Derbid, his *delicatus*, var. *chiriquensis* (p. 139), being a good species.

In the Cicadidæ, Mr. Distant's new name of *Germari* (p. 140) for *Proarna* ||*grisea* (Germar) is unnecessary, as on his own showing there are other names available. The insect should probably be known as

Proarna invaria (Walker). Mr. Distant has copied the mistake into his Catalogue of Cicadidæ.

The second volume of the Homopterous part ends very abruptly at p. 316, in the middle of a sentence; this was published in August, 1903!

In the Heteroptera (Vol. II.) Mr. Champion has confused under one generic name, *Lutevopsis*, two distinct genera.

Lutevopsis, type *longimanus*, Champ., has a few large spines on the fore femora, and the hind femora extend much farther than the abdomen posteriorly, and are not pilose; the tegmina are not picturate.

Panamia, gen. nov., type *ornata* (Champ.), is somewhat allied to *Ploiariodes*, White, but has no scutellar spines; it has no large spines on the fore femora, the hind femora do not extend farther posteriorly than the abdomen, and are lightly pilose; the tegmina are picturate.

The head and pronotum are also very different in the two genera.

Since the publication of Bulletin IV of the Div. Ent. H. S. P. A., I have received Melichar's fine Monograph of the Issinæ, and have been able to confirm the two Issines noted by me from Arizona.

(1) *Bruchomorpha mormo*, Kirk., is allied to *B. pallidipes*, Stal, but is concolorous except part of the legs (duly described).

(2) *Picumna ovatipennis* (Walker) may be confirmed.

1. *Plinthærus mexicanus*, Spinola, 1850, Mem. Soc. Ital. Modena, XXV (sep. p. 115). This genus is treated by Stal, in discussing the Ethiopian forms, as a homonym of *Ptyelus*, Lep. and Serv. I cannot identify *P. mexicanus* with any of the Cercopidæ enumerated by Fowler.

2. The use of *Tetigonia* in Hemiptera has been objected to by Jacobi (in his current works) as being preoccupied by *Tettigonia* in Orthoptera. I cannot agree, especially as Geoffroy does not refer to Linneus's genus; even then, however, Jacobi's new name, *Tettigoniella*, would fall before *Cicadella*, Latreille, 1817 (Cuv. Règne An., III, '06), of which the *Tettigonia* of Olivier and Germar is the typical subgenns, as stated by Latreille himself.

3. *Microcentrus*, Stal, 1869, = *Phaulocentrus*, Fowler, 1896. Stal gives *caryæ* (Fitch) as the type of his Membracid genus. Fowler rarely cites types for his genera, but as *caryæ* is the first mentioned, it may be taken as the type.

4. In the B. C. A. Hom., II, Fowler refers to the *Achilius bicinctus*, Spinola, redescribes and figures what he supposes to refer to it.

I do not believe that Spinola's species really refers to *Colgorma* (=||*Rudia*); Stal was uncertain. Fowler's *bicinctus* can scarcely be the same as Spinola's, as the venation is too discordant. Spinola's figures are mostly excellent, and there is no reason to force his South American form to fit an at least superficially different Central American. I therefore propose *Colgorma Fowleriana*, n. n., for *Rudia bicincta*, Fowler, not = *Achilius bicinctus*, Fowler.

A PRELIMINARY LIST OF THE CONOPIDÆ OF NEBRASKA.

BY PAUL R. JONES, UNIVERSITY OF NEBRASKA, LINCOLN, NEBRASKA.

1. CONOPS, Linné.

1. *Conops brachyrhynchus*, Macquart.—Specimens from West Point, Lincoln and Meadow, Nebraska, which agree with the description, except that the cheeks and facial grooves are slightly darkened in some of the specimens. There is also a variation in size, the specimens being from 8 to 12 mm. in length.

2. *Conops fronto*, Williston.—Numerous specimens from Glen, Sioux County, Lincoln, Nebraska City, Haigler, McCook and Pine Ridge, Nebraska. Common in northwestern Nebraska in the fall.

3. *Conops xanthopareus*, Williston.—Numerous specimens from Lincoln, West Point and Glen, Sioux County, Nebraska. Common in the eastern and in the north-western part of the State in August and September. This is the first record of its being taken this far west.

2. PHYSOCEPHALA, Schiner.

1. *Physocephala affinis*, Williston.—Specimens from West Point and Glen, Sioux County, Nebraska, which show considerable variation in the frontal stripes, markings of cheeks and wings, and length of the ultimate segment of the fourth vein. The cheeks in two specimens are entirely brown

2. *Physocephala marginata*, Say.—Two specimens from Lincoln, one from Weeping Water, and one from West Point, Nebraska, which answer to the description, except that the specimens from Lincoln and Weeping Water are about 15 mm. in length. The specimen from West Point is smaller, and slightly lighter in colour. Formerly recorded from Pennsylvania and New Hampshire.

3. ZODION, Latreille.

1. *Zodion fulvifrons*, Say.—Numerous specimens from Lincoln, West Point, Halsey, Cedar Bluffs and Glen, Sioux County, Nebraska, which show great variation in size and coloration. Very common over the entire State.

2. *Zodion obliquefasciatum*, Macquart.—Six specimens from Dundy Co. and Lincoln, Nebraska.

3. *Zodion parvum*, Adams.—Seven males and four females from Glen, Sioux County, Nebraska, August, 1906, on *Helianthus* and *Solidago* (P. R. Jones). As this species has hitherto been known from but a single male from Arizona, I give a description of the female:

♀.—Length, 3.5 mm. Black species. Face and cheeks yellow, the latter with a silvery reflection, front fulvous, with a narrow black line on each side, vertex black. Antennæ red, first joint and upper part of third blackish, arista black. Proboscis black, 2.4 mm. in length, labella in length equal to the height of the eye. Palpi short. Mesonotum and scutellum black, subfulgent, pollen gray, more evident on the sides. Legs black, except the base of tibiæ, metatarsi and pulvilli, which are yellow. Coxæ and outer part of tibiæ with a silvery sheen. Wings nearly hyaline, very slightly tinged with brown; first posterior cell closed and petiolate, petiole nearly as long as the posterior cross-vein. Pile everywhere black.

4. *Zodion scapulare*, Adams.—Ten males and ten females, and two pairs taken in copula; Lincoln, Nebraska, July and September, and Glen, Sioux County, Nebraska, August (P. R. Jones). Formerly known from a single male from Arizona. The female agrees with the description of the male, except that the abdomen is entirely black, subfulgent with gray pollen, which is more prominent on the sides. The whole series varies from 5 to 6.5 mm. in length. The proboscis is about 4 mm. in length, with the labella nearly as long as the height of the eye. The petiole of the first posterior cell is only slightly longer than the small cross-vein.

5. *Zodion pygmaeum*, Williston.—Numerous specimens from Lincoln, West Point and Glen, Sioux County, Nebraska, on *Solidago* (P. R. Jones). Rather common in the State from June to August. Formerly recorded from California, Colorado and Mexico.

4. Stylogaster, Macquart.

1. *Stylogaster neglecta*, Williston.—One female from West Point, Nebraska, June 22, 1905 (H. S. Smith), which agrees in every way with the description.

5. Dalmannia, Robineau-Desvoidy.

1. *Dalmannia nigriceps*, Loew.—Two males from Lincoln, Nebraska, and two females from Sioux County, Nebraska, which agree with the description, except that the posterior femora of the males are black, with the base and apex yellow, and the anterior femora in the females are black, except at the apex, which is yellow.

6. ONCOMYIA, Robineau-Desvoidy.

1. *Oncomyia abbreviata*, Loew.—One male from Sioux County, Nebraska, May, on *Oxytropis*. The legs are black, except the base and apex of hind femora, base of all the tibiæ and metatarsi, which are yellow.

2. *Oncomyia Baroni*, Williston.—Specimens from West Point, Lincoln and Glen, Sioux County, Nebraska, which show considerable variation in the coloration of the antennæ and legs.

3. *Oncomyia loraria*, Loew.—Two males from Lincoln, Nebraska, which on account of their small size I believe should be placed here. They agree with Loew's description, except that the lines of the thorax are indistinct, and the second joint of the proboscis is not longer than the first, but is about equal to it. Length, 3.5 mm.

4. *Oncomyia propinqua*, Adams.—A male on *Cleome* and a female on *Petalostemon*, both from Glen, Sioux County, Nebraska, August, 1906 (H. S. Smith). This species is evidently very close to *O. Baroni*, if not a variety of it. It can be separated, however, by its more slender form, longer and more delicate proboscis, and more black colour in general. The legs are entirely black, except the extreme base of the tibiæ, which is yellow.

1. MYOPA, Fabricus.

1. *Myopa clausa*, Loew.—Numerous specimens from Lincoln and Sioux County, Nebraska, April and May. The specimens vary from 5.5 to 9.5 mm. in length, and show some colour variation also.

PRACTICAL AND POPULAR ENTOMOLOGY.—No. 21.

THE SCOLYTIDÆ OR ENGRAVER-BEETLES.

BY J. W. SWAINE, ITHACA, N. Y.

(Continued from page 195.)

THE AMBROSIA- OR TIMBER-BEETLES.—The Ambrosia- or Timber-beetles breed entirely within the wood, the eggs of some species being laid well within the heart-wood. There may be several secondary egg-tunnels cut by two or more females, branching from a primary tunnel, which leads from the common entrance hole. Rarely the tunnels of closely-allied species branch from a common entrance hole.

The number of males in this group is small, in some species there being seldom more than one or two males in a brood of fifteen or twenty. In many species the males are apterous, and the females are fertilized before leaving the tunnels in the spring. Among the Bark-beetles the males are apparently quite as numerous as the females.

In two genera, Platypus and Xyleborus, the eggs are deposited free in the tunnels. The larvæ of Platypus live free in the tunnels until nearly ready to pupate, when pupal cells (cradles) are cut from the sides of the tunnels deep within the wood.

The larvæ of Xyleborus live and pupate within the parent tunnels without cutting pupal cradles. In Corthylus, Trypodendron, Pterocyclon and Gnathotrichus the eggs are laid in shallow niches cut by the female along the sides of the tunnel, and usually well within the wood; the larvæ extend these niches away from the tunnel, forming larval cradles, in which they remain until mature. The length of the completed cradles is slightly greater than that of the adult beetle.

The adults of the Ambrosia-beetles bestow great care upon the young larvæ, supplying them with the food-fungus, referred to below, and removing the excrement from the cradles. In some species even older larvæ assist in caring for the eggs and younger larvæ. The habits of many species are almost as remarkable in this respect as are those of the social Hymenoptera.

The chief and probably the entire food of these beetles is a fungus known as Ambrosia, which they propagate within their tunnels. From this habit comes the name "Ambrosia-beetles." The tunnels are kept entirely free from chips and refuse, and the walls are covered by the fungus growth. So far as known, except in the cases of a few closely-allied forms, each species of beetle uses a characteristic species of fungus. The mycelium of the fungus pervades the tissue about the tunnels for one or two millimetres, colouring the wood dark brown or black, so that the tunnels have the appearance "of having been bored with a red-hot wire." By this means the tunnels of Ambrosia-beetles are easily distinguished from those of all other wood borers. When new tunnels are cut, the fungus is carried there by the beetles, and started upon the tunnel walls, in some cases upon specially-prepared beds of chips and excrement.

When working in large trees some species enlarge the same set of tunnels through several generations; but usually each generation excavates a new abode.

An excellent discussion of the habits of the Ambrosia-beetles, by Mr. H. G. Hubbard, is published in Bulletin No. 7 of the U. S. Division of Entomology.

THE TWIG-BEETLES.—The Twig-beetles include a few species belonging mainly to the genera Hypothenemus, Pityophthorus and Micracis. They bore into the bark and wood of terminal twigs of trees and shrubs both for food and for breeding purposes. They feed upon the bark and wood, and in some cases apparently upon buds and young shoots. Some engrave the wood surface as do the Bark-beetles; some have in addition deep chambers within the wood; and with others the primary tunnel is cut through the pith itself. With some species the eggs are laid free in the primary tunnels, and the larvæ either feed upon the tunnel walls or cut longer or shorter mines through the wood. Several species of this group have a very close relation to a fungus always found in their tunnels.

A summary of the burrowing habits of these first three groups brings out some interesting relations. Among the Bark-beetles the eggs are usually laid in niches along the sides of the primary tunnels, and the larval mines are usually well-developed. A few species cut their tunnels and mines entirely in the bark; many cut them between the bark and the wood, the pupal-chambers being merely an enlargement of the ends of the larval-mines; others form the pupal-chamber by driving the ends of the larval-mines a half inch or less vertically into the wood, some even cutting the distal half of the larval-mines just below the wood surface; and lastly, a very few small species cut almost the entire system of tunnels and mines slightly below and parallel to the surface of the wood. The Twig-beetles cut both tunnels and mines, when the latter are present, through the wood and pith of twigs. Among the Ambrosia-beetles the tunnels are in all species entirely within the wood, but the depth to which they enter varies considerably with the species. In the genera Corthylus, Pterocyclon, Trypodendron and Gnathotricus the eggs are laid in niches along the sides of the tunnels, and the larvæ cut very short mines, known as cradles. The species of Platypus lay the eggs free in the tunnels, but the larvæ when nearly ready to pupate cut short cradles in which they pupate and remain until mature. In the genus Xyleborus the eggs are laid free within the tunnels, but the larvæ cut no cradles, pupating in the primary tunnels. There is thus a fairly well-marked gradation both as to the depth of the tunnels and mines below the surface and as to the degree of development of the larval mines.

The fourth group contains those species not included among the Bark-beetles, Ambrosia-beetles and Twig-beetles. The American species are few in number. *Coccotrypes dactyliperda*, an imported form, burrows in date seeds; *Cryphalus jalappæ* is found in jalap root; *Hypothenemus eruditus* burrows in nuts, book-bindings, and other dry substances, as well as in dead twigs of grape and orange, and the young leaves of sugar-cane; *Pityophthorus coniperda* occurs in pine cones; *Xyleborus sacchari* attacks the sugar-cane; *Hylastinus obscurus* bores in the roots of clover; and *Cactopinus Hubbardi* in the pith of the giant cactus.

Enemies of the Scolytidæ.—The Scolytids have many natural enemies. They are preyed upon by many predaceous and parasitic insects, by birds, and are frequently attacked by fungous diseases.

Adults and larvæ belonging to the families Cleridæ, Staphylinidæ, Colydiidæ, Histeridæ and others enter the burrows and feed upon the eggs, larvæ, pupæ and adults of the Scolytids. The predaceous larvæ often burrow through the larval-mines after the Scolytid larvæ, which they finally overtake and devour. Various dipterous larvæ feed upon the eggs and younger stages. Many hymenopterous parasites, Braconids, Chalcids and Proctotrypids, prey upon the larvæ and pupæ, and have even been bred by Dr. Hopkins from the adults, the parasite emerging through a hole cut in the elytra. Larvæ of large wood-boring beetles, such as Monohammus, destroy the Scolytid tunnels and prove serious enemies to the beetles. Woodpeckers destroy large numbers of the Bark-beetles, but apparently do little to check their ravages.

The tunnels, especially of the Timber-beetles, are frequently overrun with various species of mites. The eggs of these mites hatch before the young beetles are ready for their flight, and in this way young and adult mites are carried by the beetles to the new tunnels. At certain times the declivity of the elytra of various species of Ips (Tomicus) will be found covered with minute mites, and *Pterocyclon mali* and *P. fasciatum* are frequently almost completely covered with them upon emerging from their tunnels in the spring.

Fungous diseases are sometimes very injurious. All stages of the insects are frequently found, more particularly in wet weather, filled and covered with the white mycelium of the fungus. In a felled pine log I noticed that hundreds of adult *Ips pini* had died from this cause in less than two weeks.

Friends of the Scolytidæ.—As these beetles feed mainly upon dying and dead branches and trunks of trees, any cause which tends to weaken or destroy the trees aids the Scolytids in supplying the proper food-plant. Heavy storms, forest fires, other insects, and the destructive work of man, are perhaps the chief of these.

Economic Importance.—Owing to the destructive habits of many of its members, the family Scolytidæ is of considerable economic importance. The injury done by these beetles may take two forms: living trees may be weakened and killed, and standing and felled timber and sawn lumber may be rendered useless for many purposes by the tunnels of the beetles.

But few Scolytids attack living, healthy trees, although there are a few species which apparently choose only trees in this condition. The majority of species attack only dying or dead trees.* Stumps, diseased or dead branches, brush piles and recently-felled logs are their favourite breeding places. Most species will not, as a rule, molest living trees at all if rapidly-dying and recently-felled food-plants are available, but if trees in this condition are not to be had in sufficient quantity, many of these species will attack perfectly healthy trees and prove very destructive. Between 1882 and 1889 *Polygraphus rufipennis*, which does not ordinarily feed upon living trees, destroyed, according to Dr. Hopkins, approximately 10% of the 500,000 acres of growing spruce in West Virginia.

The injury done by the species which attack healthy and diseased trees is, in certain regions and at recurring intervals, very considerable. The work of *Dendroctonus frontalis* in the spruce and pine of West Virginia and the adjoining States, of *D. piceaperda* in the spruce of the Northeast, and of *D. ponderosa* in the spruce and pine of the Black Hills of South Dakota, may be cited in illustration. *D. frontalis* and *D. ponderosa* attack the living, healthy spruce and pine, and in spite of the resin are able successfully to rear their young within the bark. The tunnels and mines thus formed interfere seriously with the flow of sap, and either kill the tree outright or induce an unhealthy condition favourable to the attacks of other borers and fungous diseases. It seems very probable that many destructive forest fires have been fed by trees dying or dead from the attacks of Scolytids. In 1903 Dr. Hopkins estimated that the destruction, in the previous three or four years, of 10% of the white pine and 75% of all other species of pine, throughout an area of over 10,000 square miles in the States of Virginia and West Virginia, was to be attributed to the ravages of *D. frontalis.* In 1904 the same writer pointed out that *D. ponderosa* had been the primary cause of the destruction of 1,000,000,000 feet of Bull Pine in the Black Hills of South Dakota and the Rocky Mountain region.

The Timber-beetles, by driving their tunnels through the wood in many directions, often render timber unfit for use.

Hylastinus obscurus breeds in the roots of clover in many parts of the Northeastern States and in Canada, and in some localities proves a serious pest.

Corthylus punctatissimus occasionally does considerable damage in young sugar-maple plantations.

Scolytus rugulosus, the fruit bark-beetle, attacks unhealthy fruit trees of all sorts, and occasionally bores in apparently perfectly healthy trees.

Phlœotribus liminaris frequently attacks diseased peach and cherry.

Xyleborus dispar sometimes occurs in diseased apple trees.

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*(A few breed in dead wood only.)

Mailed July 8th, 1907.