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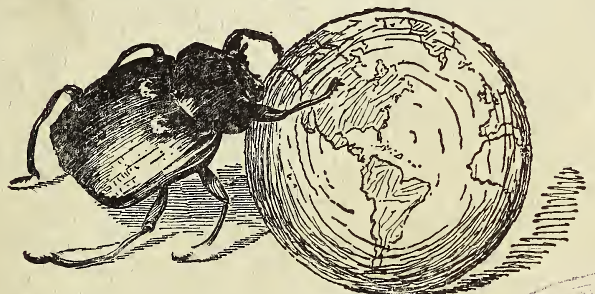

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Edited by HARRY B. WEISS

Publication Committee

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# JOURNAL

OF THE

New York Entomological Society

VOL. XLII MARCH, 1934 No. 1

ARANEARUM SPECIES NOVÆ, II

BY PROF. S. SPASSKY

NOVOCHERKASSK, U. S. S. R.

Drassus Shumakovi nova species.

Femina. Cephalothorax 3.75–4.5 mm. longus, 2.75–3.25 mm. latus, postice late emarginatus, parte cephalica anteriora versus modice angustatâ.

Oculorum series posterior leviter procurva; oculi medii postici lateralibus paullo majores, pallidi, deplanati, oblongi, obliqui, inter se radio majore remoti; laterales ab eis spatio sescuplo eorum diametro paullum majore distantes; oculi antici subæquales, medii inter se diametro, a lateralibus ne dimidio radio quidem remoti. Area oculorum mediorum rectangula, paullo longior quam latior. Clypeus sub oculis lateralibus eorum diametrum altitudine aequat.

Mandibulæ ad sulcum unguicularem dentibus armatæ antice 3, e quibus superrimus caeteris multo minor, postice—1, graniformi.

Maxillae transversim impressae, latere exteriore emarginato.

Labium duplo fere longius quam basi latum, apicem versus angustatum, apice rotundato-truncatum.

Pedes, praesertim coxae, femora et tibiæ, subter pilis longis, pallidis tecti. Femora omnia supra ad latus anticum aculeis 1. aut 1.1. ornata; praeterea femora quatuor anteriora aculeis dorsalibus 1.1., posteriora quatuor aculeis dorsalibus 1.1.1. et supra ad latus posticum 1.1. ornata. Tibiæ I. subter ad latus anticum 1.1. et ad latus posticum 1. aut nullo; tibiæ II. subter utrimque 1. et in latere antico in dimidio apicali 1; tibiæ III. aculeo dorsali 1. aut nullo, subter ad latus anticum 1.1.1. et ad latus posticum 1.1., in latere antico 1.1.1., et in latere postico 1.1.; tibiæ IV. aculeis dorsalibus 1.1., utrimque 1.1., supra ad latus anticum et posticum 1. et subter 2.2.2. ornatæ. Metatarsi quatuor anteriores subter ad basim 2., metatarsi quatuor posteriores supra ad latus anticum 1.1., subter 2.2.2., in latere antico 1.1.1., præterea metatarsi III. supra ad latus posticum 1.1. aut 1.1.1. et in latere postico 1.1., metatarsi IV. supra ad latus posticum 1.1.1. et in latere postico 1.1.1. ornati. Tarsi omnes et metatarsi I et II. scopulis densis instructi.

Abdomen mamillis exclusis 4–6.5 mm. longum, 2.5–4 mm. latum, pilis plumatis dense tectum.

Epigynes (Fig. 1.) area subrotundata; in areæ dimidio postico duæ foveæ sitæ, paene transversæ, inter se circiter diametro suo majore remotæ, sat profundæ, fere reniformes, marginibus nigris corneis,—margine antico concavo—circumdatæ; fovearum margines interiores in costas duas corneas, nigras producti, posteriora versus directas, postice inter se appropinquantas et usque ad epigynes marginem posticum pertinentes. Ad foveæ utriusque latus anticum, internum et posticum et partim in foveæ fundo macula longa (receptaculum seminis), nigricans, curvata, sigmoidea, antice rotundato-dilatata et incurvata, postice rotundata translucet. Areæ epigynes pars inter maculas supradictas sita leviter impressa.

Cephalothorax rufus, antice plus minusve ferrugineus, sulco nigro-fusco, margine concolore. Mandibulæ, labium et maxillæ ferrugineæ.

Sternum infum, margines versus ferrugineum.

Palpi et pedes rufi, apicem versus ferruginei.

Abdomen cinereo-albidum.

Mas. Parum differt a femina.

Palporum pars femoralis sat longa, depressa, incurvata, apicem versus dilatata, supra aculeis 1.2. et supra ad latus anticum 1. ornata; partes patellaris et tibialis desuper visæ longitudine subaequales; pars patellaris setis dorsalibus 1.1. et supra ad latus anticum 1. ornata; pars tibialis (Fig. 2) subter et in apice,—praesertim in latere exteriore—pilis valde longis pallidis tecta; tibiæ latus exterius in apice processu valde longo, subrecto, tenui, acutissimo, in dimido apicali corneo et translucenti, foras et anteriora versus directo, instructa; præterea tibia aculeis ornata: supra ad latus anticum 1.1., supra ad latus posticum 1. et in latere antico 1.1.; tibiæ margo apicalis subter in angulum, corneum, parum prominentem productus. Laminæ tarsalis margines pilis longis ornati, præterea eius margo interior aculeis 1.1.1. armatus. Bulbus convexus in dimidio apicali processibus duobus corneis fortibus, instructus, quorum processus externus, e parte membranacea initium capiens, rectus, ca. 5–ies longior quam latus, lateribus parallelis, anteriora versus directus, apice acuminato et leviter introrsus curvato bulbi marginem apicalem attingens; ad apicem in latere interiore processus externus unco instructus corneo forti, longiore quam processus latitudo, intus et leviter anteriora versus directo, deorsum, anteriora versus et foras curvato, ultra bulbi marginem apicalem parum prominenti. Bulbi processus internus a parte inferiore visus crassus, fere triangularis, in longitudinem carinatus, processu externo partim occultus, anteriora versus directus, processu externo langior et ei pæne parallelus, ultra bulbi marginem apicalem prominens et apice in spinam intus, anteriora versus et sursum curvatam desinens; processus huius latus internus a bulbi partibus interioribus sinu profundo separatus. Inter apices processus externi et interni lamella parva, membranacea, pellucida, curvata, sat longe ultra bulbi marginem apicalem prominens, sita.

Patria. Rossia meridionalis. Exempla pauca huius speciei ad Sareptam (Tinguta) 25.II–25.III, 1912. B. Shumakov legit.

Tegenaria lapicidinarum nova species.

Femina. Cephalothorax 2.6–4.2 mm. longus, 1.8–3.2 mm. latus, modice,—

præsertim in medio,—nitidus, pilis simplicibus et longe plumatis tectus, parte cephalicâ supra palporum insertionem leviter constrictâ.

Oculorum series posterior paullum procurva; oculi laterales postici mediis paullo majores, laterales a mediis circiter diametro suo, hi inter se paullo longius remoti. Area oculorum mediorum postice latior quam antice et æque circiter lata atque longa. Oculi laterales antici mediis insigniter majores, elliptici, paullo obliqui, oculi medii antici inter se circiter diametro suo, ab lateralibus spatio paullum minore remoti; oculi laterales antici a clypei margine circiter sescuplo suo diametro remoti.

Mandibulæ sub clypeo fortiter convexæ; sulcus unguicularis antice ornatus dentibus 4; quorum primus reliquis minor, secundus-major, postice dentibus 5–6 subæqualibus.

Femora omnia supra ad latus anticum aculeis 1.1., (II. rarius 1.1.1.), femora I., II. et III. supra aculeis 1.1. et supra ad latus posticum 1.1., præterea femur I. antice aculeo 1., IV. supra 1. et supra ad latus posticum 1. ornata. Patellæ I. et II. supra pilo apicali setiformi 1., a pilis cæteris parum distincto, patellæ III. et IV. supra aculeo apicali 1 et aculeo 1. tenui, setiformi, ad basim sito ornatæ. Tibiæ quatuor anteriores subter aculeis 2.2., præterea tibia II. antice aculeo 1., tibiæ quatuor posteriores supra aculeis 1.1., subter 2.2.2. et utrimque 1.1. Metatarsi I., II., et III. subter aculeis 2.2.1., præterea I. utrimque in apice 1., II. antice 1.1., postice 1., III. utrimque 1.1.2., IV supra 1., supra ad latus posticum 1.1.1., subter 1.2.2.1. aut 2.1.2.1., antice 1.1.2. et postice 1.

Abdomen mamillis exclusis 2.9–6.5 mm. longum, 1.7–3.9 mm. latum, maximam partem pilis brevissime plumatis tectum. Mamillarum supremarum articulus apicalis basali paullo brevior.

Epigynes (Fig. 3) area sat convexa foveâ ornatur, quæ lamella repletur pallida, subquadrangula, in longitudinem convexâ, sescuplo circiter latiore quam longiore, antice insigniter constrictâ, postice usque ad epigastrii marginem pertinenti. Foveæ margo anticus leviter procurvus, parum expressus; margines laterales nigrofusci, maximam partem paralleli, antice incurvati et hic in foveolas parvas, nigrofuscas abeuntes; lamellæ pars inter foveolas sita plus minusve transverse impressa.

Cephalothorax fulvus, utrimque 3 vittis radiantibus, cuneatis, nigricantibus, brevibus, in parte thoracicâ sitis, marginem lateralem non attingentibus ornatus, parte cephalicâ plus minusve rufescenti; partis thoracicæ margo lateralis fuligineus, inæqualis, uterque plus minusvre distincte ter dilatatus. Pars cephalica secundum totam longitudinem lineâ fuligineâ parum expressâ notata; ad marginem posticum partis cephalicæ utrimque macula fuliginea formâ irregulari sita; utraque macula anteriora versus lineas fuligineas emittit binas, inter se fere parallelas, primo foras, tum intus curvatas, partim inter se confluentes et oculos seriei posticæ attingentes; haec pictura cephalica nonnunquam obsoleta.

Mandibulæ fulvæ, plus minusve rufescentes.

Sternum fuligineum, vittâ mediâ inæquali, totam longitudinem occupanti, et utrimque maculis 3, coxis sex anterioribus oppositis, fulvis ornatum.

Pictura haec nonnunquam bene expressa, nonnunquam deest fere omnino.

Palpi et pedes fulvi, apicem versus plus minusve rufescentes; femora et tibiæ III. et IV. in exemplis nonnullis indistincte annulatæ.

Abdomen pallide—fulvus, supra colore fuligineo ita pictum, ut restent maculæ pallidiores, plus minusve distinctæ, hae: antice vitta longitudinalis, abdominis medium attingens, et ad eam utrimque maculæ duæ formâ irregulari; posterius utrimque maculæ 3–4, gradatim minores et inter se per paria plus minusve conjuctæ. Abdominis latera colore dorsi, maculis, lineis et punctis fuligineis, in vittas obliquas, parum manifestas, dispositis, ornata. Venter pallide fulvus, fuligineo pictus, vittis duabus fuligineis, ab epigastrio abeuntibus, interruptis, parum expressis, notatum. Mamillæ infimæ fulvæ, supremarum articulus basalis fuligineus, apicalis pallide fulvus.

Mas. Cephalothorax 2.75–3.6 mm. longus, 2–2.7 mm. latus.

Palporum pars femoralis longa, leviter incurvata; pars patellaris desuper visa sescuplo circiter longior quam latior; pars tibialis desuper visa duplo circiter longior quam pars patellaris, latere exteriore in apice processibus tribus compressis ornata (Fig. 4); processus superior nigrofuscus, latior quam longior, lamelliformis, corneus, anteriora versus et foras directus, supra convexus, subter concavus, angulo apicali superiore in denticulum parvum producto, angulo inferiore rotundato. Processus medius brevis, latus, rotundatus fere, pallidus, anteriora versus, foras et deorsum directus, parte sua superiore cum processus superioris superficie inferiore confluens, angulo apicali inferiore rotundato. Processus infimus latus, brevis, rotundatus, pallidus, margine cinctus tenui fusco, in costam humilem in tibiæ latere inferiore sitam, productus. Pars tarsalis duplo circiter longior quam latior, rostro angusto æque circiter longo atque pars lata.

Conductor (Fig. 5), ad basim bulbi, in eius latere exteriore initium capiens, lamellam format magnam, pellucidam, anteriora versus et intus curvatum, partis tarsalis maginem exteriorem magnam partem sequentem, concavam, in suam concavitatem embolum recipientem et apice obtuso sub rostrum laminæ tarsalis parum ingredientem. Ad basim conductoris in bulbi latere exteriore processus duo siti, cornei, plus minusve unciformes, inter se fissurâ sat profundâ disjuncti. Embolus longus, tenuis, parti bulbi interiori innatus, anteriora versus directus, primo anteriora versus et foras, tum foras et deinde foras et retro curvatus.

Cæterum mas feminæ similis.

Patria. Rossia meridionalis. Exempla pauca adulta utriusque sexus sub lapidibus in vicinis urbis Novocherkassk mense Yulii 1914. N. Spasskaja legit.

Figure 1. Drassus shumakovi, epigyne.
Figure 2. Drassus shumakovi, maris palpus dexter ab imo visus.
Figure 3. Tegenaria lapicidinarum, epigyne.
Figure 4. Tegenaria lapicidinarum, palpi dextri maris apex partis tibialis a latera exteriore visus.
Figure 5. Tegenaria lapicidinarum, maris palpus dexter ab imo et paullum a latere interiore visus.

Fig.1

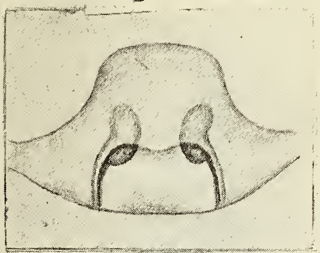


Fig.3

Fig. 2

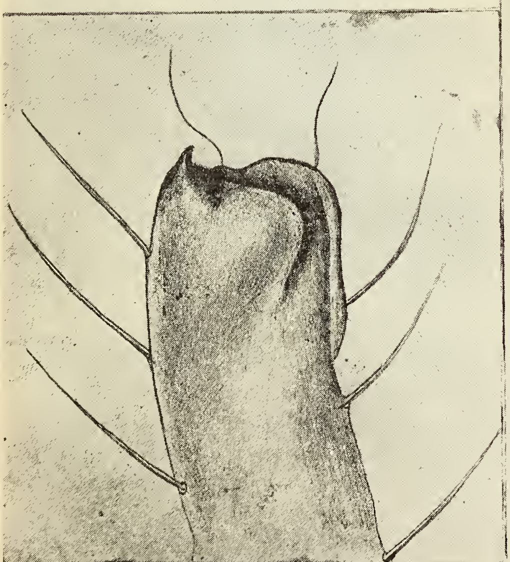


Fig.4

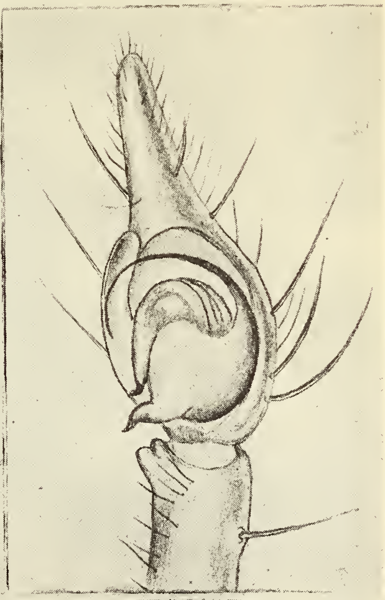


Fig.5

Aranearum

ON CERTAIN NORTH AMERICAN ELATERIDÆ, NEW AND OLD

BY H. C. FALL
TYNGSBORO, MASS.

In the proceedings of the California Academy of Sciences (March, 1932) appeared an extended paper by Dr. E. C. Van Dyke on various genera of Elateridæ. This important paper, the most notable contribution to the literature of our Elateridæ since the days of Le Conte and Horn, is of especial value to present day students of the family because of the inclusion of analytical tables and bibliographies of all our known species of such difficult and long-neglected genera as Limonius, Athous and Ludius, which are now brought up to date and into convenient shape for further study. There still remains some work of a similar nature to be done, for, among lesser needs, that most difficult genus of all — *Melanotus* — has yet to be brought under subjection. It is to be hoped that Dr. Van Dyke's paper will tempt some competent coleopterist having the necessary time, energy and material to undertake this task.

In so considerable a taxonomic work it would be strange if nothing were open to criticism. In going over the paper I find myself in a few instances unable to accept the author's conclusions. Whether it be a question of fact or merely one of individual opinion these several matters will be touched upon in the following pages, in which also will be found miscellaneous notes together with descriptions of a number of new species.

Adelocera Latr.

Adelocera mexicana Cand.

Dr. Van Dyke uses this name for a large species occurring with us in southern Arizona. I have recently (Can. Ent., 1932, p. 58) described this species as new under the name *A. nobilis*, and in the same paper, p. 59, have referred certain Florida specimens to *mexicana*, following Dr. Horn's identification of similar specimens in his own cabinet.

The two species are closely allied but apparently sufficiently distinct by a number of small differences. In the Arizona species the form is perceptibly more cylindrical, the squamiform hairs of the upper surface slightly narrower, the ventral punctures a little finer, the strial punctures of the elytra coarse at base but diminishing conspicuously in size apically, where they are sensibly equal in size to the interstitial punctures, which are everywhere finer than in the Florida species. In the latter the strial punctures diminish in size very little apically. Either species conforms well enough to Candeze's description of *mexicana,* which, however, makes no mention of the very conspicuous decrease in size of the strial punctures from base to apex, which is the chief distinguishing feature of the Arizona species. An actual comparison of specimens with the type of *mexicana* may be necessary to settle the uncertainty.

Conoderus Esch. (Monocrepidius Esch.)

In preparing his paper Dr. Van Dyke overlooked the several species of *Monocrepidius* described by me in the Canadian Entomologist, March, 1929. These are briefly referred to below.

Monocrepidius ferruginosus Fall Ariz.

This species runs to *athoides* by Van Dyke's table and it may be that the ferruginous form of the latter mentioned in his brief diagnosis is the same. I believe, however, that *ferruginosus* is distinct by the color, and especially by the distinctly rougher elytral intervals.

Monocrepidius delicatus Fall Ga.

Although the lobe of the fourth tarsal joint is narrow and inconspicuous in this species, it is, I think, most nearly related to *vespertinus* and *varians,* between which it may be placed. The short and nearly equal second and third antennal joints, which together are shorter than the fourth, as well as the smaller size at once separate it from *vespertinus,* and also according to description from *varians,* in which the third joint is said to be longer than the second, the two together as long as the fourth. The carina of the hind angles of the thorax does not turn obliquely inward in front as it does in *varians* and *aversus,* but is parallel to the margin as it is in *vespertinus. Delicatus* is distinctly smaller than either *vespertinus* or *varians,* the length of my two examples being 5.75 mm. and 6.5 mm.

Monocrepidius difformis Fall Ariz.

Length 6.5 mm., dark brown with obscure interrupted vittæ on the elytral intervals. It has the hind angles of the thorax unicarinate, the carina evidently diverging from the side margin. As in *blandulus* Lec. and *auritus* Hbst. there are finer punctures intermixed with the coarser ones of the pronotum, these being somewhat more numerous in the present species. These three species form a natural connecting link between the more typical *Monocrepidius* and the subgenus *Heteroderes,* in which the fine punctures are far more numerous, generally more minute, and form a dense ground sculpture among which the larger punctures are scattered.

Monocrepidius (Heteroderes) planidiscus Fall Fla.

This is the same as the *M. fuscosus* of Blatchley (not *fucosus* as written by Van Dyke), which was published four years earlier (Can. Ent., 1925, p. 163) and overlooked by me at time of writing. Van Dyke uses the name *amplicollis* Gyll. for this species. This is not permissible according to Candeze, who states that in *amplicollis* the body beneath is marked with a double system of punctures the same as above. In *fuscosus (=planidiscus)* the punctures are simple and equal. *Amplicollis* is tabulated by Van Dyke as having the hind angles of the thorax unicarinate. They are, however, described as bicarinate by Candeze and the same is true of *planidiscus* as described by me. Blatchley merely says of *fuscosus* "hind angles strongly carinate." The inner carina is finer and much shorter than the outer but is distinct enough, at least in the great majority of specimens.

Conoderus suturalis Lec. Ala., Ind.

It seems to have escaped notice that this species also possesses a dual system of pronotal punctuation and is therefore to be included in the subgenus *Heteroderes.*

Conoderus rudis Brown* Ala.

Moderately slender; piceous brown above, the rear margin and all the angles of the prothorax diffusely testaceous; elytra each with a somewhat obscure irregular median rufotestaceous spot longer than wide and included between the second and eighth striæ; beneath fuscous brown, the prosternum somewhat paler, legs and antennæ pale testaceous; pubescence fine, short, recumbent. Antennæ rather slender, slightly passing the hind angles of the thorax, joint 2 very little shorter than 3, the two together perceptibly longer than 4, all joints elongate, median ones nearly twice as long as wide. Prothorax slightly longer on the median line than the maximum width, sides with a faintly perceptible sinuation at the base of the distinctly produced but not divergent hind angles, thence feebly convergent and just visibly arcuate to the rounding in of the front angles. Head and prothorax rather densely punctate, the punctures of the latter a little finer than those of the head, on close attention somewhat unequal in size but without that ground sculpture of micropunctulation which constitutes the distinguishing feature of the *Heteroderes* group; surface evenly convex, hind angles unicarinate, the carina rather fine, of moderate length, diverging gradually but not strongly from the lateral margin. Elytra equal in width at base to the thorax and fully two and one-third times as long as the latter; not quite two and one-half times as long as wide, sides barely visibly convergent from the base, becoming gradually more strongly so apically; striæ strongly impressed, intervals a little convex, finely punctate and slightly rugose. Body beneath finely punctate, the prosternal punctures a little coarser; lobe of fourth tarsal joint rather narrow but a little wider than the fifth joint so as to be perceptible from above. Length 5.8 mm.; width 1.7 mm.

Alabama: Grand Bay, May 28, 1931. A single specimen sent by Mr. Loding, who has others in his cabinet.

This species seems most nearly allied to *aversus* although the carina of the hind angles of the thorax being less divergent from the side margin than in that species might lead one to refer it to "15" of Van Dyke's table. It is an appreciably smaller species than *aversus*, the pronotal punctuation less fine and the second and third antennal joints nearly equal in length, whereas in *aversus* joint 3 is very distinctly longer than joint 2. If traced through "15" of the table it runs to *suturalis* and *lepidus*. *Suturalis* as before remarked must be transferred to the *Heteroderes* group, while *lepidus* is a very small slender pale testaceous species with narrow black elytral markings which are not well indicated in the table.

Since writing the above Mr. Loding has sent me all his remaining examples of this species, eight in number. Six of these conform well to the above description, but two show a marked longitudinal extension of the elytral spot, and in one of them the spot also breaks through narrowly to the side margin and the elytral apex is also paler. One very large specimen measures 7 mm. in length. Mr. Loding writes that he has seen specimens only from the southern Alabama and Mississippi coast section.

Drasterius Esch.

From any standpoint the disposition of this genus in the Leng list is open to criticism and its make-up has been badly bungled. In the first place the transference of the species *dorsalis, comis* and *livens* to the genus *Æolus* is ill advised, and so far as I know is unsupported by any specialist in the Elateridæ. Certainly Candèze, Champion and Otto Schwarz, who recognize *Æolus,* all place these species in *Drasterius;* indeed, the only one of our species that they do refer to *Æolus* is *amabilis.* So far as our own fauna is concerned the modification of the fourth tarsal joint, on which *Æolus* is based, is so feeble and gradual and even in its most extreme form *(amabilis)* is so trifling, that in my judgment it is unworthy of even subgeneric import. It is probable that in many of the very numerous foreign representatives of the genus *Æolus* its characters are better developed, but the fact remains, as remarked by Champion, that it merges insensibly into *Monocrepidius* on the one side and *Drasterius* on the other.

* This species was described in the Canadian Entomologist, August, 1933, p. 174, while Prof. Fall's paper was in press. The description and remarks stand as Prof. Fall wrote them but Mr. Brown's name has been substituted for the one proposed by Prof. Fall.—ED.

The very close affinity of the above genera must be obvious to the most casual student and yet in the "List" *Monocrepidius* and *Æolus* are separated by some three hundred species of unrelated genera from *Drasterius* and its nearly allied genera *Megapenthes, Elater,* etc.

The recording of *dorsalis, comis* and *livens* in the "List" as three distinct species is not in accordance with the authorities, but this is a matter of little consequence since at best it is at present merely a matter of opinion whether these three names cover one, two or three species.

In 1917, Mr. Schaeffer described four species of *Drasterius,* two of which—*nigriventris* and *scutellatus*—he designated as referable to *Æolus* in case that genus were recognized. As the List recognizes *Æolus* these two species should have been placed there; all four however will be found under *Drasterius.*

D. fretus Csy. This is certainly nothing but *amabilis* as was long ago established and should not have been resurrected.

D. præses Cand. This is a synonym of *Ludius (Corymbites) conjungens* Lec. as Candeze himself admits in his 1891 catalogue. *L. (Corymbites) præses* Horn (1871) is the same thing.

Drasterius incongruus new species.

Moderately elongate, not very convex, integuments moderately shining; pubescence fine, short, recumbent, pale in color. Head blackish, pronotum rufotestaceous with broad fuscous stripe, elytra rufotestaceous at base, blackish in about apical two-thirds, the dark area not very sharply limited anteriorly and extending along the suture to base; beneath metasternum and abdomen entirely piceous, prosternum lightly infuscate, parapleura legs and antennæ rufotestaceous. Antennæ slender, not reaching the base of the thorax, not evidently serrate, joints 2 and 3 subequal and about one-half longer than wide, together longer than 4, the latter longest and fully twice as long as wide, 5–10 each subequal to 2 or 3 but slightly wider, the outer joints diminishing slightly in length. Front convex, punctures well separated, frontal margin strongly evenly rounded, not appreciably reflexed. Prothorax slightly longer than wide, rounded in front, thence nearly parallel to the apices of the hind angles, which are triangular, acute, not carinate; punctuation fine, sparse, evenly disposed, the punctures separated by about twice their own diameters and not at all larger or closer at sides; disk convex, median line not impressed. Elytra not quite two and one-half times as long as the thorax, at base as wide as the latter, widest at about the middle, the sides feebly arcuate; striæ fine, finely punctate; intervals flat, sparsely punctulate. Prosternum and propleura rather sparsely and evenly punctate, the latter a little less finely so; metasternum and abdomen somewhat more finely and closely so. Tarsi very slender, basal joint of hind tarsus but little longer than the second and distinctly shorter than the two following united. Length, 4.6 mm.; width, 1.4 mm.

Described from a single individual taken by the writer near Rimouski, Quebec, on the south shore of the Lower St. Lawrence River, July 4, 1931. The sex of the type is uncertain but the fact that the antennal joints beyond the third are clothed, especially beneath, with numerous longer erect hairs suggests that it may be a male.

By the generic tables this species runs straight to *Drasterius,* and it is provisionally assigned to that genus for the present. However, it does not look like a *Drasterius,* in which the relatively larger thorax produces quite a different facies. Moreover, the comparatively longer second and third antennal joints, the non-carinate hind angles of the thorax and the more slender tarsi with shorter basal joint all differ from the corresponding conditions in that genus. The presence of bristling erect hairs on the antennæ, other than the usual tactile setæ, has not been observed by me in either sex of any species of *Drasterius* examined.

Since writing the above a second example, in every respect like the type, has turned up in a small lot of Elaterids sent for identification by Mr. J. N. Knull. This specimen bears locality label Lake Opasatika, Quebec, June 3rd, and is returned as a paratype to Mr. Knull.

Elater Linn.

Elater sturmii Germ.

On page 301 of his paper, Dr. Van Dyke remarks: "This species should be restored. It was omitted in the Leng catalogue. It is a true *Elater* as observed by Le Conte, not a *Megapenthes* and a synonym of *granulosus* as he formerly believed." In this very positive statement I am convinced that the Doctor is in several respects mistaken.

That the *sturmii* of Germar was not the same as Melsheimer's *granulosus* was determined by Candèze from an actual specimen of the latter sent him by Le Conte for that purpose (see Cand. Mon. of Elateridæ II, p. 497). Moreover Candèze, to whom the type or typical specimens of Germar's species were accessible, placed it unqualifiedly in *Megapenthes*.

This dictum of Candèze, which is also borne out by Germar's original description, so far as the latter is determinative, was properly accepted by Le Conte, who in his "Smithsonian List" of 1863 refers to *sturmii* Germ. under *Megapenthes granulosus* Melsh. as having been previously cited in error. Germar in his description vaguely assigns his species to North America, but according to Candèze, Germar obtained the specimens, from which his descriptions were drawn, from Dejean, and the latter, both in his catalogue and collection, indicates Cuba as the actual locality. And this fact in itself makes it highly improbable that Germar's species is a true Elater, since according to Leng and Mutchler's List of the Coleoptera of the West Indies this genus is not known from that region. Several species of *Megapenthes*, however, are listed and in their supplement to the list they specifically mention *Megapenthes sturmii* as being represented from Cuba in the U. S. National Museum collection.

In 1884, Le Conte, in a posthumous paper published by Horn, includes *sturmii* Germ. in a table of our species of *Elater*, but without explanation or comment thereon. There is in the Le Conte collection among the species of the genus *Elater* a single example from Enterprise, Florida, bearing the name "*E. sturmii* Germ." in Le Conte's handwriting. In form, size, intense black color and very dense pronotal sculpture it strongly suggests Germar's species and I have no doubt is the basis for the reappearance of this species in the '84 paper. If this be the case Le Conte's diagnosis must have been a very superficial one, for the specimen in question is neither an *Elater* nor a *Megapenthes*, but because of its lobed tarsi belongs to the tribe Dicrepidii and may perhaps be referred to Ischiodontus, though not typical of that genus. I have in my own collection a specimen from Cleveland, Fla., (J. N. Knull, collector) which is closely similar and probably specifically identical with the Le Conte specimen. I believe the species to be undescribed.

E. dimidiatus Lec. and *E. affinis* Lec.

These two species are assigned to two different categories in Van Dyke's synoptic table (p. 304), the former among those species having the pubescence black on the pronotum and the latter among those in which the pronotal pubescence is yellowish. As a matter of fact, the pubescence is yellow or brownish yellow in both species as is stated by Le Conte in his original descriptions, and *dimidiatus* should be placed after *affinis* under caption ''10'' in the table. *Affinis* differs from *dimidiatus* by the shorter black apical space on the elytra, which is a little indented on the suture. In *affinis* the thorax is rather densely punctate and slightly more coarsely so than in *dimidiatus,* in which the punctuation is perceptibly sparser and the surface more strongly shining. The third antennal joint is relatively a little longer in *dimidiatus,* being in *affinis* but little longer than the second.

Megapenthes Kies.

Megapenthes solitarius new species.

Slender, attenuate, shining black; antennæ and legs piceous, the tibiæ and tarsi brownish; pubescence sparse, recumbent or inclined, obscure brownish fuscous. Head evenly convex, strongly not densely punctured, frontal margin prominently rounded at middle, narrowly reflexed at sides. Antennæ passing the hind angles of the thorax, widely sharply serrate, second joint very small, slightly wider than long, third joint twice as wide as the second, outer side a little oblique and equal to the length, the free angle acute; joints 4–10 similar to the third, the outer ones becoming slightly narrower, all destitute of the erect hairs present in the males of many species of the genus. Prothorax one-fifth longer than broad, sides gradually convergent and just perceptibly arcuate from base of hind angles to apical margin; hind angles parallel, unicarinate; disk highly polished, rather strongly but sparsely punctate, the punctures distant from one to two times their diameters except near the side margins where they are somewhat closer; median channel shallow, visible only posteriorly. Elytra barely as wide at the base as the thorax, about two and one-half times as long as the latter and three times as long as wide; sides feebly convergent from the base to behind the middle, apex narrowly rounded; striæ fine, strial punctures very fine, scarcely perceptible apically; intervals finely sparsely punctate, not perceptibly rugose. Prosternum and propleura coarsely rather sparsely punctured, metasternum and abdomen more finely and evenly so; basal joint of fore tarsi as long as the next three, of hind tarsi equal to the next two. Length, 5.9 mm.; width, 1.4 mm.

This interesting little species is represented by a solitary male example obtained from the Bischoff collection. It bore the simple label ''4–lake,'' which New York collectors translated for me as Fourth Lake in the Adirondack region.

The third antennal joint similar to and equal in size to the fourth would exclude this species from *Megapenthes* according to standard generic tables. However, we already have included in this genus three species (*lepidus* Lec., *tarsalis* Schf. and *illinoisensis* Van D.) with this general type of antennæ and the present species may well be placed with them. Strictly speaking, no one of these three species has the third and fourth joints precisely equal, the third joint being slightly smaller though of the same triangular form as the fourth. *Solitarius* differs from all these in the uniformly jet black color of the body, and from *tarsalis* in addition by its shorter basal joint of hind tarsus, which in the latter species is said to be nearly as long as the four remaining joints.

Anchastus Lec.

Anchastus longulus Lec.

This species was described in 1878 from a single specimen taken at Enterprise, on the Upper St. John's River, Florida. Shortly afterward (1882) it appeared in the Index to Le Conte's Species by Henshaw as the male of *digitatus* Lec., previously described (1853) from Pennsylvania. I do not know on whose authority this assignment was made, but it has passed current for many years and the name *longulus* does not appear at all in the Henshaw List. In the Leng List (1919) *longulus* reappears as a distinct species, and as before I am unaware as to who is responsible for the change. Be that as it may the move is a correct one for *longulus* is by no means specifically the same as *digitatus*. The latter is known to me only by the unique type in the Le Conte collection and would seem to be an extremely rare thing. It is less elongate and more fusiform than *longulus,* and of a dark fuscous brown color throughout. *Longulus,* on the other hand, is reddish brown or ferruginous in color and of more cylindrical form in both sexes. In *longulus* the basal declivity of the elytra is paler in all specimens seen and the punctures in that region are simple. In *digitatus* the basal declivity is not at all paler than the rest of the surface and the punctures are rough; the sex of the type is not evident.

In Dr. Van Dyke's bibliography of the species of *Anchastus,* *longulus* is placed as a synonym of *digitatus,* probably in deference to the long-established custom. His tabular characters for *digitatus* are obviously drawn from specimens of *longulus,* but it should be remarked that whereas he regards the hind angles of the thorax as unicarinate (though admitting there may be a vague outer carina sometimes present), Le Conte describes *longulus* as having the hind angles bicarinate. In my own series the outer carina of the angles is, in my judgment, sufficiently distinct to warrant the term bicarinate. An examination of the type of *digitatus* shows the angles are also bicarinate, although Le Conte's description would lead one to infer that there was only a single carina.

Anchastus fumicollis new species.

Slender, rufotestaceous, moderately shining, finely pubescent. The pronotum is infuscate in variable degree, the margins, more or less, and often the median line diffusely paler; body beneath reddish brown, legs and antennæ testaceous. Antennæ scarcely at all serriform, passing the apices of the hind angles of the thorax by three joints in the male, slightly shorter in the female; joints 2 and 3 subequal or 3 slightly longer than 2, together scarcely as long as 4 in the male and about equal to 4 in the female; following joints subequal and fully twice as long as wide. Prothorax evidently longer than wide, sides feebly convergent and nearly straight from base almost to apex, and without perceptible sinuation before the hind angles, which are acutely produced and not divergent. Head and thorax evenly convex and densely rather coarsely subvariolate punctate; hind angles bicarinate, the outer carina longer than the inner, somewhat variable in length, quite close to the margin posteriorly and only feebly diverging in front. Elytra scarcely wider at base than the thorax, sides parallel for about two-thirds their length; striæ finely impressed, punctate; intervals sparsely but distinctly punctulate. Prothorax beneath rather coarsely punctate, the punctures on the propleura in part variolate and somewhat sparser along the prosternal sutures; venter more finely punctate. Hind coxal plates strongly and rather abruptly dilated inwardly. Length, 5.9 to 7.3 mm.; width, 1.6 to 1.75 mm.

Florida: Royal Palm Park, Dunedin, and Haulover; five examples. The type is a male from the first-named locality, bearing date Mar. 27, 1924, and collected by W. S. Blatchley.

This species is nearest *longulus* and is very likely mixed with it in collections, probably under the name *digitatus.* It is quite distinct from *longulus* by the smaller size, clouded thorax and longer antennæ.

Anchastus subdepressus new species.

Elongate, subdepressed, parallel sided, equally narrowed before and behind; rufocastaneous, shining, finely pale pubescent. Antennæ slightly passing the hind angles of the thorax, scarcely serriform, joints 2 and 3 very short, transverse, 3 just perceptibly longer than 2, together shorter than 4, which is about one-half longer than wide. Head convex, coarsely closely punctate, clypeal margin convex. Prothorax very slightly wider than its median length, rather coarsely and densely punctate laterally, more sparsely and finely at middle of disk, where the punctures are distant on the average by their own diameters; hind angles bicarinate, the outer carina longer, quite near the margin and perfectly parallel thereto throughout, the margin not visible from above. Elytra barely visibly wider than the thorax and three and one-half times as long, almost three times as long as wide, sides parallel in basal two-thirds, thence arcuately convergent to the narrowly rounded apex; striæ fine, finely punctate; interspaces sparsely punctulate. Prosternum rather loosely punctate, propleura densely rather coarsely so externally, less closely along the prosternal sutures; venter more finely punctate; hind coxal plates strongly dilated inwardly. Length, 8.8 mm.; width, 2.3 mm.

Santa Rita Mts., Arizona: A single example, sex unknown, received many years ago from Prof. Snow.

By Van Dyke's table this species runs unequivocally to *sericans* Cand., but according to Mr. Liebeck, who has kindly compared the above with Horn's type, the latter is materially larger, much more convex, especially the thorax, which is only slightly narrowed in front, with hind angles more strongly bicarinate. In the present species the sides of the thorax are rather strongly arcuately convergent in front, becoming parallel basally.

Hypnoidus Steph.

Hypnoidus (Cryptohypnus) valens new species.

Elongate, depressed, piceous black, shining; legs red, basal joint of antennæ red, following joints dull rufous at base, their apices more or less dusky; pubescence of upper surface short, brownish and rather obscure; beneath denser, more grayish and appressed. Antennæ nearly attaining the hind angles of the thorax, all joints longer than wide. Head one-half as wide as the thorax, front slightly concave, rather coarsely not very closely punctate. Prothorax slightly longer on the median line than wide, widest just behind the middle, sides slightly convergent and feebly arcuate anteriorly, sinuate behind, the hind angles slender, divergent and carinate; disk flattened and impressed medially, coarsely punctate throughout, the punctures a little elongate, nearly in contact laterally but separated by about their own diameters at middle. Elytra just perceptibly wider than the thorax and 2.4 times as long as the latter on the median line, fully twice as long as wide; disk moderately convex; striæ indistinctly punctate; intervals nearly flat with numerous irregularly placed fine punctures. Propleura very coarsely punctate; the prosternum more sparsely so except on the lobe, where the punctures are densely placed; metasternum and ventral segments more finely and sparsely punctured; the intervals between the punctures of the lower surface everywhere finely punctulate. Length, 10 to 10.7 mm.; width, 2.95 to 3.2 mm.

Described from two examples collected by Ricksecker many years ago. They bear label Sylvania, California, which is, I believe, near Santa Rosa. The type is, I think, a female and carries date 4–13–96.

This species is nearest *grandicollis* Lec. and was, at least at one time, so identified by Dr. Van Dyke. A comparison with Le Conte's type, however, shows at once that such reference is impossible. The Le Conte type is a female somewhat smaller (about 9 mm.) than the present species, a little less depressed, with slight æneous lustre, the antennæ entirely red, the elytra perceptibly shorter as compared with the thorax, being only about two and one-sixth times as long as the latter, the thoracic punctures finer and circular rather than elongate, separated by their own diameters at sides and still finer and more remote at middle. In the second example in the Le Conte cabinet, the so-called male from Oregon (see Horn's remarks, Trans. Am. Ent. Soc., 1891, p. 5), the pronotal punctures are still sparser, being nearly as remote at sides as at middle. The interstitial punctures of the elytra are nearly twice as numerous in *valens* as in either of the two Le Conte examples of *grandicollis*. Le Conte described his type of *grandicollis* as from "Canada," an unsatisfactorily vague locality, but it is likely that it came from somewhere east of the Rocky Mountains.

In his recent paper Van Dyke compares his *Hypnoidus glacialis* n. sp. with *grandicollis* in such terms as to indicate that he does not know the true *grandicollis* and may still be confusing the present species with that of Le Conte.

Hypnoidus manki new species.

Elongate, moderately convex, black with faint æneous lustre and without markings; surface finely sparsely cinereo-pubescent; body beneath black, legs piceous, extreme base of thighs also tibiæ and tarsi more or less evidently paler. Antennæ extending well beyond the hind angles of the thorax, not much shorter than half the length of the body, piceous, second joint pale and distinctly shorter than the third, the latter a little narrower than but subequal in length to the fourth. Head flatly convex, somewhat roughly punctate. Prothorax about as wide as long, widest at middle, quite strongly convex, shining; sides strongly arcuate, sinuate at the hind angles, which are acute and divergent; disk finely evenly not densely punctate, the punctures just perceptibly coarser in front, a narrow median smooth line; carina of hind angles attaining about the basal third. Elytra slightly to scarcely wider than the thorax, not quite twice as long as wide, widest more or less before the middle; discal striæ not deep but all distinct and entire, finely punctate; intervals nearly flat and finely punctulate. Body beneath shining, finely sparsely punctate throughout. Prosternal sutures single; hind coxal plates externally narrow but not obliterated. Length, 2.7 to 3.3 mm.; width, 1 to 1.2 mm.

Described from six examples taken in Glacier Park, Montana, by Miss Edith Mank of Lawrence, Mass., in whose collection are additional specimens. The type is a male bearing date July 8, 1929. The species is dedicated with much pleasure to Miss Mank in recognition of her several successful collecting trips to the Park and of many valued contributions to my cabinet.

By Horn's table (Trans. Am. Ent. Soc., 1891, p. 2) the present species runs to the Melsheimeri group if the pronotal punctures are regarded as appreciably coarser in front than posteriorly. They are only just visibly so at best, but this is also true of certain species included by Horn in the group, e.g., *tumescens,* after which *manki* may be placed. It differs from *tumescens* by its narrower form, and notably by its longer antennæ having the second joint shorter than the third, while in *tumescens* as well as other species of the group the antennæ are distinctly shorter and have the second joint equal to or longer than the third. In antennal characters and indeed in general aspect *manki* exhibits a marked similarity to *restrictulus,* but in this latter species the elytral striæ are in part faint or almost obliterated, and the males possess a unique sexual character in the form of the last ventral segment. The resemblance of *H. restrictulus* to *Oedostethus femoralis* is noted by Horn in his paper (p. 26) and his remarks apply with equal force to *H. manki.*

Horistonotus Cand.

Horistonotus pallidus new species.

Form narrowly elongate, moderately convex, color above and beneath including antennæ and legs flavotestaceous, the extreme sutural edge of the elytra rufous or rufescent; pubescence fine, inclined, pale yellow; surface somewhat shining. Antennæ slender, passing the hind angles of the thorax, joints proportioned as usual. Eyes large, their vertical diameter about five-sixths the width of the front. Prothorax as long as wide, widest at or slightly in advance of the middle, sides arcuately convergent in front, nearly straight and just perceptibly convergent posteriorly; surface of head and pronotum with the usual dual punctuation, the coarser punctures of which are very fine and uniformly distributed, the finer punctures quite minute but visible. Elytra distinctly wider than the thorax, very nearly three times as long as the latter and about 2.3 times as long as wide; humeri well defined, not oblique; striæ fine and feebly impressed on the disk, a little deeper at base and sides; strial punctures distinct at base, becoming finer apically; interspaces nearly flat on the disk, sparsely irregularly finely punctate. Propleura, prosternum and metasternum very minutely punctulate with sparse slightly larger punctures intermixed; ventral segments similarly but somewhat more closely and distinctly punctured. Length, 5.7 to 6.3 mm.; width, 1.7 to 2 mm.

Described from a series of six specimens, all taken on the Colorado Desert at Indio, California. The type is a male.

This species belongs to "Series B" of Horn's table, where it will come under caption "7," having the base of the thorax distinctly wider than the apex. Horn's further statement that the thorax is as wide at base as at middle does not, however, apply to the present species, nor is it true, at least in certain examples, of either *curiatus* or *gracilis*. From the associated species *pallidus* is at once separable by its color.

Horistonotus fidelis new species.

Closely related to *simplex* Lec. (for description of which see Horn's paper) but differing as follows. The size is materially smaller (5.75 to 7.1 mm.), form a little less stout, color reddish brown, the eyes in the male relatively a little larger, the antennæ longer, distinctly passing the hind angles of the thorax in the male and fully attaining the angles in the female, sides of thorax almost perfectly straight and parallel in posterior half; other characters virtually the same as in *simplex*.

In *simplex* the length ranges from about 7.5 to 8.5 mm.; the color is fuscous brown, the antennæ do not quite reach or at most do not pass the hind angles of the thorax in the male and are still shorter in the female, the sides of the thorax posteriorly are less straight and parallel, showing a feeble arcuation.

H. fidelis is represented in my collection by six specimens from Indio, California; La Puerta Valley, San Diego Co., California; and Las Vegas, Nevada. The type is a male from Indio, collected and sent me by Mr. F. Stickney.

H. simplex was described from Cape San Lucas, Lower California, and all the typical examples I have seen are from the Peninsula.

Horistonotus fidelis fuscus new subspecies.

This name is proposed for a form represented in my collection by a series of six specimens from the Baboquivari Mts. in Southern Arizona. It is closely similar in nearly all respects to *fidelis* but differs in its dark fuscous brown color, somewhat larger size and rather shorter antennæ although these in the male slightly pass the apices of the hind angles of the thorax. The sides of the thorax are straight behind the middle or very nearly so as in *fidelis*. The length ranges from 7.3 to 8.1 mm.; width, 2.3 to 2.5 mm. The type is a male bearing date September 25, 1923; collected by Poling.

It is probable that all three of the above forms are included by Horn in his conception of *simplex,* and the less critical student may, if he prefers, regard them all as variants of a single species.

Esthesopus Esch.

I much regret to say that in describing my *Horistonotus flavidus* I failed to notice the small lobe of the fourth tarsal joint, which I now find to be present. This makes it necessary to refer the species to the genus *Esthesopus,* where it is very nearly allied to *E. dispersus* Horn, from which the narrower form and pale flavotestaceous color may be sufficient to distinguish it. The type of *flavidus* was from Palm Springs, California; more recently I have received another specimen from Indio, California, not far from the type locality.

Horn describes *dispersus* as reddish brown and moderately robust, which correctly characterizes the two Texas examples in the Le Conte cabinet, one of which bears the name label in Horn's hand, and also fits well enough several South Arizona specimens in my own collection which I provisionally refer to *dispersus.*

Esthesopus indistinctus new species.

This name is proposed for a species represented in my collection by a small series of specimens from the vicinity of San Diego, California (Jacumba, La Puerta Valley), which do not quite agree with either *dispersus* or *flavidus.* They are rufotestaceous in color, and of slightly stouter form than in *flavidus,* but their chief claim to distinction is the very faint or nearly obliterated micro-punctulation of the pronotum, this being quite evident in both *dispersus* and *flavidus.* In size and practically all other respects except color and pronotal punctulation they conform well enough to Horn's description of *dispersus.* The type is a male bearing date VII, 1911; specimens all collected by Mr. G. H. Field.

Melanotus Esch.

As Dr. Van Dyke truly remarks, this genus is very poorly represented in California. The three species, *longulus, oregonensis* and *variolatus,* described by Le Conte comprise the characteristic *Melanotus* fauna of the State, and their satisfactory delimitation has always proved a perplexing problem for the student. Van Dyke cuts the Gordian knot by setting them all down as phases or variations of a single species. The problem, however, does not admit of so simple a solution. The aggregation which he includes under the oldest name, *longulus,* embraces certainly two and probably three species, with an outside chance that still another may be involved.

1. First, there is the rather small slender brown form occurring about San Diego and ranging east into the desert. This is typical *longulus.* A little farther north, in the vicinity of the coast, at Pasadena, Pomona, etc., is a similar though usually slightly stouter form, most often black but sometimes brown, which one would be tempted to consider as distinct from *longulus,* especially if black examples only were at hand. I have, however, been quite unable to separate them from the typical form and dissection shows that the male genital characters are identical.

2. *Oregonensis.* This was described from a single specimen collected in Oregon, specific locality not stated. The type is brownish black, 12 mm. long, and of rather narrow form. As indicated by Van Dyke *oregonensis* ranges north into Washington and British Columbia, and south into Northern California, through the Sierra Nevadas and eastward into Utah. The species

is brown or blackish brown, probably never truly black, and the smaller specimens look not unlike the larger brown examples of *longulus;* the male genitalia, however, are quite different and the two species are unquestionably distinct.

3. *Franciscanus* VanD. With the type of *oregonus* in the Le Conte collection are placed four stouter black specimens (2 ♂, 2 ♀), all from California, one of the females bearing locality label ''Berkeley,'' and all probably from the vicinity of San Francisco. These black specimens are not identical with the type, but are the so-called ''race or subspecies'' *franciscanus* of Van Dyke. They differ from *oregonus* in their distinctly more robust form, deep black color, somewhat shorter and broader antennæ, with the third joint relatively shorter, generally less divergent hind angles of prothorax, and oftentimes more sparsely punctured pronotum. The male genitalia are very much alike, but in the few specimens dissected I notice a small difference in the form of the side pieces or lateral lobes, these being in *franciscanus* slightly less sinuate before the apical dilatation, which is in consequence a little less marked. For these reasons I prefer to consider *franciscanus* a distinct species and believe further experience will support this view.

4. *Variolatus* Lec. Just what this species is it is hard to say and herein lies the outside chance for a fourth species. The Le Conte series comprises three specimens. The first specimen, bearing the name label and to be regarded as the type, is a female, 11 mm. long, dark brown, moderately robust, third antennal joint not much longer than the second, sides of thorax only very faintly sinuate posteriorly, the hind angles parallel. The second and third examples are male and female of the less slender black form of *longulus* referred to above and which is the common form in Los Angeles County. These two specimens are different in color from the type, with more slender antennæ, a longer third antennal joint, the hind angles distinctly divergent as is typical of *longulus*. They look different from the type and may well be so. Some one—probably Van Zwaluwenburg, who studied the Le Conte collection—has attached a small label to each of the second and third examples expressing the opinion that they are not the same as the type. Nevertheless, for the

present and until females identical with the type and accompanied by males are available, it seems best to consider the type as an individual variant of *longulus*.

Limonius Esch.

The presentation of a synoptic table and bibliography of all our known species of this difficult genus is one of the most notable and acceptable features of Van Dyke's valuable paper. No American coleopterist has ever ventured to offer such a table, and that by Candèze in 1860 is much too old to be of satisfactory service today.

I am glad to note that Van Dyke does not accept *Pheletes* Kies. in full generic sense. It may have a more definite value in the few European species, but Candèze long ago rejected it for the much more numerous American species because of the gradational nature of the character on which it is based. Even when used in a subordinate sense the character of the prosternal sutures, whether excavated in front or not, is somewhat ambiguous, and the placing of certain annectent species is more or less a matter of individual opinion.

Certain instances of synonymy accepted or proposed by Van Dyke in his paper suggest the following comments.

Limonius discoideus Lec.

Of this species the author says in his table (p. 340), "a lighter phase of *canus* restricted to females." I seriously question the accuracy of this statement. It is true that all typical specimens of *discoideus* are females, but corresponding males, while quite similar to *canus,* are not *canus.* This assertion is well illustrated by a good series of specimens in my collection from Healdsburg, Sonoma Co., California. Of these the females are all typical *discoideus,* while the males closely resemble *canus* but differ from typical examples of the latter from the San Francisco sand hills region by the notably longer antennæ, which pass far beyond the hind angles of the thorax. In the males of *canus* the antennæ scarcely or only very slightly pass the thoracic angles. The disparity between the shorter antennæ of the females of the two species is noticeable but perhaps less marked; I have seen too few females of *canus* to speak with much certainty here.

Le Conte's type of *canus* was described from San Diego. My specimens are from San Francisco and Carmel. I have seen no specimens from the interior and do not know whether its range extends farther north along the coast than San Francisco. *Discoideus* is found in the northern Rockies and thence west to the Pacific Coast, down which it extends through Northern California, and probably farther in the mountains. I have no doubt that it is this species and not *canus* that Mr. M. C. Lane has studied in Washington State.

Limonius occidentalis Cand.

The suppression of *occidentalis* as a distinct species and its union with *californicus* as a mere color phase appears to be abundantly justified by my own series.

Limonius ectypus Say and *L. agonus* Say

These two species of Say's are united by Van Dyke, but whether from personal conviction or merely in acceptance of the authority of the Leng List, which in turn is virtually a transcript from Otto Schwarz in "Genera Insectorum" does not appear. In any case the synonymy is not valid. There are three external characters mentioned below, any one of which enables the two to be separated with a little care, and which taken together should be of sufficient weight to warrant their retention as distinct species; but if this is not enough I may add that the male genitalia are distinctive. In *agonus* the third antennal joint is slightly larger than the second, but more nearly resembles it in form than it does the fourth joint. In *ectypus* the third joint is relatively wider and more triangular, thus showing a greater likeness to the fourth joint than to the second. In *agonus* the sides of the thorax are rounded in at the hind angles which are not at all produced; in *ectypus* the sides of the thorax show a slight sinuation basally, the hind angles slightly longer and either parallel or (usually) perceptibly though feebly excurved. These differences in the hind angles are recognized by both Say and Le Conte in their descriptions. In *agonus* the elytral striæ are perceptibly impressed and more strongly punctate, while in *ectypus* they are scarcely impressed and the strial punctures are finer. Van Dyke's tabular diagnosis for "*ectypus* (*agonus*)" fits *agonus* well as to antennæ and elytral striæ, while his diagnosis of *anceps* Lec. would serve well for *ectypus.* In this connection it should be remarked that he says of *anceps,* "probably only a phase or variety of *ectypus,*" in which opinion I quite agree with him.

Limonius infuscatus Mots.

It has been my experience that there has existed among collectors a general feeling of uncertainty as to just what this species is. In the Le Conte collection *infuscatus* is represented by a row of five specimens, of which the first in line was sent to him by Motschulsky and bears a label with name and locality "Calif." in the latter's handwriting. This specimen is a male, 8.8 mm. long, with æneofuscous thorax and reddish brown elytra, the vertices of the hind angles of the thorax paler. With the exception of length it agrees in all respects with Motschulsky's description and must be regarded as a typical exponent of the species.

In the matter of length a peculiar situation exists. Motschulsky in his description gives as the length of *infuscatus* "3–3⅔ l.," or 6–7⅓ mm., which indicates an insect scarcely larger than our *L. quercinus.* I have never seen a specimen of so-called *infuscatus* so small as the larger of these measurements and the typical example sent by Motschulsky himself has a length of 8.8 mm. as stated above. The fact that Motschulsky in his remarks speaks of *infuscatus* as being considerably smaller than his *L. angulatus,* to which he gives a length of 4⅕ l. (8.4 mm.), seems to forbid our ascribing the apparent inconsistency to a mere slip of the pen or to a printer's error. On the other hand, Van Dyke gives as the limiting lengths of *infuscatus* 11 to 14 mm., which to me is equally extravagant in the opposite direction, since not one of my so-called *infuscatus* measures up to the lower limit which he sets and only two examples of my *vernalis* series reach this limit. The natural inference would be that *infuscatus,* as I understand it, does not enter into Van Dyke's conception of the species, and that *vernalis,* which he considers a subspecies of *infuscatus,* cannot be included in his measurements, since the average length of the 18 examples of *vernalis* in my collection is only 9.2 mm.

But to return to the Le Conte series. The second example in line is apparently a male of *vernalis;* it bears a gold disk locality label indicating California, and is probably from the southern part of the State. It is closely related to the Motschulsky type, differing in its slightly more elongate thorax, with less rounded sides and the presence of a small though perceptible sinuation at the hind angles; the antennæ are also a bit longer though otherwise the same. The third and fourth specimens bear a blue locality disk (Oregon); they have the thorax entirely black and feebly æneous, the sides with no posterior sinuation; one of them is a male by the exposed genitalia and has the antennæ scarcely or barely attaining the hind angles of the thorax (distinctly passing the hind angles in *vernalis*). This is what I have long assumed to be *infuscatus,* but I am now doubtful if it can be the same as the Motschulsky type. The fifth Le Conte specimen is from California; it is in rather poor condition, but seems to be the same as the two Oregon ones.

Aside from the disturbing measurements, which we may perhaps ignore, two other statements in Van Dyke's tabular diagnosis of *infuscatus* would, if strictly interpreted, exclude the typical example in the Le Conte collection. He says: "Prothorax always slightly longer than broad" and "subparallel toward the base." In the Motschulsky specimen the prothorax by actual measurement is as wide as the length on the median line, and it is distinctly narrowed both before and behind as the description calls for ("antice posticeque angustato"). If the word "always" in the first of the above statements were changed to usually, it would probably apply with sufficient accuracy to the true *infuscatus,* to which a series of specimens in my collection from Northern California closely approximates. In these the thorax is as a rule longer than wide, but varies to slightly wider than long.

In the Southern California *vernalis* the thorax is really longer than wide in all specimens known to me and is distinctly narrowed behind. In the Oregon specimens of the Le Conte series and in others from Washington in my own collection the thorax is more nearly entirely nigroæneus, the sides nearly parallel behind without basal sinuation and the antennæ shorter than in the above forms; they are nearly allied to *infuscatus* and *vernalis,* but look different and probably deserve a distinctive name.

From the above considerations it must be evident that the matter is somewhat involved. In any case a definition of *infuscatus* must be such as to include the typical example from Motschulsky in the Le Conte cabinet, and must conform to the essentials in the original description, barring possibly the mysterious measurements.

Limonius pilosulus Cand. (*pilosus* Lec.)

Represented in the Le Conte collection by the unique male type from San Diego. A moderately large example (10.5 mm.) of stoutish form, color of body, including legs and antennæ, entirely black with merest trace of æneous surface lustre. The thorax at middle is very finely and sparsely punctured, but the punctures become rapidly larger and closer toward the sides; joints four and five of antennæ as wide as long, none of the joints with sharply formed outer angles, but all with more or less rounded vertices. This Le Conte type bears no resemblance to *infuscatus* and it is impossible to believe that Van Dyke is justified in uniting it with the latter.

Limonius semiæneus Lec.

While probably rightly regarded as not specifically distinct from *basilaris* Say, *semiæneus* should be given varietal standing and not be placed as a mere synonym of the former as is done in the Leng List. The more or less pale front margin and angles of the thorax and the pale yellow elytra varying to fuscous with yellow margins give it an appearance quite distinct from *basilaris.* In common with *basilaris* it possesses an almost unique character in the genus in the presence in both sexes of numerous short bristling erect hairs on all but the basal three joints of the antennæ. Le Conte, in his 1853 paper, casually mentions this feature in his remarks on *basilaris,* but apparently without appreciation of its unique character. I have noticed nothing like it in any other species of the genus save a feeble approach in *nimbatus* Say.

Semiæneus was described from Georgia. It has been taken by

Blatchley recently at Gainesville, Florida, and by myself on the East Coast at St. Augustine.

Limonius rectangularis new species.

Elongate, parallel, rufotestaceous throughout, the legs scarcely paler; conspicuously but not densely pilose, the pilosity consisting of semierect more or less recurved hairs mingled with longer erect ones, the latter subserially arranged on the elytral intervals; surface somewhat shining. Head nearly flat, densely coarsely punctate, clypeus feebly reflexed, the edge broadly evenly arcuate, not perceptibly impressed at middle. Antennæ long and rather slender, passing the hind angles of the thorax by about four joints; feebly serrate, joints 2–4 gradually longer and wider, each fully twice as long as wide, 4–11 very gradually narrower, 8–10 each about two and one-half times as long as wide, 11 slightly more elongate. Prothorax about one-eighth longer than wide, sides virtually straight and parallel throughout, base and apex equal, base angles not at all produced, rectangular; apical angles with narrowly rounded vertices; punctures rather coarse and close but nowhere in contact, the interspaces polished; median line feebly impressed posteriorly, hind angles with a short carina very near the margin. Elytra three times as long and one-sixth wider than the prothorax, not quite three times as long as wide, sides parallel to behind the middle; striæ of rather strong close set punctures scarcely impressed on the disk and only lightly so at sides; interspaces distinctly irregularly not very closely punctate, hardly rugose. Beneath moderately punctate and pubescent, the last ventral somewhat more coarsely punctured; prosternal sutures double, scarcely grooved in front; basal joint of hind tarsus slightly longer than the second. Length, 9.2 mm.; width, 2.5 mm.

Described from a single specimen, probably a male, collected by Poling at Alpine, Texas, May 20, 1926.

This rather unusual species has somewhat the appearance of certain *Athous,* but the critical characters are all those of Limonius. By Dr. Van Dyke's table it places between *dubitans* and *infuscatus,* but does not resemble either of these species. There is, I think, no previously described species in our fauna in which the thorax is not in some degree at least narrowed in front; in the present species it is almost perfectly rectangular in outline. In this respect it must resemble the Mexican *quadraticollis* of Candèze, but the description of this latter shows it to be quite a different thing.

Elathous Reit.

Elathous brevicornis new species.

Moderately elongate, chestnut brown, basal declivity of the elytra rufous; epipleura, body beneath, legs and antennæ rather dark rufotestaceous; integuments moderately shining, clothed with a very short fine suberect pile. Head deeply triangularly impressed in front, rather coarsely and closely punctate, clypeal margin well advanced, arcuate. Antennæ (♂) not reaching the apices of the hind angles of the thorax, joints 2 and 3 subequal, each a little longer than wide, together longer than 4, the latter wider but very little longer than 3, a little longer than wide, 5–10 similar to 4 but gradually feebly decreasing in both length and width. Prothorax apparently distinctly longer than wide but by actual measurement the length on the median line and the maximum width are 2.5 and 2.3 mm. respectively; sides rather strongly arcuately convergent anteriorly, a small but evident sinuation just before the apices of the hind angles, of which the vertices are a little everted; disk rather strongly convex, median line impressed only near the base; punctuation somewhat coarse, close and variolate at sides, becoming much finer, sparser and simply perforate along the middle; hind angles with an acute but not long carina which diverges strongly from the margin. Elytra a little wider than and slightly more than two and one-half times as long as the thorax; parallel and feebly arcuate in basal half; striæ finely impressed and finely punctate, intervals faintly convex and sparsely punctured. Propleura coarsely rather closely punctate, prosternum somewhat less coarsely so, metasternum and ventral segments much more finely punctate. Length, 9.5 mm.; width, 2.7 mm.

Described from a single male specimen taken by myself in the San Bernardino Mts., California.

This species must be nearly allied to *californicus* VanD., but there are several differences which appear to indicate its distinctness from the latter. As compared with *californicus*, it is smaller, somewhat less dark in color and with less disparity in tint between the upper and under surfaces; the antennæ are shorter, not reaching the hind angles of the thorax, whereas in *californicus* they extend beyond the angles. In the present species joint three of the antennæ is barely visibly longer than two, and two and three together are much longer than four, while in *californicus* joint three is conspicuously longer than two, and together they are barely longer than four. In *californicus* the pronotal punctures are said to be but little coarser laterally; in the present species they are very distinctly coarser at sides.

Elathous brunnellus new species.

Dark piceous brown above, the hind angles of the prothorax obscurely and the margin of the basal declivity of the elytra more brightly, rufotestaceous; beneath dark brown, the prosternal lobe, inner and rear margins of propleura, epipleura and legs rufous or rufotestaceous. Integuments shining, pubescence fine, short and semierect, yellowish brown but rather obscure.

Antennæ brown, very nearly attaining the tips of the hind angles of the thorax; joint 2 slightly longer than wide, 3 perceptibly narrower and very little longer, the two together evidently longer than 4, joints 4–10 scarcely serrate, each elongate triangular, 4 less than twice as long as wide, 10 fully twice as long as wide. Head strongly impressed anteriorly, punctures rather coarse, well separated. Prothorax distinctly longer than wide, sides moderately convergent and just perceptibly arcuate from base of hind angles to apex; hind angles triangular, acute, divergent, with fine sharp carina close to the outer margin and concealing the latter from above; disk evenly convex, median line not visibly impressed, sparsely finely punctate at middle, the punctures becoming larger, closer and subvariolate toward the sides. Elytra subparallel; striæ moderate, distinctly punctate basally, becoming obsoletely so apically; intervals a little convex, sparsely punctate and transversely rugulose. Body beneath shining and finely simply punctate except on the propleura, where the punctures are coarser, closer and subvariolate. Length, 6.7 mm.; width, 2.1 mm.

Pine Flats, Sierra Madre Mountains, 7000 feet, Southern California. A single male specimen.

This species is nearly allied in all essentials with the preceding species and with *californicus,* but is much smaller than either and differs in its nearly uniform coloration of both upper and lower surfaces, and in its darker antennæ. The close approximation of the carina of the hind angles of the thorax to the side margin will distinguish it from *brevicornis,* and presumably also from *californicus.*

Ludius Esch.

Ludius cribrosus Lec. and *L. maurus* Lec.

I must confess to being completely nonplussed by Dr. Van Dyke's announcement that *cribrosus* and *maurus* are respectively male and female of the same species. The statement is positively made that the relationship "has been shown by careful field studies," yet it would be interesting to know just what the observations were that led to this conclusion.

Be this as it may, it is a fact that in my series of both *cribrosus* and *maurus* both sexes are present, and in each case the two sexes agree in possessing the characteristics of the respective species.

In the Le Conte cabinet there are six examples in the *cribrosus* series and four in that of *maurus.* The last two of the *maurus* series are later acquisitions and really belong with *cribrosus.*

One of the two genuine *maurus* is certainly a male by the exposed genitalia, the other is apparently a female.

Aside from the broader more depressed form, somewhat differently shaped thorax, and denser punctuation of the pronotal disk in *maurus,* the two species are, in my experience, always separable by antennal characters. In *cribrosus* the third antennal joint is fully twice as long as the second, very distinctly triangular, and though less wide bears a general resemblance to the fourth joint; in *maurus* the third joint is rarely if ever as much as twice the length of the second, the form much narrower and more similar to the second than to the fourth. In general the antennæ are shorter sex for sex in *maurus* than in *cribrosus,* the length in the male in *maurus* being about the same as in the female of *cribrosus.* In males of *cribrosus* the antennæ as a rule extend well beyond the tips of the hind angles of the thorax, but I notice some lack of constancy in this respect in my series. The male genitalia are quite similar in the two species but not identical.

Ludius colossus Lec.

The placing of *colossus* by Van Dyke as a giant female form of *cribrosus* is scarcely less difficult to accept than his disposition of *maurus.* If, as he implies, only females are known, and these are ''often found'' in the Southern Sierras, we certainly have to do with a remarkable situation which needs in some way to be explained. Personally I have seen very few specimens of *colossus* and have no alternative theory to offer; but in a consideration of probabilities it is pertinent to say I recall no other single instance in the genus or indeed in the entire family where a mere increase in size in one sex of a species is accompanied by a definite set of structural differences such as *colossus* possesses. Whatever be our theory as to the status of *colossus,* it is to be hoped that it may be possible ere long to test it by breeding or by the discovery in nature of actual association of the sexes.

Ludius nigricans Fall

The reference of this species by Van Dyke to *rotundicollis* as a subspecies is, in my judgment, quite unwarranted. There may well be a more or less remote community of descent between the two species, but it would be quite gratuitous to assume that either one was a direct offshoot of the other. The differences are striking, sufficiently constant and of an order that is ordinarily considered to be specific. *Nigricans* is, in the first place, a materially larger species. In it the thorax does not at all approach the peculiar rotundate quadrate form characteristic of *rotundicollis*. The pronotal punctures are very much coarser and closer than in *rotundicollis,* in which they are very sparse and fine, being only just perceptibly larger than those of the elytral interspaces. In *nigricans* the interstitial punctures are two or three times as numerous as in *rotundicollis,* and the striking disparity in size between them and the pronotal punctures is one of the most notable points of difference between the two species.

Ludius diversicolor Esch.

Dr. Van Dyke records this as a subspecies of *rotundicollis,* citing only the red thorax as the distinguishing character. Inasmuch, however, as Say described *rotundicollis* as having the thorax red, *diversicolor* appears not to have a leg to stand on and must be returned to synonymy.

Ludius castanicolor new species.

Moderately elongate, convex, dark chestnut brown, under body a little paler, legs and antennæ rufotestaceous; surface rather strongly shining, pubescence exceedingly short and sparse, almost invisible. Head strongly closely punctate, front flattened and feebly biimpressed. Antennæ barely attaining the hind angles of the thorax, third joint narrowly subtriangular, nearly twice as long as wide, about one-half longer than the second and slightly longer than the fourth; fourth triangular, slightly longer than wide, fifth to tenth as wide as long. Prothorax strongly convex, slightly wider than the median length, sides rounded and converging in front, parallel at middle, perceptibly sinuate at base of hind angles, these moderately produced and a little divergent; disk with a fine median impressed line; punctures moderate, separated by an average distance of about their own diameters, slightly coarser and closer but not in contact near the side margins; hind angles with a moderate carina. Elytra nearly three times as long as the thorax and at base as wide as the latter; two and one-eighth times as long as the width at apical two-fifths, where the width is fully one-fourth greater than that of the thorax; striæ rather deep, distinctly punctate; intervals evidently convex, sparsely finely punctulate. Prosternum moderately coarsely sparsely punctate, propleura more densely so, the punctures however nowhere in contact; metasternum and ventral surface finely nearly evenly punctured, the punctures slightly closer toward the side margins of the body. Length, 9.3 mm.; width, 3.15 mm.

Jemez Springs, New Mexico; June 20, 1923. Described from a single example of unknown sex.

This species by Van Dyke's table runs to "68," except that the form is less flattened than there indicated and the intermediate joints of the antennæ are fully as wide as long. In form it bears considerable resemblance to Van Dyke's var. *ater* of *cruciatus,* but the latter is black, the antennæ less stout and the pronotum without or with but faint trace of impressed line, at least in the specimens which I have seen. It also somewhat resembles in color the eastern *splendens,* but is of more convex form and is entirely devoid of the metallic lustre which characterizes that species.

Eanus Lec.

The small group of species once recorded in our Lists under the generic name *Paranomus* have of late years been included as a section of *Ludius.* If they are to be recognized as a separate genus the name *Paranomus,* being preoccupied, must be abandoned and the generic name *Eanus* of Le Conte must be restored. This has been done by Mr. W. J. Brown, who gives a synopsis of our species in the *Canadian Entomologist* of July, 1930.

It is evident that Brown's paper was overlooked by Van Dyke, in whose synonymy (p. 444) some change is necessary. Whether our well-known transcontinental species should continue to be called *costalis,* as identified by Candèze, seems now a matter of uncertainty. Mr. Brown, after comparing European specimens with our own, claims in his paper that our species is distinct from the European and must be known as *decoratus* Mann. I have made like comparisons in my own cabinet and have been unable to come to a definite conclusion. Certainly size and elytral maculation (or lack of it) have no weight. The other points mentioned by Brown I am able to detect in some specimens, scarcely so in others, and on the whole they seem rather tenuous.

Eanus maculipennis Lec. (= *pictus* Cand.)

The placing of this species as a synonym of *costalis* in the Leng List is a bit of absurdity for which I suppose the List is not responsible, but which is difficult to account for, since the two species are palpably distinct. Brown has shown that *maculipennis* has a slight priority over *pictus,* though we have been accustomed to the reversed synonymy, which I think was accepted without question by Le Conte himself.

Eanus subarcticus Brown

After examining a typical example from Mr. Brown and carefully comparing with my own series and the Le Conte types, I feel certain that this is not specifically distinct from *estriatus* Lec.

NEW CICADAS FROM NORTH AMERICA

By Wm. T. Davis
Staten Island, N. Y.

There are at present one hundred and fifty named cicadas described from North America north of Mexico, nearly all of which are considered species; a few are evidently geographic races, and several are varieties.

While W. L. Distant in 1881, in ''Biologia Centrali-Americana,'' and again in his catalogue of 1906, mentioned or described many of the Mexican cicadas, the total did not exceed the number of species now known to inhabit Texas or some of the other southwestern states. It was therefore evident that many more species must exist in a land so favorable for cicadas as we know Mexico to be. Texas has a cicada fauna of forty known species, and in the Chisos mountains there are no doubt species that extend into Mexico as they are suggestive of forms known only from that country. Also along the southern boundary line of Arizona there are several species that extend southward.

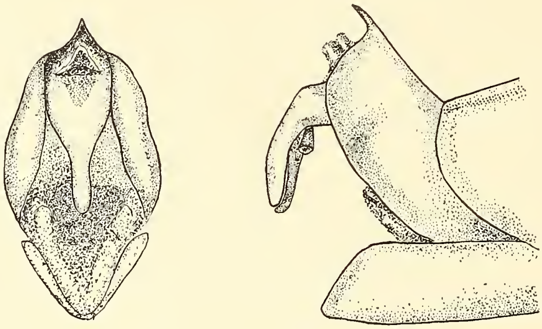
The foregoing facts explain why so many new forms are here described from Mexico which evidently has not been very thoroughly explored for cicadas. Owing to their number the writer was apprehensive that he might have overlooked some of the known Mexican species, so he sent most of the cicadas to the British Museum. Mr. W. E. China reported that he did not find any of them represented in that extensive collection. I am indebted to him for making the comparisons, and to Mr. Hans L. Stecher, of the Staten Island Institute of Arts and Sciences, for making most of the text figures.

Tibicen chisosensis new species (Plate II, Figs. 1–2).

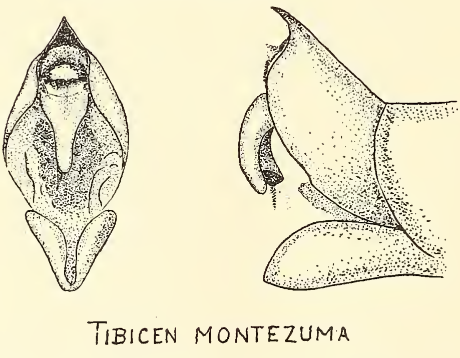
Type male and allotype female from Chisos Mts., Brewster Co., Texas, June, 1932.

Resembles *Cicada montezuma* Distant, described in Biol. Centr.-Amer., Rhynch. Hom. 1 p. 8; t. 2, fig. 2, from Mexico, but is larger; has longer opercula and the front of the head is more prominent, protruding about as in *Tibicen townsendi* Uhler. In *Tibicen parallela, Tibicen paralleloides* and related species, the posterior margin of segment two in the male, when viewed from above, slants obliquely to the sides of the abdomen. In *Tibicen montezuma* and in *Tibicen chisosensis,* the posterior margin of the segment has hardly any slant.

Head across eyes about as broad as the anterior part of the pronotum, front considerably produced; no median sulcus; transverse rugae well defined. Many white hairs about the face, also numerous hairs on the under side of the abdomen. The opercula contiguous but not overlapping, with the extremities broadly rounded and reaching the extremity of the second abdominal segment, the outer sides converging. Last ventral segment broad at the extremity and without a notch. Uncus as in the illustration and much like that of a male from Cuernavaca, Mexico, identified as *T. montezuma,* the uncus of which is also figured.



TIBICEN CHISOSENSIS



TIBICEN MONTEZUMA

Head black with six pale spots; one at front; one posterior to this; one each side above antenna, and one each side near the eye but on the posterior margin. Pronotum black with the hind margin narrowly bordered with olive green and the central portion variegated faintly with olive green. In the paratype the pronotum, except for the posterior margin is black, with hardly discernible spots of a paler color. Mesonotum with each of the inner obconical areas terminated posteriorly with a pale spot, and with outer adjacent spot also pale. Cruciform elevation pale; centrally black, with a black spot on each of the anterior limbs. Sides pale with a narrow, pruinose line near the base of each fore wing. In the allotype the mesonotum is nearly all black, but the pruinose line is present. Abdomen black, tympanal coverings brownish, a small pruinose spot each side on segment one; larger spots each side on segments three and eight. Each segment both in the type and allotype is margined posteriorly with brownish. Under side with the legs striped and variegated with black; opercula pale; central portion of the abdomen, including valve, pale; the sides pruinose with each segment dark anteriorly and pale posteriorly. Fore wings with venation dark, the first and second cross veins clouded; the basal area orange; black outwardly, and the membranes at the base of the wings orange with a pinkish tinge. Membranes at the base of the hind wings orange with a more decided pinkish tinge.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	34	29
Width of head across eyes	11	10
Expanse of fore wings	83	79
Greatest width of fore wing	13.5	13
Greatest width of operculum	7.5	

This species was kindly sent to me for identification by Dr. Dana B. Casteel and Mr. H. B. Parks, Jr., of the University of Texas.

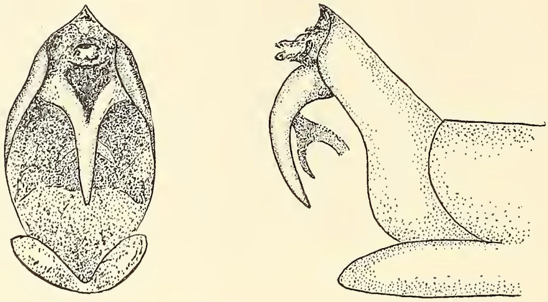
Tibicen paralleloides new species (Plate II, Fig. 3).

Type male from vicinity of Compostela, Nayarit, Mexico. Davis collection.

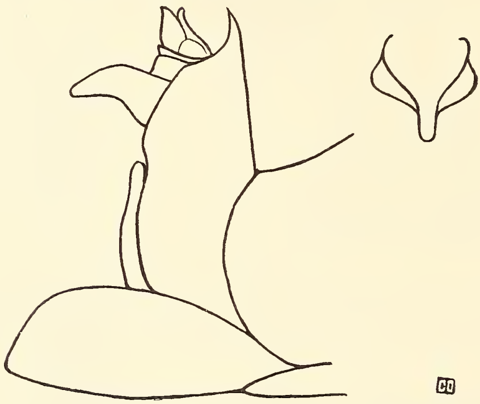
Resembles *Tibicen parallela* described and figured in this JOURNAL for March, 1923, and March, 1925.

Head across eyes broader than the pronotum, front moderately produced and about as in *parallela;* no median sulcus; transverse rugae well defined. Many white hairs about the face, also numerous hairs on the under side of the abdomen about as in *parallela.* The opercula overlapping at base with extremities rounded and not extending beyond the second abdominal segment; the outer sides nearly parallel as in *chiricahua,* and not as converging as in *parallela.* Last ventral segment broad at the extremity and with a shallow open notch. Uncus as in the illustration, and very differently formed from that of *parallela* figured in 1923 and here reproduced.

Body above nearly black. Head with a greenish spot at base and apex of front and a narrow stripe each side above antenna of the same color extending from the black rugae to the eye. A pale, irregular spot extending



TIBICEN PARALLELOIDES



TIBICEN PARALLELA

to back of head near each posterior ocellus. Pronotum with the collar olive green and the anterior portion variegated with green and black. In *parallela* the pronotum is black with the collar sometimes pale at the extremities each side. Mesonotum with two curved greenish colored lines centrally extending backward from the front margin and joining those extending forward from the cruciform elevation, which is pale except for a central, black spot. Abdomen black above with a well defined, pruinose spot each side on segment three. Under side of body pale, pruinose on each side of the abdomen, also about the base of the legs. Fore wings with the basal area clouded, the first and second cross veins clouded; the venation in both pairs of wings brownish, costal margin paler. Membranes at the base of the fore wings are bright orange. The basal membrane of hind wings is not quite as highly colored. Both fore and hind wings very closely resemble those of *parallela* in shape and color.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	33
Width of head across eyes	13
Expanse of fore wings	82
Greatest width of fore wing	13
Greatest width of operculum	7

Looking at *paralleloides* from above, the size, color and markings closely resemble those of *parallela* from New Mexico and Arizona, but an examination reveals a remarkably shaped uncus as well as other differences.

In the collection of Cornell University there is a female, probably *Tibicen paralleloides* from Guadalajara, Mexico, in the State of Jalisco, which adjoints Nayarit on the south, and extends to the Pacific Ocean. This female (Plate II, Fig. 4) is like the male in having no small red spots along the sides of the abdomen, one on the hind margin of each segment. The posterior margin of the pronotum is pale and the rostrum as in the male type extends about to the end of the hind coxæ, whereas in the five specimens of *parallela* in the writer's collection the rostrum is not quite as long. The first cross vein of the fore wing in type of *paralleloides,* as well as in the female from Guadalajara, starts from radius 3 nearer to the base of the wings than in any of the five specimens of *parallela* from Arizona and New Mexico.

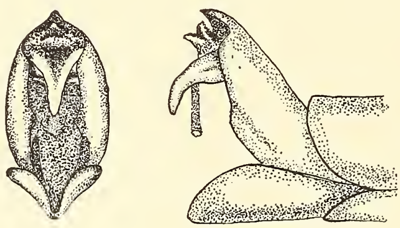
Tibicen minor new species (Plate II, Fig. 5).

Type male from All. Correa Nicto. Lomas de Sta. Fe D. F., Mexico. Davis collection.

This insect has sometimes been identified as *Cicada hilaris* from Mexico, described and figured by Distant in Biol. Centr.-Americana (1881). *Hilaris* expands 52 millimeters, while *minor* is much smaller and presents other differences as well.

Head across eyes broader than the front margin of the pronotum; front not conspicuously produced; hairy; no median sulcus, and with the transverse rugæ defined chiefly by hairs and pruinose stripes. The opercula overlapping with extremities broadly rounded; not extending beyond the second abdominal segment, and with the outer sides nearly parallel. Last ventral segment broad at the extremity which is shallowly sinuate. Uncus as in the illustration and much more compressed in lateral view at the extremity than in the next species.

Body above black. Head with the following pale: a spot at the front; one each side near the eye; a central one in the depression in front of the median ocellus, and one each side extending to the hind margin. Pronotum with the anterior margin narrowly pale; the posterior margin or collar more broadly so and with a pale spot each side near the lateral margin. Mesonotum narrowly pale along each side to the base of the wings; cruciform elevation pale except for a central black area. Abdomen black above with the lateral margins of segments 3 to 8 inclusive broadly pale and more or less pruinose. Under side of the abdomen and opercula pale straw colored throughout; the legs and under side of head variegated with black. Fore wings with the basal area and the first and second cross veins clouded; the anterior margins pale; the venation of both pairs of wings brownish with the hind wings paler than the fore wings. Membranes at base of fore wings pale, or pale orange in some of the paratypes. Also in some of the paratypes the pronotum is more variegated with pale spots in the depressions, and there are indications of obconical spots on the mesonotum at the anterior margin. The membranes at the base of the hind wings are almost white in some individuals.



TIBICEN MINOR

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	17
Width of head across eyes	6
Expanse of fore wings	47
Greatest width of fore wing	8
Greatest width of operculum	4.5

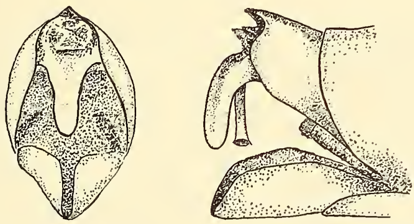
The following paratypes all from the collection of the U. S. Nat. Museum have been examined: Guadalajara, Mex., July, 1885, male; also a second male in this lot but without data; two males labeled "Mex, 302," and a male without data.

Tibicen fusca new species (Plate II, Fig. 6).

Type male, Mexico D. F. (J. R. Inda collector). U. S. National Museum Collection.

This species resembles *minor* in size, but may be readily told from it by the narrower head, more prominent front, and brownish clouded wings with coarse venation. The uncus is also differently shaped.

Head across eyes very slightly broader than the front margin of the pronotum, the width of the head and pronotum being conspicuously narrower than the abdomen across the middle. The opercula and the last ventral segment are as in *minor*. The *uncus* is as figured and not as much compressed when seen in profile as in *minor*. Also the terminal, dorsal spine of the abdomen is more robust than in *minor*.



TIBICEN FUSCA

Body above blacker than in *minor*, but with some of the same spots faintly represented. There is no pale and pruinose margin on segments 3 to 8, the abdomen being entirely black above with slight indications of a paler area each side on segment eight. Under side of the abdomen with the segments fuscous, margined posteriorly with greenish straw color. The opercula pale in color except at base. Front and hind wings brownish with venation more heavily clouded and coarse than in *minor;* membranes of all of the wings pinkish.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	16
Width of head across eyes	5
Expanse of fore wings	37
Greatest width of fore wing	6
Greatest width of operculum	4

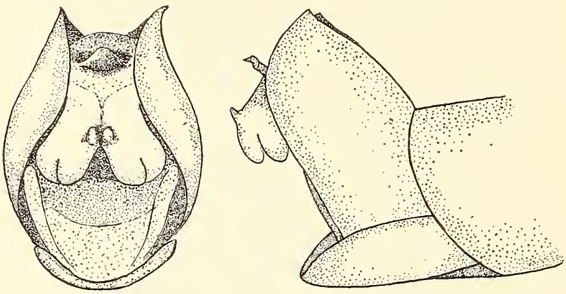
Only the type has been examined.

Diceroprocta lucida new species (Plate III, Fig. 1).

Type male and allotype female from Cuautla, Morelos, Mexico, 1927. Davis collection.

Resembles *Diceroprocta digueti* Distant from Lower California and the adjacent mainland of Mexico, but the front of the head is much more produced and is shaped as in *D. bulgara* Distant, from Mexico. Also the pruinose stripes on the sides of the abdomen often conspicuous in *digueti* on segments 4 to 7 are wanting.

Head across the eyes broader than the front margin of the pronotum; front very prominent; median sulcus shallow; transverse rugæ well defined with the grooves conspicuously white and tomentose. The opercula broad, not extending beyond the second abdominal segment; extremities rounded and almost meeting at the inner basal portion. Last ventral segment broadly rounded with a small and shallow notch at the extremity. Uncus as figured. The notch in the ventral segment of the allotype is broad and well defined.



DICEROPROCTA LUCIDA

Body above conspicuously shining, especially on the mesonotum which is nearly devoid of the white and golden pubescence occurring on the remainder of the body. A much lacerated, broad, black stripe, connects the eyes; the grooves and hollows in the pronotum are black; collar greenish with a dark irregular spot at each extremity. Mesonotum almost black, with two obconical spots extending backward from the front margin. The pale lines encircling these spots are almost joined (or joined in some of the paratypes) by the pale fore limbs of the cruciform elevation. Sides pale to base of fore wings. Abdomen mostly covered by a golden or whitish pubescence but where this has been removed the segments are nearly black, pale on the posterior margin. A conspicuous pruinose spot each side on segment 8. Segment 9 pale on the sides. Under part of the abdomen pruinose at the sides, with an irregular, broad, central stripe. The opercula are pruinose and pale on the outer sides but almost black on the inner portions. The legs are pale, the front pair darkest, and there are long white hairs near the eyes. The venation of all of the wings is brownish, especially along the front margin of the fore wings and about the marginal cells. The basal cell is conspicuously darkened at the anterior outer angle; the membranes at the base of all of the wings are gray, being darkest in the fore wings.

MEASUREMENTS IN MILLIMETERS

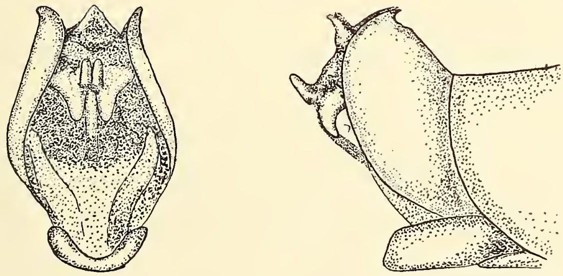
	Male Type	Female Allotype
Length of body	30	28
Width of head across eyes	12	12
Expanse of fore wings	90	90
Greatest width of fore wing	12	12
Greatest width of operculum	7	

In addition to the type and allotype 12 males and 7 females have been examined from Cuautla, all collected in 1927, and one female from Jojutla, Morelos, Mexico, collected in June, 1929.

Diceroprocta operculabrunnea new species (Plate III, Figs. 2–3).

Type male and allotype female from Cuautla, Morelos, Mexico, June, 1929. Davis collection.

Resembles *Diceroprocta transversa* Walker, but with the front of the head and eyes not as prominent. The opercula are very long reaching the 6th abdominal segment, and are bright brown in color. They are straw colored and pale in *transversa* and *marevagans*, as well as being much shorter.



DICEROPROCTA OPERCULABRUNNEA

Head across eyes a little broader than the front margin of the pronotum; median sulcus shallow; transverse rugæ well defined with the grooves white and tomentose. The opercula are very long, slightly overlapping at the base, and with the widely diverging rather sharp extremities reaching the 6th and occasionally the 7th abdominal segment. Last ventral segment rounded at the extremity, with a notch, and clothed with numerous long white hairs. Uncus as figured. The notch in the ventral segment of the allotype is broad and double, that is one within the other.

Body above black and brown. The head is black with a small pale spot on the front and the grooves pale; the central ocellus is surrounded by pale; the other two by black; the back of the head is pale. The hind margin and sides of the pronotum or collar greenish brown, or green in some of the paratypes; the central elevations of the same color with the intervening grooves black. Mesonotum with four obconical spots outlined by green or greenish, extending backward from the front margin toward the cruciform elevation. The anterior, pale limbs of this elevation enclose a dark, shield-shaped, central spot, which has two black dots, one each side of the central line. The posterior margin of the pronotum is pale. Abdomen covered with white and brown appressed hairs, which form a white spot each side on segment three; segment 8 also conspicuously white each side in some of the paratypes forming two spots. Under side of the abdomen chocolate colored centrally; shining; paler at the extremity and pruinose each side. Opercula conspicuously red-brown. Head, pronotum and mesonotum covered with white hairs, and legs straw colored, striped with brown. Wings clear, membranes at base of all wings gray, first and second cross-veins of fore wings infuscated.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	24	22
Width of head across eyes	9	9
Expanse of fore wings	70	70
Greatest width of fore wing	10	10
Greatest width of operculum	6	

In addition to the type and allotype three males have been examined from Cuautla, Morelos, Mexico, June, 1929, and six males from Jojutla, Morelos, Mexico, June, 1929.

Diceroprocta bequaerti Davis.

The standing of this species was last considered in this JOURNAL for June, 1932.

From June 28 to July 14, 1933, Mr. F. F. Bibby and his associates, Messrs H. B. Mills, J. M. Landrum and R. A. Garham, sent me 14 male and 57 female *Diceroprocta bequaerti* taken about Waco, McLennan County, Texas. As is usual in the allied *D. vitripennis* Say, the females collected far outnumbered the males. This lot of 71 specimens can be readily separated from *D. vitripennis* found by Mr. Bibby at Midway, Madison County, Texas, in June, 1931, and from the many other specimens of that species in the writers' collection, by the larger head in *bequaerti*, as well as by the other characters noted in 1932.

In his letter of August 6, 1933, Mr. Harlow B. Mills states that by that date *bequaerti* had become uncommon, and that the greatest number of specimens had been taken about the middle of July. "The emergence at Waco must surely have assumed the proportions of a brood this year. The species was abundant in the bottom-lands, and cast skins were very common on small willows. On the upland, specimens were taken in a mesquite-postoak pasture where, however, they never became abundant. . . . The species was most abundant on the flood-plain of the Brazos River where it was common on willows growing on a sand-bar, and in tall weeds back from the river bank. Specimens were not uncommonly heard singing in cotton near the river and occasionally in upland cotton fields. In the flood-plain regions it was associated with the large *Tibicen marginalis*."

Diceroprocta bequaerti was seen by Mr. Mills ovipositing in cotton wood (*Populus deltoides*), willow, and the weed *Chenopodium anthelminticum*. Three specimens of the robber-fly *Proctacanthus hinei* Bromley, were taken with *D. bequaerti* as prey, and a dead one was found in the grasp of a spider determined by Willis J. Gertsch as *Phidippus purpuratus*. The song of *D. bequaerti* is "a high-pitched, penetrating, rasping, rapidly repeated *zee-zee-zee*. Occasionally it takes the form of a broken song instead of the common long-continued performance. . . . On the river bottom, where the species was abundant, the united song of thousands of individuals raised a clamor reminding one of an emergence of the seventeen-year cicadas."

Beameria new genus.

It is proposed that this genus have as type what was originally described as *Prunasis venosa* Uhler, and include the species here described as *Beameria wheeleri*.

The genus *Prunasis* Stål, of which *P. viridula* Walker, of Brazil, is the type, is characterized as follows by Distant in his Catalogue (1906), p. 140: "Head with front prominently triangularly produced; margins of front and vertex discontinuous, somewhat at right angles to each other." The hind wings have four apical areas, and the notch in the last ventral segment of the female is deep and well defined.

In *Beameria* the hind wings normally have six apical areas, but sometimes less; the head is not triangularly produced, but has the front more rounded, and there is but a slight indication of a notch in the last ventral segment of the female.

In "Annals, Magazine of Natural History" (8), vol. 8, p. 134 (1911), Distant without comment removes *venosa* from the genus *Prunasis* and places it in *Proarna,* of which *hilaris* Germar, from the Antilles, is the type. In having the "transverse vein at base of second apical area more or less vertical," and also six apical cells in hind wing, *venosa* approaches the dozen or more species of *Proarna* of Mexico, Central and South America, but in them the genitalia is quite unlike that of *venosa,* and the proportionally longer marginal cells of the fore wings and amplified lateral margins of pronotum are in strong contrast, as is the size and the markings. In the females the notch in the last ventral segment is much deeper than in *venosa.*

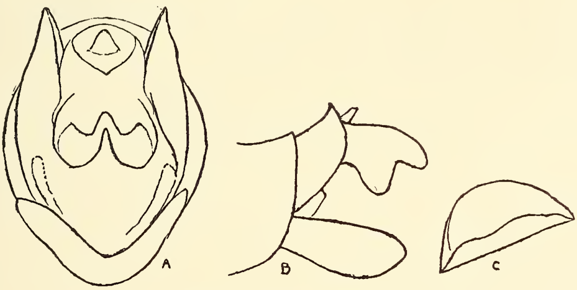
The accompanying figures and descriptions will more fully characterize *Beameria,* which is named for Dr. Raymond H. Beamer, who has kindly sent to me for examination the many cicadas collected by himself and associates during their extensive field excursions for the University of Kansas.

Beameria venosa (Uhler). (Pl. III, fig. 5.)

Prunasis venosa was described by Uhler in *Entomologica Americana,* Vol. IV, p. 82, 1888, from "Middle and Southern Texas, not on the coast. Only males have thus far been examined; three specimens of which are at present in my collection. The venation is coarser than in any of the small cicadas which I have had the opportunity to examine." He gives the "length to the tip of abdomen 11–13 mm. Expanded wing covers 31–32 mm. Width of pronotum across the middle 3½–4 mm."

In the writer's collection there are three *venosa* that were compared in 1916 with Texas specimens in the Uhler collection, now in the U. S. National Museum. They were labeled *Prunasis venosa* by him. The species is now known from Nebraska, Kansas, Oklahoma, Texas, Colorado, New Mexico and Arizona, and there are at present in my collection nearly 300 specimens from these states. With a few exceptions they all conform with the measurements given by Uhler in the original description.

In 1917 a Biological Expedition was organized at Cornell University and the cicadas collected were reviewed in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for December, 1917. On page 213 of that volume 94 specimens of *venosa* are recorded from Texas and New Mexico. Three of these, all males, were collected at Alamogordo, New Mexico, July 1, 1917, by Prof. Wm. M. Wheeler, who was with the expedition for a time. Their expanse of wings is about 40 mm., and they are thus considerably larger than the remaining 91 specimens, which, however, they otherwise superficially resemble.



BEAMERIA VENOSA

In 1932 Dr. Raymond H. Beamer and J. D. Beamer, collected 25 *venosa* in New Mexico, and in Arizona, and also a male at Blue Springs, New Mexico, June 27, and six males at Alamogordo, N. M., June 30, 1932, of the large form. This led to an examination of all of the material, and it was found that the ten large males belonged to what is here considered a new species.

Beameria wheeleri new species (Pl. III, Fig. 6).

Type male. Alamogordo, N. M., July 1, 1917 (Prof. Wm. M. Wheeler). Davis collection.

In this insect the wings expand about 6 mm. more than in *venosa;* the front of the head is usually more prominent, the tymbals are not as exposed along the posterior margin, but are covered to a greater extent by the forward extension of the second abdominal segment; the opercula are slightly longer with the tips not as rounded as in *venosa.* These differences, as well as those in the genitalia, are shown in the accompanying figures, "C" showing the relative amount of the tympanal covering.

BEAMERIA WHEELERI

Color pale, and as in *venosa,* with the venation surrounding the marginal cells of the fore wings black or nearly so. The obconical dark marks on the mesonotum are the same in both species.

MEASUREMENTS IN MILLIMETERS

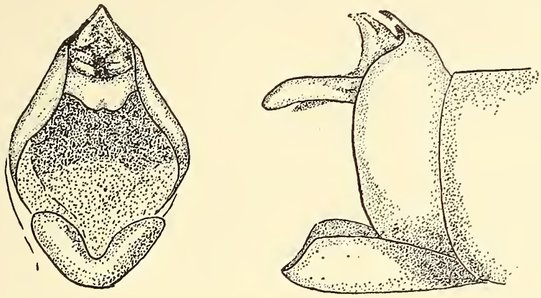
	Male Type
Length of body	16
Width of head across eyes	4.5
Expanse of fore wings	39
Greatest width of fore wing	7

Daza nayaritensis new species (Plate IV, Figs. 1–2).

Type male and allotype female from near Compostela, Nayarit, Mexico, October, 1932. Davis collection.

Resembles *Daza* (*Odopœa*) *montezuma* (Walker) of Mexico and type of the genus, figured in Biol. Centr.-Amer., Rhynch. Hom. Plate 3, fig. 5, but is slimmer and has spotted wings.

Head including eyes about as wide as mesonotum, front rounded; lateral margins of the pronotum dilated as in *montezuma;* in some individuals the lateral angles not quite as pronounced. The opercula as in *montezuma,* short and broad and not quite reaching the hind margin of the second abdominal segment. Last ventral segment shaped as in *montezuma.* Uncus as figured. The allotype has a notch in the ventral segment to accommodate the ovipositor.



DAZA NAYARITENSIS

General color greenish with dark brown or black markings. Head with the following black: narrow line at front, area about each ocellus; narrow irregular line extending from each of the outer ocelli to in front of the eye and four dots near the posterior margin and between the eyes (in some of the paratypes but two of these dots are present). Pronotum green with the grooves blackened and a central black spot near the hind margin but in front of the collar. Mesonotum greenish with the obconical spots extending backward from the front margin, a central line with two irregular spots each side, and two round, small, ones near the anterior extremities of the cruciform elevation, black. Cruciform elevation greenish with the anterior limbs black at the extremities. Abdomen yellowish green with irregular areas along the sides and the basal part of segment 8, blackish. Under side of the abdomen greenish with the basal part of each segment darkened. In the allotype there is a round black spot on segment 7 each side of the notch. Opercula green. Head green with the front edge including the fore part of the transverse rugæ, blackened; also the dilated, lateral margins of the pronotum edged with black. Legs green, variegated with black and brown. Wings nearly clear; first and second cross veins in the fore wings clouded, and sometimes the third cross vein as well. In each of the first seven of the marginal areas of the fore wings there is a faint central stripe, and the ends of the veins are clouded near the outer margin. Membranes at base of first pair of wings, gray; of the second pair, white, edged outwardly with dark gray.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	34	35
Width of head across eyes	11	11
Expanse of fore wings	102	102
Greatest width of fore wing	15	15
Greatest width of operculum	7.5	

In addition to the type and allotype 18 males and 25 females have been examined, all collected in Nayarit, Mexico, in October, 1932, and October and November, 1933.

Chinaria new genus.

The type of this genus is the species described in this paper as *Chinaria mexicana,* known from the states of Morelos and Sinaloa, Mexico. The lateral margins of the pronotum are dilated and medially angulated about as in *Odopœa, Miranha, Zammara, Collina* and *Daza.* In the shape of the pronotum, in that of the 8th marginal area of the fore wing and in the uncus, the type of this genus might be considered under *Odopœa,* but in *Odopœa* the tympana are covered at the outer sides by a forward extension of segment two of the abdomen. This is lacking in *Chinaria* where a continuous view of the sound apparatus may be had from the dorsal to the ventral part of the abdomen owing to the short opercula. There is but a slight forward extension or sinuation of segment two near the auditory capsule, not the prominent one as in the genera mentioned above, *Collina* excepted. In *Collina* the tympana are even less protected than in *Chinaria,* the head is narrower, the sides of the pronotum much less dilated, and the fore wings have a rather sudden bend or curve near the base.

The uncus is as figured and differs considerably from *Daza montezuma, Daza nayaritensis* or *Collina medea.*

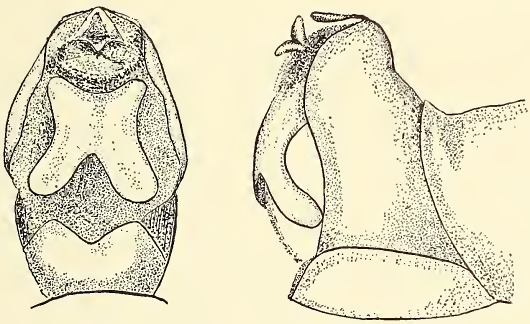
I take pleasure in calling this genus *Chinaria.* Mr. W. E. China has kindly compared numerous specimens sent to him by me with those in the collection of the British Museum.

Chinaria mexicana new species (Plate IV, Fig. 3).

Type male and allotype female from Cuernavaca, Morelos, Mexico, June, 1922 (Mrs. E. P. Hinton). Davis collection.

Head including eyes not quite as broad as the mesonotum, front rounded, lateral margins of the pronotum considerably dilated. Opercula very short and rounded, the inner extremities being far apart. Last ventral segment not quite evenly rounded at the extremity; in the allotype there is a small notch. The abdominal walls are very thin in the males, and from the under side an examination of the interior may be made when the insect is held in a strong light. In *Collina* the walls of the abdomen are also quite thin.

Color greenish, with the tergum of abdomen somewhat yellowish; wings much spotted with brown, and as illustrated. Head yellowish green with a stripe in the groove each side of the ocelli, and four dots near the posterior margin between the eyes, the outer two being the largest. Pronotum green, including the collar, with the grooves darkened. In one of the paratypes the pronotum is almost entirely green. Mesonotum with four obconical spots extending backward from the front margin, the inner pair the shorter. The cruciform elevation is green with a dark spot each side near the anterior limbs. Abdomen nearly uniform yellowish green in the type; in one of the paratypes segment eight is pruinose. In the female allotype the tergum is darker with a row of spots, one on each segment near the lateral margin, and a large one each side on segment nine. Under side uniformly pale with the central segments of the abdomen translucent. In one of the paratypes the under side is pruinose along the sides of the abdomen and especially about the legs and under side of the head.



CHINARIA MEXICANA

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	34	28
Width of head across eyes	9.5	9
Expanse of fore wings	88	83
Greatest width of fore wing	12.5	12
Greatest width of operculum	6	

A second male collected at the same place and time as the type, and a male from Venvidio, Sinaloa, Mexico, July 27, 1918 (J. A.

Kusche, through Mr. Morgan Hebard), have also been examined, as well as two females collected at Compostela in July and August, 1933.

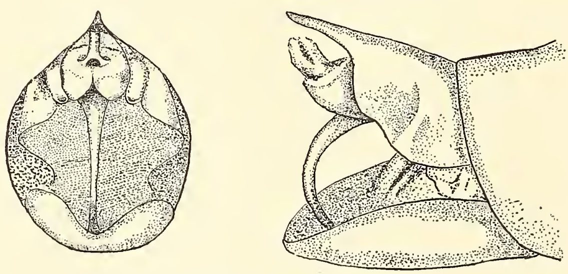
Carineta martiniquensis new species (Plate III, Fig. 4).

Type male from Martinique, French West Indies, March 27, 1930, and allotype female same locality, no date, both collected by Prof. L. M. Stöhr. Davis collection.

This insect has a rather broader head and more prominent eyes than is usual in *Carineta* for which reason it might be considered under *Herrera* if it were not for the narrow wings.

Head including eyes about as wide as the mesonotum, front moderately produced with the median groove narrow but well defined. Opercula with the inner extensions very narrow, as in *Carineta cingenda* figured in *Homoptera Andina, Cicadidæ,* by A. Jacobi. Last ventral segment truncate at extremity; in the allotype the notch is very deep extending almost to the base of the segment.

General color olive green, paler in some of the paratypes. Head greenish, blackened about the ocelli; front green. Pronotum, with a narrow, dark colored stripe extending from behind each eye to the collar; front margin of the collar with a dark stripe. In some of the paratypes the entire dorsal surface is greenish and without dark spots except about the ocelli. Mesonotum greenish with the obconical spots extending backward from the front margin faintly outlined, the central pair most prominent. Cruciform elevation greenish with a dark area in the hollow between the anterior limbs, and also a dark area each side not well defined. Abdomen greenish, the segments edged posteriorly with green; segment eight darker than the others. The entire under surface is greenish with a central, narrow brown line extending from segment three to segment six and broadening to cover segment seven; valve also brown beneath. The allotype is without these dark marks, being almost unicolorous beneath.



CARINETA MARTINIQUENSIS

MEASUREMENTS IN MILLIMETERS

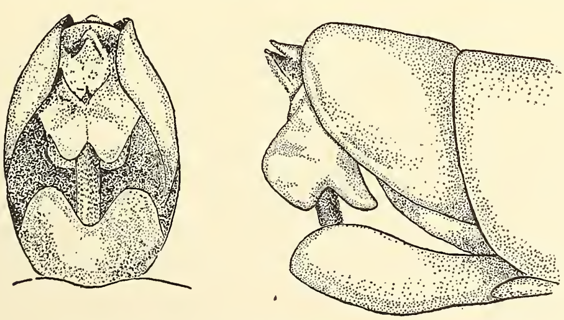
	Male Type	Female Allotype
Length of body	18	20
Width of head across eyes	6.5	7
Expanse of fore wings	47	54
Greatest width of fore wing	8	8.5

In addition to the type and allotype Prof. L. M. Stöhr has kindly sent to me from Martinique five males and one female. This last was collected December 6, 1928; the others from January 18 to June 26, 1930. It evidently has a long season.

Fidicina compostela new species (Plate IV, Fig. 4).

Type male from near Compostela, Nayarit, Mexico, October 8, 1932. Davis collection.

Some species of *Fidicina* have the costal margin of the fore wing nearly straight to a considerable distance beyond the radial area, while others have a noticeable bend in the wing at the end of this area. In *pronœ* and *picea* the wing is evenly curved, while in *viridis, cachla* and numerous others, there is a noticeable bend. The present species belongs to this last group. (See figures in Biol. Centr.-Amer. Rhynch. Hom.) In general appearance it may be compared to *F. fumea* as figured in Biol. Centr.-Amer., but the head is narrower with the front more rounded and less prominent. The eyes are rather prominent, and more so than in *fumea* and *drewseni.* The tymbals are considerably exposed and the forward projection from segment two is narrow and rather sharp pointed. Operculum short and truncate and with the outer extremity forming a right angle bend. Last ventral segment gradually rounded to the extremity which has a shallow notch. Under side of abdomen and valve with numerous hairs. Uncus as figured.



FIDICINA COMPOSTELA

Body of a general brown color. Head orange with a broad, black band connecting the eyes; the band bends backward centrally and includes the ocelli. Pronotum olive or greenish orange, irregularly blackened along the front margin; collar narrowly black along the front margin. Mesonotum olive with four obconical spots extending backward from the front margin; inner pair shortest. Cruciform elevation orange with an irregular dark spot in the hollow between the anterior limbs. Abdomen with the segments broadly black anteriorly edged with orange posteriorly, the second segment conspicuously so. Under side of body greenish orange with the segments blackened at base; opercula black at base. Legs greenish orange; tarsi darker. Both pairs of wings clear except at base, where they are rather broadly and irregularly browned, the color being more chestnut than in *fumea* Distant, in which it is much darker. The basal area in the fore wing is included in the darkened area, as in *fumea*.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	25
Width of head across eyes	10
Expanse of fore wings	78
Greatest width of fore wing	11
Greatest width of operculum	7

In addition to the type there is a second male in the writer's collection that is slightly greener in color than the type. It also came from near Compostela, Nayarit, Mexico, collected October 30, 1932. [Since the above was written, 4 males and 2 females of the species, collected at Compostela between September 26 and November 1, 1933, have been received.]

Okanagodes

Some of the facts about *Okanagodes terlingua, O. gracilis* and variety pallida, were reviewed in this Journal for June, 1932, and attention called to the interesting account of *Okanagodes gracilis,* of its habits and song given by L. D. and R. H. Beamer, in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for September, 1930, page 298. Of the sixty three males and two females taken, all were of the usual *gracilis* form in which "the color varies from almost white to greenish and tan with dark markings." No colony or brood of the brightly green colored specimens was encountered in Arizona by the Beamers in the summer of 1929.

In June, 1931, Mrs. Martha Morfoot sent me two brightly green colored specimens of *gracilis* collected near Oracle, Arizona; in June, 1932, she sent twenty four more collected near Tucson, and in June, 1933, thirty three additional males and four females, all of the same color and from the same locality. In 1932, Mr. F. H. Parker furnished twenty two green males and three females collected in June near Tucson, and one male of the same color collected July 16, 1932, in the Santa Rita Mts., Arizona. In June, 1932, Mr. D. K. Duncan collected a great many typical *gracilis,* and also about twenty of the green form on the Tucson-Florence desert, and on June 30, 1933, he collected twelve males and two females of the green variety about 5 miles south west of Tucson. On July 1, 1933, he took fourteen males of the typical straw-colored form at Florence Junction. Mr. Duncan writes as follows: ''Regarding the *Okanagodes.* The green specimens were taken four or five miles south west of Tucson on the San Xavier Road; they were in the green weeds, probably a species of sage, at least it smells like sage when crushed. One was taken on a green mesquite branch, but this is rare. Surroundings typical desert; flat, hot, dry, sage, cactus, mesquite and Acacias. Last year I took these green forms as far north of Tucson as 20 miles. The pale form [*gracilis*] was taken this year north of Florence and probably 100 miles from the green form. I find that this form [*gracilis*] tends to run to a few pale green examples on through pale straw-color into pale straw-color with dark brown markings, in other words is much more variable than the green form which is almost constant in color.'' He adds: ''I consider them a valid variety all right.''

This green form, which appears in broods by itself, may be designated *Okanagodes gracilis* variety *viridis,* with the following as type and allotype: Type male and allotype female from about five miles south west of Tucson, June 30, 1933 (D. K. Duncan). Davis collection.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	21	20
Width of head across eyes	5	5
Expanse of fore wings	52	55
Greatest width of fore wing	8.5	9

In addition to the type and allotype there are over one hundred specimens of variety *viridis* in the writer's collection, received from Mrs. Morfoot, Mr. F. H. Parker, and D. K. Duncan. It is possible that in the course of years these cabinet specimens may fade somewhat, as green insects sometimes do, but the two collected at Oracle in 1931, are still brightly green.

PLATE II

Figure 1. *Tibicen chisosensis.* Type.
Figure 2. *Tibicen chisosensis.* Allotype.
Figure 3. *Tibicen paralleloides.* Type.
Figure 4. *Tibicen paralleloides* ♀. Mexico near type locality.
Figure 5. *Tibicen minor.* Type.
Figure 6. *Tibicen fusca.* Type.

CICADIDAE

PLATE III

Figure 1. *Diceroprocta lucida.* Type.
Figure 2. *Diceroprocta operculabrunnea.* Type.
Figure 3. *Diceroprocta operculabrunnea.* Type; underside.
Figure 4. *Carineta martiniquensis.* Type.
Figure 5. *Beameria venosa* Uhler.
Figure 6. *Beameria wheeleri.* Type.

CICADIDAE

PLATE IV

Figure 1. *Daza nayaritensis.* Type.
Figure 2. *Daza nayaritensis.* Allotype.
Figure 3. *Chinaria mexicana.* Type.
Figure 4. *Fidicina compostela.* Type.

CICADIDAE

THE ANATOMY OF CHRYSOCHUS AURATUS, FAB., COLEOPTERA: (CHRYSOMELIDAE) WITH AN EXTENDED DISCUSSION OF THE WING VENATION

BY SLOAN JACOB WILSON

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF WICHITA, WICHITA, KANSAS

I

INTRODUCTION

Chrysochus auratus was first described in 1775 by Fabricus. It is described in *Coleoptera of Indiana,* by Blatchley (1), as "oblong and convex. Green, brightly polished; elytra often with a coppery tinge; antennae, legs and under surface bluish black. Head and thorax with coarse, very sparse, deep punctures intermingled with minute ones. Elytra finely and irregularly punctate." Blatchley states further that the species is common throughout the state and is present from June 11 to August 10, and occurs on dogbane or Indian hemp (Apocynum) as well as milkweed (Asclepias).

The species was found in great numbers during July, 1931, in this region, being so plentiful in one spot on the campus that it was possible to gather over two hundred specimens in less than an hour.

The specimens obtained were preserved in a 10 per cent solution of formalin. Due to the deep color of the insect it was necessary to bleach in 10 per cent KOH in order to study the external anatomy. About four weeks, with an occasional changing of the liquid was necessary.

II

EXTERNAL ANATOMY

Similar to all other insects, *Chrysochus auratus* is divided into three large divisions; head, thorax and abdomen. The prothorax is free so that it appears to form all of the second or thoracic region of the body. The location of the hinder two pairs of legs shows which part belongs to the thorax. The body is very strongly chitinized.

Parts of the Head
(Plate VI)

Fixed parts of the head

The fixed parts of the head are fused and form a strong, firm box.

Epicranium.—The epicranium of all beetles is in reality a compound sclerite (4), being composed of the true epicranium and front. An epicranial suture is visible on the cephalic portion of the head. It is not a continuous line but is broken. Two lines run cephalad and meet the clypeal suture. A frontal ridge is evident below which the antenna arises just cephalad to the compound eye. Small pits are scattered over the epicranium.

Clypeus.—The clypeus is apparently fused to the front of the epicranium and is not distinguishable as a separate element.

Genae.—The genae are situated below the eyes and the antennae. The genae, with certain portions of the occiput form the lateral portion of the ventral part of the head.

Occiput.—The occiput is fused to the epicranium. The postgenae and the occipital regions cannot be distinguished as separate elements but are fused to the epicranium.

Gula.—The gula is a broad sclerite on the ventral portion of the head and is bounded by the gular sutures. Among the coleoptera the gula is usually a well developed sclerite and plainly visible, Comstock (4).

Appendages of the head

Antennae.—The antennae are moderately long, filiform and twelve jointed. The second segment is longer than the basal segment. The antennae are inserted between the eyes and the frontal ridge, and are widely separated at the base.

Mouth parts

Labrum.—The labrum covers the mandibles, in part. It is comparatively long and narrows at its distal end.

Mandibles.—The mandibles are of the blunt, herbivorous type.

The left mandible is longer than the right which fits into a groove in the left mandible.

Maxillae.—The cardo is large and broad and is triangular in shape. The median portion of the maxilla is composed of stipes, palpifer and subgalea. The stipes and the galea are fused forming a large sclerite. The lacinia is short and blunt and bears hairs on its tip. The palpifer is a fairly large sclerite from which arises a four jointed palpus. The galea is fairly large and tongue shaped.

Labium.—A straight transverse line divides the labium from the gula. The submentum is very narrow but wide. The submentum and the mentum are separated by a transverse suture. On either side of the mentum lie the palpigers from each of which arises a labial palpus which is three jointed. Projecting forward from the mentum is the ligula, which consists of a pair of movable flaps.

Hypopharynx.—On the inner surface of the labium lies a large hypopharynx which almost covers the labium. The large size is probably due to the adaptation of the insect to the food plant which is very juicy in nature and would have to be lapped to be eaten.

Parts of the Thorax
(Plate V)

Prothorax

Dorsal aspect.—The pronotum is not divided into separate sclerites but is prominent and rounded. A lateral line is apparent and the lateral portion is called the prothoracic epipleuron.

Ventral aspect.—The ventral portion is formed by the sternum and the pleural sclerites. The episternum is a small, almost triangular, sclerite and forms a portion of the body wall between the sternum and the epipleura. The epimeron is a sclerite enclosing the coxal cavity, caudad and laterad.

Mesothorax

The mesothorax is much reduced in size, its chief function being to support the elytra and to keep them together by means of the scutellum.

Dorsal aspect.—When the elytra are in position the only visible part of the mesothorax is the scutellum. After removing the elytra the scutum may be seen. The praescutum is represented by a narrow membranous strip. The postscutellum is a small curved bar which is seen laterad on each side of the caudal apex of the scutellum.

Ventral aspect.—The sternal and the pleural sclerites compose the ventral aspect. The mesosternum completely surrounds the coxal cavity and is plainly marked off by the sutures. The episternum is a small triangular sclerite and does not reach the coxal cavity. The epimeron is a larger sclerite than the episternum and does not reach the coxal cavity.

Metathorax

The metathorax is much larger than the mesothorax due to the attachment of the heavy muscles for flight.

Dorsal aspect.—The median portion has a large groove extending caudo-cephalad along the middle of the back with strongly chitinized margins projecting upward. In these the elytra rest. Due to the fusion it is difficult to discern the sclerites of the metathorax.

Ventral aspect.—The metasternum is the largest sclerite of the ventral aspect of the entire thorax. A round blunt tongue meets the caudal projection of the mesosternum. A distinct suture is present on the median line of the sclerite. A line or suture is apparent near the caudal margin of the metasternum. The portion of the metasternum caudad of the suture is the antecoxal piece. A long narrow sclerite lies laterad to the metasternum which narrows toward its caudal end. This is the episternum. The small sclerite caudad to the episternum is the epimeron.

Appendages of the Thorax

Wings

The mesonotum and metanotum each bear a pair of wings. The elytra are the wings of the mesanotum and are heavily chitinized to form the hard case of the beetle. The wings of the metanotum are membranous and used for flight. These will be discussed later.

Legs

The unusual part of the legs is the tarsi. The tarsi are dilated and pubescent underneath. The third joint is deeply bilobed. The fourth and fifth tarsal joints are joined firmly together, the fourth joint being very small, the tarsi therefore appearing but four jointed. The claws are without serrations.

Abdomen
(Plate V)

The abdomen is composed of flattened segments. The dorsal surface is completely covered by the elytra. Six sterna are seen on the ventral side, the most anterior being the largest. The most posterior sternum is very small and rounded on the caudal margin. The external genitalia are not visible from the ventral aspect.

III
WING-VENATION AND VARIATIONS

The comparative study of the wing veins of the various groups of insects, and that of their larva wing trachea, has shown the wing-venation to be based on a common plan, with modifications in the different orders. Venation of the coleoptera is unique and complicated resulting in many differences of opinion. The venation of *Chrysochus auratus* Fab. in this paper is based, principally, on the study of W. T. M. Forbes (5).

The Main Veins
(Plate VIII)

Costa.—The costal vein lies along the costal border of the wing.

Subcosta.—The second vein is concave and lies at the foot of a trough in the surface of the wing. In the wings examined there is a short fusion of costa and subcosta. This is in the region of the humeral cross-vein.

Radius.—The third vein of the wing is strongly convex and forms the principal articulation with the thorax and arises from the anterior tracheal branch. Costa, subcosta and radius are very close together near the costal margin.

Media.—Media is the most unstable of all the veins in the various orders of insects. The main stem has dropped out leaving a short portion of M_{1+2} and M_{3+4} (or M_1 and M_4), Forbes (5).

Cubitus.—Cubitus is a strong vein, the distal end fusing with M_4 which swings down and fuses with it.

First anal.—The base of 1st anal is lost and gives the vein the appearance of being a fusion of Cu and 1st anal for a portion of its length. This is due to the cu-a cross-vein which remains. 1st anal is branched.

Second, third and fourth anals.—The 2nd and 3rd anals are branched. The 4th anal is not branched.

Permanent cross-veins.—Certain cross-veins are so constant in the higher insects as to be considered a part of the hypothetical plan. The humeral is present as a short fusion of costa and subcosta. An arculus is also present.

Forking of the Veins

(Plate VIII)

The distal portion of R and Sc are fused.

Radius.—According to Forbes (5) there is little reason to doubt that the anterior branch of the radial stem continues in the common cavity as R_1. The base of Rs is atrophied leaving the outer part as an apparent backward projecting spur—the radial recurrent (Rr). A short portion of Rs is present and a radial cross-vein exists between R_1 and Rs. A second radial cross-vein swings into this portion of Rs and is usually regarded as being a portion of radial recurrent.

Media.—The base of media has dropped out leaving in evidence M_{1+2} and M_{3+4} (or M_1 and M_4). M swings down and fuses with Cu toward the margin.

Cubitus.—Cubitus is not branched (if the first anal is not considered a branch as it is by some authorities) but exists as a heavy vein fusing with M_4 near the margin.

First anal.—The base of the 1st anal has dropped out and the cross-vein cu-a remains to connect it with the stem of cubitus. It is entirely possible, however, that the 1st anal is fused with the stem of cubitus but the evidence seems to be to the contrary as will be noted in the discussion of the variations. 1st anal is branched, the first branch extending to the margin and the second branch is fused with the first branch of the 2nd anal.

Second anal.—The 2nd anal is branched. The first branch is fused with the second branch of the 1st anal and extends nearly to the margin. The second branch fuses with the first branch of the 3rd anal. On the basal side of the cell thus formed exists an oblique vein running from the stem of the 2nd anal to the upper branch of the 3rd anal. As stated by Forbes (5) it is not clear whether this is a branch of the 2nd anal which has joined the first branch of the 3rd anal or a cross-vein.

Third anal.—The 3rd anal forks once. The upper branch is connected to the 2nd anal by two transverse veins enclosing a cell between them.

Fourth anal.—The 4th anal is a heavy vein and stiffens the alula. It is not forked. Forbes (5) states that the 4th anal of coleoptera is comparable to the jugal brace of the lepidoptera.

Cross-veins
(Plate VIII)

The order Coleoptera is considered by Forbes (5) to have descended from a form or forms with a considerable number of cross-veins. The humeral has already been discussed as a short fusion of costa and subcosta.

Two radial cross-veins are present.

A cross-vein exists between Rs and M_{1+2} but is very faintly outlined.

A cross-vein exists between M_{1+2} and M_{3+4} but is very faintly outlined.

The cross-veins in the anal region have been discussed.

An arculus is distinctly present.

Variation of Wing-venation
(Plate IX)

The anal region of wing-venation may vary as seen in Plate IX. Two groups are shown, one showing the right wing of various specimens and the other showing the variations in the right and left wings of the same specimen.

The wing-venation, especially in the anal region, is difficult to determine unless more than one specimen is examined. It was found that if a number of wings were examined, the variations in forking and the fusion of the anal branches were a great aid in determining the venation as a whole in the anal region.

Variations in Different Specimens

Fig. 1.—1st A and 2nd A_1 seem to be fused for a short distance. They then fork into 1st A_1 and 1st A_2 + 2nd A_1. 1st A_2 + 2nd A_1 fork at the distal end and exist as separate veins. 2nd A_2 and 3rd A_1 fuse and fork as separate veins at the distal end.

Fig. 2.—1st A_2 exists as a cross-vein meeting and fusing with 2nd A_1 where they again branch as separate veins at the distal end. 2nd A_2 and 3rd A_1 fuse and do not fork.

Fig. 3.—2nd A_1 fuses for a short distance with 1st A_2. It then forks into 1st A_1 and 1st A_2 + 2nd A_1. 1st A_2 + 2nd A_1 does not fork at the distal end.

Fig. 4.—1st A_2 exists and crosses over to fuse with 2nd A_1. These fork as separate veins near the distal end. 2nd A_2 and 3rd A_1 fuse and do not fork.

Fig. 5.—A cross-vein exists between 1st A and 2nd A_1 which seems to be comparable to the cross-vein between the base of 2nd A and 3rd A_1. 1st A and 2nd A_1 fuse for a short distance and branch into 1st A_1 and 1st A_2 + 2nd A_1. An entirely new cell is formed due to the presence of this cross-vein.

Fig. 6.—The cross-vein exists between 1st A and 2nd A_1 as before. 1st A and 2nd A_1 do not fuse however. 1st A_2 crosses over and fuses with 2nd A.

Variations of Right and Left Wings of the Same Specimen

Fig. 7.—In the left wing 1st A_2 and 2nd A_1 fuse and do not fork at the distal end. In the right wing 1st A_2 and 2nd A_1 fuse and fork at the distal end.

Fig. 8.—In the left wing 1st A_2 crosses over and fuses with 2nd A_1. In the right wing the same occurs and a cross-vein also exists between 1st A and 2nd A_1 forming another cell.

Fig. 9.—In the left wing 1st A and 2nd A_1 fuse for a short distance and forks into 1st A_1 and 1st A_2 + 2nd A_1. A cross-

vein also exists between 1st A and 2nd A_1. In the right wing 1st A and 2nd A_1 fuse and then fork into 1st A_1 and 1st A_2 + 2nd A_1. The cross-vein is not present.

Forbes (5) states that in species where the base of 1st A has dropped out and the cu-1st a cross-vein exists it is difficult to tell whether 1st A has fused with Cu or whether a cross-vein exists. However, if the specimen is examined under a microscope a bump exists where the base of 1st A would exist. It would seem that the base of 1st A has dropped out leaving the cu-1st a cross-vein.

After examining many specimens, the conclusion was reached that there are many variations in the anal region and no one specimen may be taken as a constant, even though there is a similarity in them. There were no variations noticed in the other regions of the wings.

Wing Folding Pattern

In Plate VIII the dark portions are the areas of the wing which are reversed in folding. The Axillary, Antemedian, Pivot, Principal and two areas in the apical portion of the wing are reversed in folding.

IV

Gross Internal Anatomy

Only the digestive tract and the reproductive systems of the male and female will be discussed.

Alimentary Tract
(Plate VII)

From the dorsal aspect the pharynx is not visible as the head is telescoped into the prothorax as far as the eyes.

Œsophagus.—From the dorsal aspect the œsophagus appears to come from the floor of the prothorax due to the position of the head. The œsophagus is short.

Proventriculus.—The beginning of the proventriculus is marked by a constriction. The posterior end is marked by the position of the gastric cæca and the œsophageal valve. The proventriculus is short and lies in the prothorax and the metathorax.

Ventriculus.—The ventriculus is enlarged and from the cephalic end project the gastric cæca, sixteen in number. The ventriculus narrows toward the posterior end of the body on the left side and coils twice before the attachment of the malpighian vessels, which marks the posterior end of the ventriculus. The malpighian vessels, over fifty in number, nearly fill the body cavity.

Intestine.—The small intestine is very short turning left and cephalad to meet the large intestine. The rectum is clearly defined in this species.

Reproductive System

The reproductive systems of this species are unusual in many respects. The reproductive systems of both male and female are comparatively large in relation to the body cavity. (This is probably due to the fact that the specimens examined were taken during the mating season).

Male

The testes are bifurcated, giving the appearance of four testes, two on each side of the body and located on the ventral portion of the abdominal cavity. A small duct leads from each lobe of the testes meeting the vasa efferentia. The vasa efferentia fuse into a common tubule and enter the caudal end of the seminal vesicle which lies dorsad to the ventriculus. From the cephalic end of the seminal vesicle extends the vas deferens. There is a single vas deferens present in this species and in the specimens examined was always on the left side of the body lying dorsad to the alimentary tract. After much coiling the vas deferens joins the ejaculatory duct. The penis is very heavily chitinized, surrounded by heavy muscles and lies ventrad to the rectum. In the specimens examined, the penis was always in a position having the hooked end toward the right.

Female

The ovaries lie laterad on each side of the ventriculus. They are supported by the ligaments of the viscera which are plainly visible. The egg-tubes which make up the ovaries fill a large part of the body cavity. The egg tubes open posteriorly into the oviduct. The two oviducts unite near the caudal end of the body, ventrad to the rectum, and form the vagina. Emptying into the vagina on the dorsal side is a coiled tubule leading to the spermatheca, which is on the right side of the body. The spermatheca is very strongly chitinized and, more or less, pear shaped. A small white spermathecal gland is present and is attached to the large chitinized end of the spermatheca. Near the caudal end of the body are two colleterial glands which are rounded and flat and lie over a part of the ventriculus. A coiled tubule leads from each of the glands and joins the vagina near the body exit.

Although not a part of the internal anatomy the following observations may be given here. The females lay their eggs in what appear to be droppings and were thought to be such until no eggs appeared from about twenty-five mating pairs of beetles placed under a bell jar with their native food plant. The eggs are covered with a black dirt-like substance. After hatching, the small larvae stay beneath the covering for a period of time.

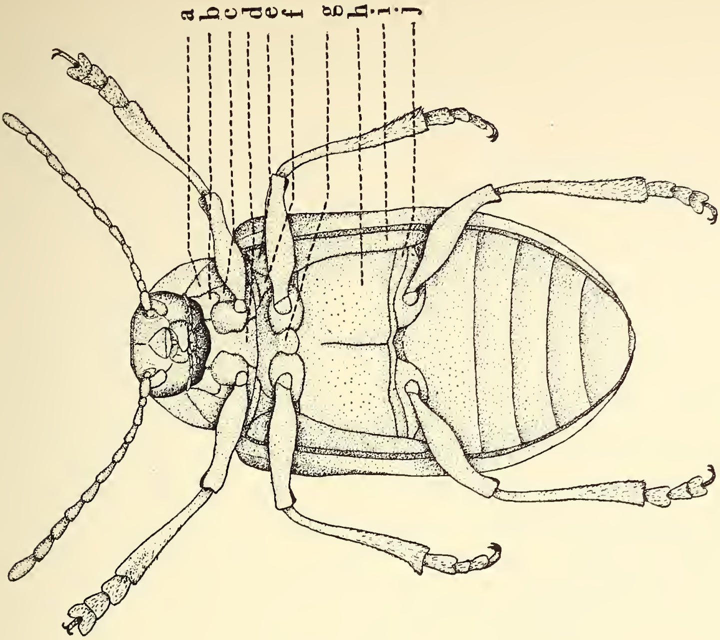
LITERATURE CITED

1. BLATCHLEY, W. S. *The Coleoptera or Beetles Known to Occur in Indiana.* Nature Publishing Co.
2. COMSTOCK, JOHN HENRY. *The Wings of Insects.* Ithaca, New York; The Comstock Publishing Co., 1918.
3. COMSTOCK, JOHN HENRY. *An Introduction to Entomology.* Ithaca, New York; The Comstock Publishing Co., 1925.
4. COMSTOCK AND KELLOGG. *Elements of Insect Anatomy.* Ithaca, New York; The Comstock Publishing Co., 1929.
5. FORBES, W. T. M. *The Wing-venation of the Coleoptera.* Annals of the Entomological Society of America, Vol. XV, No. 4, December, 1922.
6. FORBES, W. T. M. *How a Beetle folds its Wings.* Psyche, Vol. XXXI, No. 6, 1924.
7. FORBES, W. T. M. *The Wing Folding Patterns of Coleoptera.* JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, Vol. XXXIV, June, 1926.
8. HENNEGUY, L. FELIX. *Les Insectes.* Paris, 1904. Mason et Cie, Editeurs.

PLATE V

Figure 1.—Dorsal aspect of Chrysochus auratus.
a.—antenna.
b.—pronotum.
c.—scutellum.
d.—elytra.

Figure 2.—Ventral aspect of Chrysochus auratus.
a.—epipleura.
b.—episternum.
c.—epimeron.
d.—sternum.
e.—epimeron.
f.—episternum.
g.—sternum.
h.—sternum.
i.—episternum.
j.—antecoxal piece.



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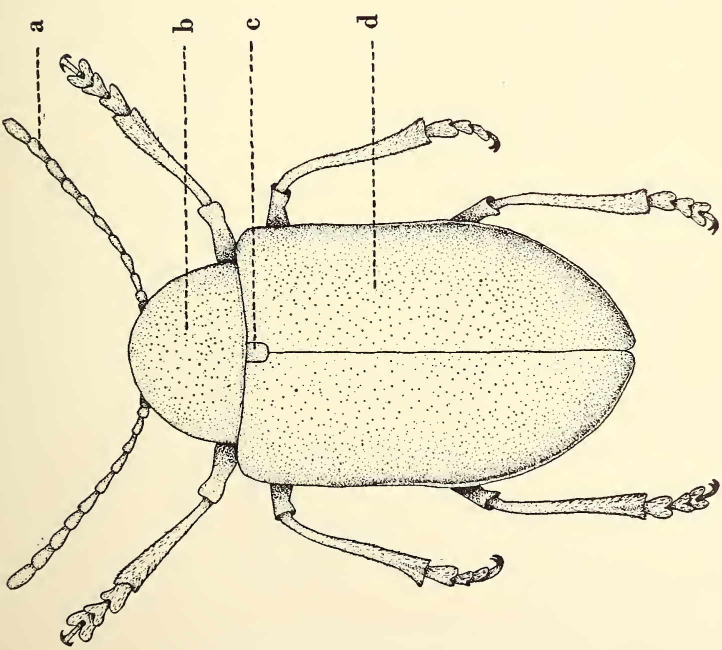

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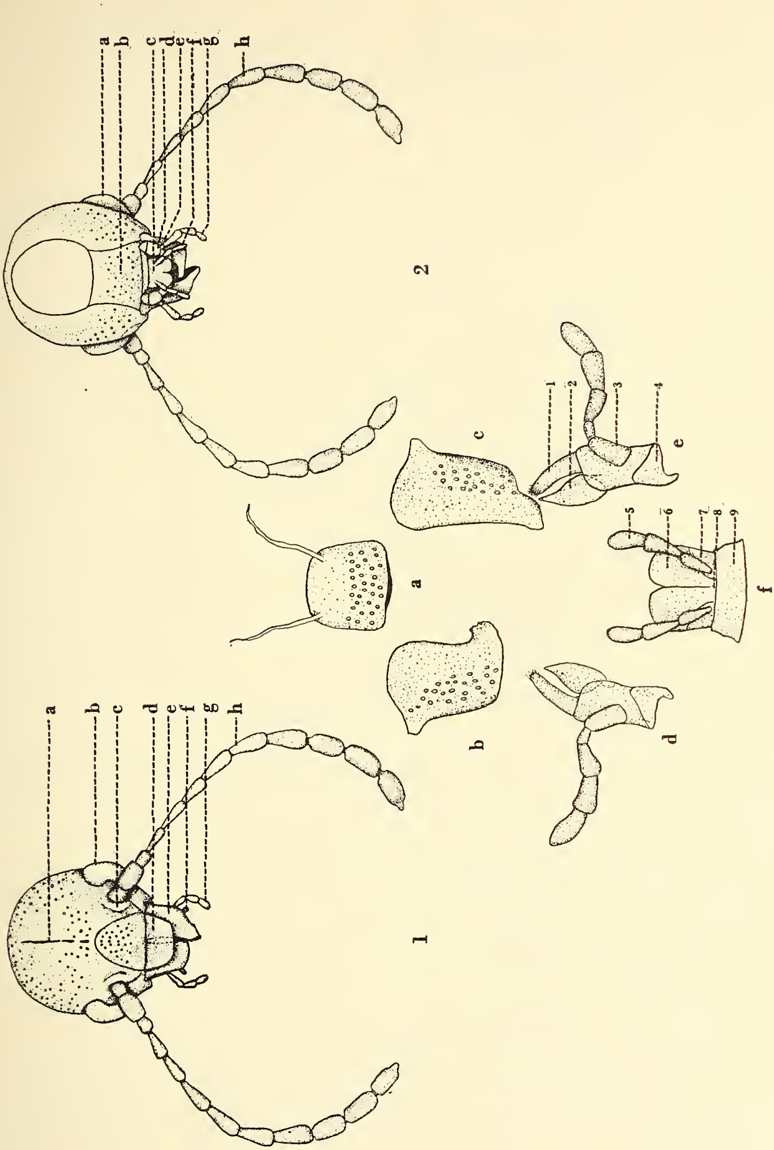
CHRYSOCHUS AURATUS

PLATE VI

Figure 1.—Dorsal aspect of the head.
- a.—epicranial suture.
- b.—compound eye.
- c.—frontal ridge.
- d.—labrum.
- e.—mandible.
- f.—labial palpus.
- g.—maxillary palpus.
- h.—antenna.

Figure 2.—Ventral aspect of the head.
- a.—compound eye.
- b.—gula.
- c.—labium.
- d.—maxilla.
- e.—mandible.
- f.—labial palpus.
- g.—maxillary palpus.
- h.—antenna.

Figure 3.—Mouth parts.
- a.—labrum.
- b.—right mandible.
- c.—left mandible.
- d.—right maxilla.
- e.—left maxilla.
    - 1.—lacinia.
    - 2.—galea.
    - 3.—palpifer.
    - 4.—cardo.
- f.—labium.
    - 5.—labial palpus.
    - 6.—ligula.
    - 7.—palpiger.
    - 8.—submentum.
    - 9.—mentum.



CHRYSOCHUS AURATUS

PLATE VII

INTERNAL ANATOMY

Figure 1.—Alimentary canal.

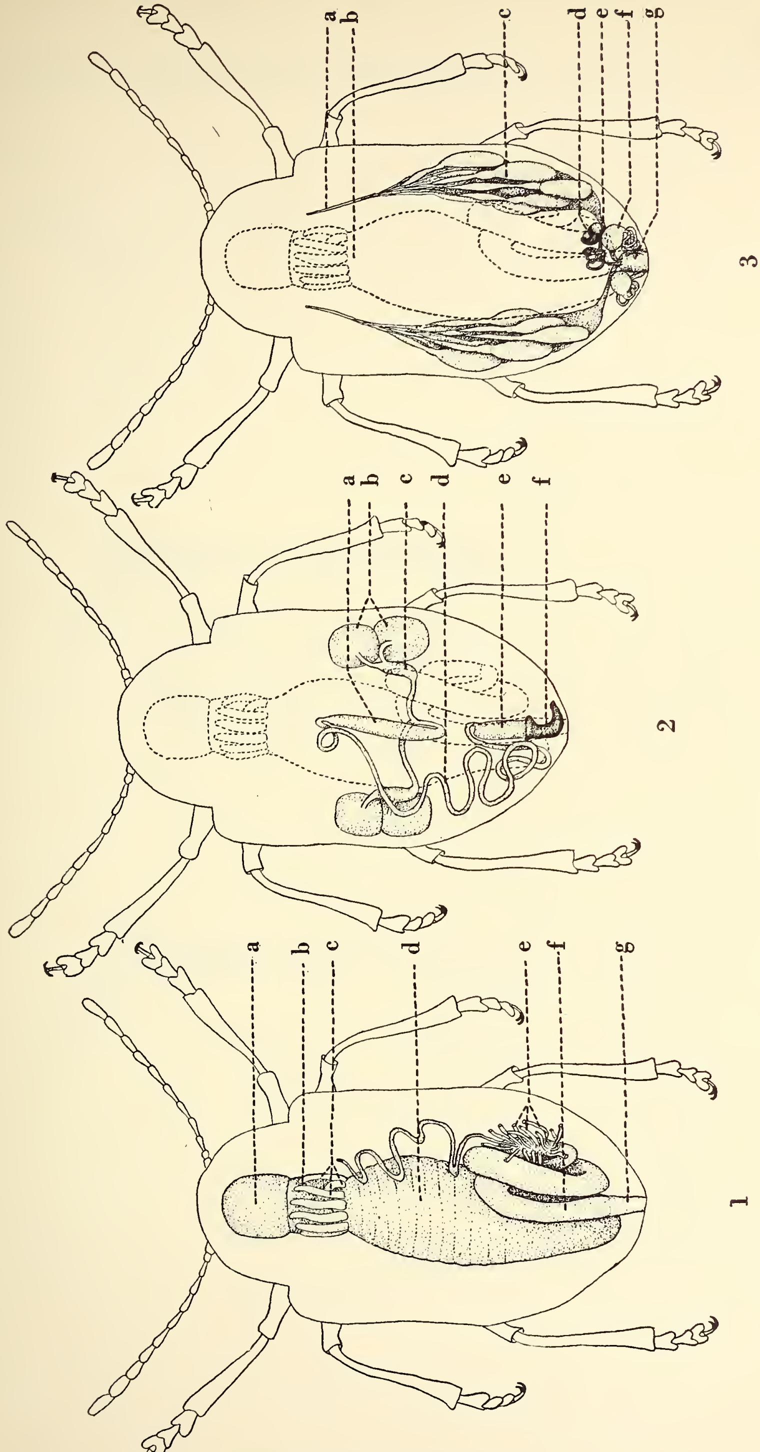
a.—oesophagus.
b.—proventriculus.
c.—gastric caeca.
d.—ventriculus.
e.—malpighian vessels.
f.—intestine.
g.—rectum.

Figure 2.—Male reproductive system in relation to alimentary tract.

a.—seminal vesicle.
b.—testis.
c.—vas efferens.
d.—vas deferens.
e.—ejaculatory duct.
f.—penis.

Figure 3.—Female reproductive system in relation to the alimentary canal.

a.—ligament of the viscera.
b.—alimentary tract.
c.—ovary (made up of egg-tubes).
d.—spermatheca.
e.—oviduct.
f.—colleterial gland.
g.—vagina.



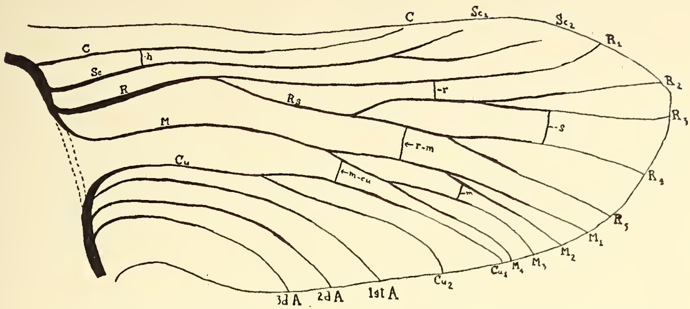
CHRYSOCHUS AURATUS

PLATE VIII

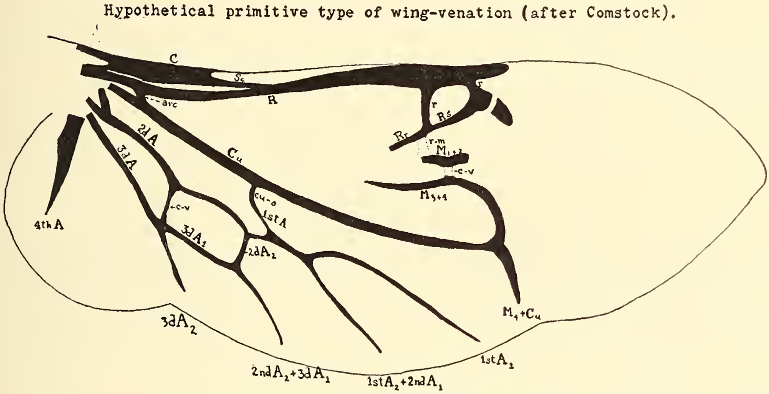
Wing-venation and Folding Pattern

Hypothetical primitive type of wing-venation (after Comstock).
Wing-venation of Chrysochus auratus.
Folding pattern of Chrysochus auratus. Dark areas reversed in folding.
Key letters accidentally omitted from illustration.

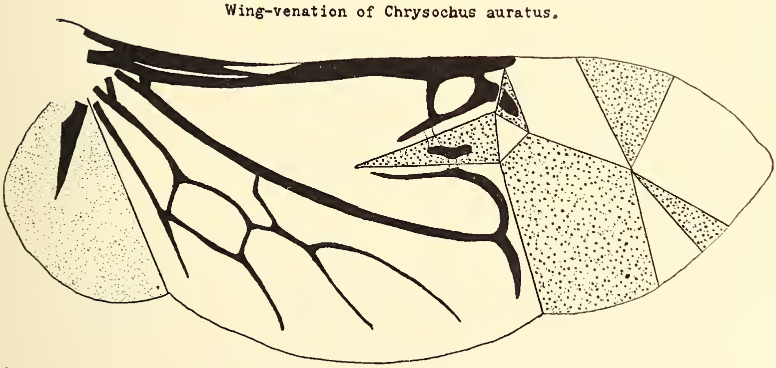
A.—antemedian.
C.—central.
D.—pivot (distal pivot).
P.—principal.
J.—jugal or axillary.



Hypothetical primitive type of wing-venation (after Comstock).



Wing-venation of Chrysochus auratus.



Folding pattern of Chrysochus auratus.

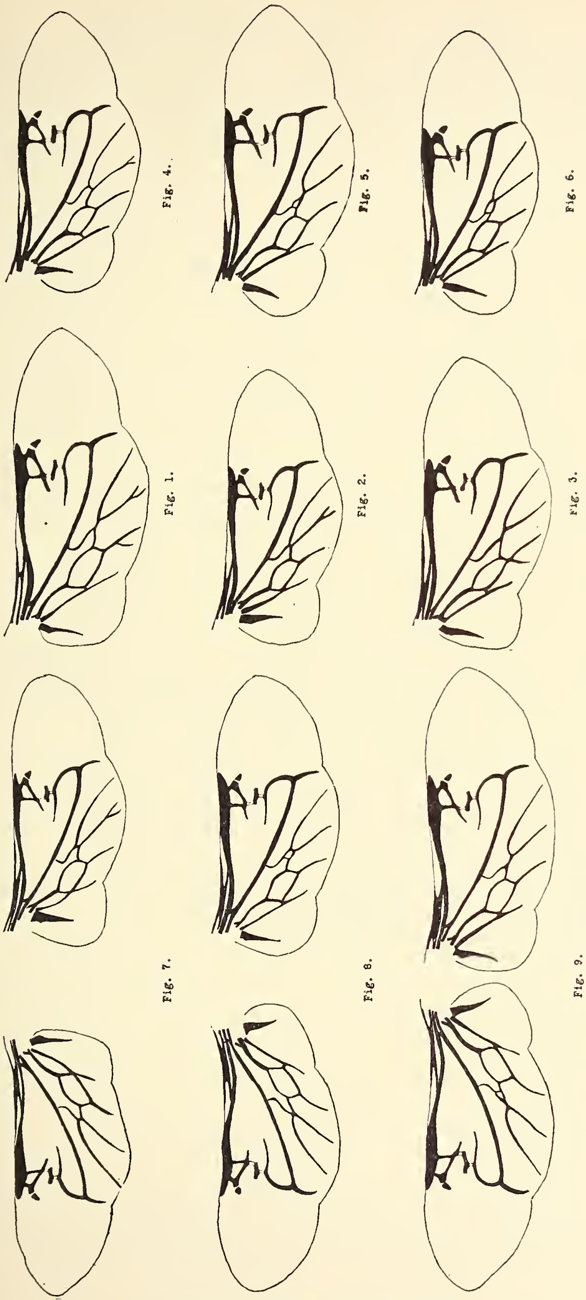
CHRYSOCHUS AURATUS

PLATE IX

VARIATION OF WING-VENATION

Variations of wing-venation of Chrysochus auratus (different specimens). Figure 1–6.

Variations in right and left wings of same specimen (Chrysochus auratus). Figure 7–9.



Variations of wing-venation of Chrysochus auratus.

Variations in right and left wings of same specimen (Chrysochus auratus).

CHRYSOCHUS AURATUS

SAPRINUS DIMIDIATIPENNIS

Saprinus dimidiatipennis. In the "Canadian Entomologist," LXI, 1929, p. 94, Dr. Hatch places this species as an aberration of *S. palmatus* Say. This is an error which we followed in our second supplement of the "Catalogue of the Coleoptera of America, North of Mexico" and which we now desire to correct.

S. dimidiatipennis was described by the elder LeConte in "Annals of the Lyceum of Natural History of New York," I, 1824, p. 170, Pl. XI, fig. 5. According to a memorandum entitled "Information concerning Annals . . . . Vol. I–IV, 1823–1848 compiled by Dr. J. H. Barnhardt and a copy given to the American Museum of Natural History in September 1933," pages 161–192 were published between September and December, 1824.

The description of *S. palmatus* was not published until July, 1825 (Jour. Acad. Nat. Sci. Philadelphia, Vol. V, pt. 1, p. 42), and therefore priority cannot be claimed for this name.

LeConte Jour. Boston Soc. Nat. History, 1845, Marsuel Ann. Soc. Ent. France, 1855 and Horn Proc. Amer. Philos. Soc., 1873, have correctly treated *dimidiatipennis.* The error, as far as we can find, had its origin in Col. Casey's Memoir, VII, 1916, pp. 260 and 269. The reference by Bickhardt in Coleop. Cat. Pt. 24, p. 107, is also in error. The error is possibly due to confusion with the younger LeConte's paper in Ann. Lyceum Nat. History, Vol. V, 1851, wherein the pages on the genus *Saprinus* conflict with those of the elder LeConte's paper but no mention is made of *dimidiatipennis* on page 170 although a reference is made to the species in a foot-note on page 165.

C. W. LENG
A. J. MUTCHLER.

THE GALUMNAS (ORIBATOIDEA–ACARINA) OF THE NORTHEASTERN UNITED STATES

BY ARTHUR PAUL JACOT

The species of this genus represent the highest development of the Galumninae occurring in the north temperate zone. This is indicated by the loss of the last vestige of segmentation (the midthoracic suture or anterior end of notogaster), and by the more highly specialized pseudostigmatic organs, which, in the immature stages, are slenderly clavate with ciliate head (figure 24). The abdomino-cephaloprothoracic suture or anterior edge of notogaster, which I now call the midthoracic suture, is distinct in the genus Zetes and broken or hazy or entirely lacking in Galumna. Careful focusing with the high power (4 mm.) objective will show this haziness to be due to an internal tissue and not to be a faint suture. In lateral aspect there is no interruption in the outline at this point. In two species the lamellae are entirely lost.

The European material was secured through a grant of the Elizabeth Thompson Science Fund.

Genus GALUMNA (1, p. 612)

Characters: Galumninae having lamellae reduced to closely appressed bands or straps curving down to anterior end of ventral plate, or lacking; tectopedia I ental; pteromorphae with transverse groove, ventral edge with distinct, angular notch; midthoracic suture externally lacking, sometimes indicated by an indistinct line which is found to be internal when focused on with high power; bristles of parasterna I gular in position; genital covers each with at least two marginal bristles; preanal bristles paranal in position; color dark.

Type: *Notaspis alatus* (8, p. 92, pl. 4, fig. 6).

Galumna virginiensis (10, p. 33)
Figures 1–4

Diagnostic characters: Pteromorphae unsculptured; median pseudoforamen of notogaster present, adalar porose areas bluntly triangular; anterior porose areas semioval; cephaloprothoracic bristles well developed; lamellae with mesal edge passing obliquely across frons halfway to median plane; lamellar bristles inserted at juncture of mesal and lateral edges of lamellae; lateral edge of lamellae raised as a slight ridge running to pseudostigmata; pseudostigmatic organs long, bent, with slenderly lanceolate head (figures 2), appearing relatively stouter when foreshortened; genital cover bristles 1 on anterior edge of covers; paranal bristles near posterior corner of anal aperture.

Description: Size medium (0.51 × 0.37 mm.); color reddish amber to tan; form somewhat elongate ovate; cephaloprothorax broad, yet elongate (figure 1), sides barely interrupted by slightly protruding lamellae; rostrum inconspicuous, not clearly demarked from above, slightly so in side view (figure 3); rostral bristles rather long and conspicuous, barbed, inserted near edge of camerostome; lamellar bristles similar, surpassing the rostral; interlamellar bristles about as long, bilaterally barbed, inserted close to shadow of the broad tectopedia I (figures 1 and 3); lamellae with lateral edge raised as a slight rim!, the mesal edge quite low down on frons (figure 4), the bristle is inserted dorsad of the juncture. Anterior porose areas fairly large; pseudostigmatic organs as above described, with very fine barbs about their surface. The organ sometimes looks shorter when foreshortened by being held more erect.

Notogaster with anterior edge quite fused to cephaloprothorax. Occasionally one sees a continuous line or shadow where the edge would normally be, but by careful focusing with a high power objective, one finds this line to appear fuzzy and not clean cut and sharp, as if out of focus, being evidently caused by an internal membrane. Mesonotal porose areas somewhat circular, the lateral one oval; insertions as in figure 1; pteromorphae with indefinite veining, pseudofissura indistinct, groove well formed, slender, long, the sides defined by well formed ribs, insertion distinct.

Ventral plate wings quite broad, with posterior bulge, but short enough to broadly expose tectopedia II behind it. This tectopedium seems to be formed of two plates on two levels; tectopedia III quite slender; tectopedia IV well developed with posterior end turned dorsad and anteriad (broken line, figure 1); apodemata I curved, with knobbed distal end which swings internally; apodemata II–III nearly straight with well-developed ceriphs, the posterior one quite long; apodemata IV fairly long, not sharply curved; leg cupboards broadly joined to lateral edge of plate; bristles much as usual, that of parasterna III very near lateral edge, rather long; genital aperture with anterior edge gently curved, posterior edge undulate; cover bristles 4 on posterior edge much nearer median than lateral edge, bristles 2 and 3 far apart, slightly nearer median than lateral edge; paramesal bristles more remote than diameter of genital aperture, midway between the two apertures; anal aperture with anterior corner fairly broadly rounded; subanal muscle plate roundish; anterior cover bristles midway between median and lateral edges and slightly nearer anterior edge; posterior cover bristles more remote than anterior; pseudofissurae very slender, curved, close to edge, at center of sides of aperture; mesal pair of postanal bristles more approximate than posterior cover bristles, lateral pair not close to corners, the four subequally spaced.

Related to *G. lanceatum* (12, p. 160), from which it differs in having very different lamellae; shorter, more blunt, really triangular adalar porose areas; a median pseudoforamen; broad ventral plate wings; lateral genital cover bristles and posterior paranal bristles.

Dimensions of the smallest male, the average of eight males, average of seven females and largest female of the cotypes are presented.

Total length of body	472	491	508	525
Breadth of same	341	352	367	369
Length of pteromorphae	267	276	278	283
Interlamellar bristle span	94	98	102	107
Median length of ventral plate	341	364	372	381
Camerostome to genit. apert.	87	90	88	94
Length of genital aperture	57	61	63	65
Breadth of same	61	65	70	74
Genit. apert. to anal apert.	82	85	90	98
Length of anal aperture	86	92	95	98
Breadth of same	94	97	98	102

Material examined: Falls Church, Va.: 23 specimens from under board; taken August 11th by Nathan Banks, slide 26B76 (*cotypes*). Eight specimens from under chips in woods; taken August 11th by Banks, slide 26B89. Also 25 specimens, slide 26B77, Banks. *Somerset, D. C.:* five specimens from under bark, rotten log; April, Banks, slide 26B65. *Pemberton, N. J.:* 34 specimens from under loose bark; taken February 21st by H. B. Scammell, slide 26B90. *Chillicothe, Ohio:* One, twenty, eight, and eight specimens from bluegrass sod, Mt. Logan; taken March 23rd, April 20th, May 25th, August 3rd 1925 by A. E. Miller, slides 32M138o, 32M9o1 (and –2), 32M69o1, 32M18o1 respectively. Nine specimens from rotting log; taken May 7th 1923 by Miller, slide 140.1 (Miller coll.). Eleven specimens from under dead corn stalk in sheath; taken September 24th 1923 by Miller, slide 407 (Miller coll.). *Lyndon, Ohio:* One specimen from under a board; taken April 12th 1924 by Miller, slide 19 (Miller coll.). Two specimens from under fence rail in bluegrass meadow; taken April 12th 1924 by Miller, slide 20 (Miller coll.). *Urbana, Ill.:* Five specimens from bark chips, at Dodson's (State Rd. No. 10); taken August 21st 1926 by Miller, slide 32M10. Five specimens from under side of moist board lying in orchard, Dodson Farm; taken August 24th 1927 by Miller, slide 0–5–27 (Miller coll.).

The stomach of this species is often full of fungal spores and hyphae, while one may occasionally find some growing on the outside of the body.

Geographical Distribution: Eastern States, upper austral zone.

Habitat: Decayed wood, meadow sod. Probably seeking minute fungi.

In oblique dorsal aspect this species may easily be mistaken for *G. lanceatum octopunctatum* as the lamellae of that species stand out more than usual in the genus, though not nearly as much is in *G. virginiensis.* In this aspect, this species may easily be differentiated by the almost total absence of mandible retractor scars (behind the anterior porose areas), the large mesonotal porose areas, and slender pseudostigmatic organ head. The adalar porose areas are often difficult to discern.

Galumna lanceatum octopunctatum (6, p. 356, pl. 34, fig. 7)
Figures 5–10

Diagnostic characters: Adalar porose areas anterior to pteromorphal groove; cephaloprothoracic bristles well developed; notogaster with some kind of median clear spots; pseudostigmatic organs with long pedicel and fairly broad head; ventral plate wings narrower than tectopedia II; genital cover bristles 1 and 4 on or close to anterior and posterior edge of covers respectively; paranal bristles posterior in position.

Description: Size medium (0.63 × 0.46 mm.); form somewhat elongate ovate, high; cephaloprothorax broad (figure 5), high, with steep front; rostrum projecting prominently beyond it; rostral bristles long, distal ends meeting some distance anterior to rostrum; lamellae rather prominently projecting, their outline dorsally evaginated to include the lamellar bristles which are thus inserted rather high up on the cephaloprothorax, lamellae thus appearing undulate in side view, bristles extending anteriad, as seen in dorso/ventral aspect, as far as rostrum; interlamellar bristles rather long, strongly curved mesad (figure 5), inserted unusually far anteriad, some distance from shadow of tectopedia I, onto the emarginate end of a raised triangular tooth (figure 10); tectopedia I broad and short; anterior porose areas small, slender, reaching to tectopedial shadow; scars of mandible retractors in a graduated series, extending from side of anterior porose areas diagonally posteromesad; pseudostigmatic organs rather long, pedicel quite slender, curved backward, head lanceolate to semiovate (figures 6) depending on angle of vision, somewhat compressed, furnished with relatively few, well-developed, slender barbs. In lateral view the head appears semioval and long apiculate as in the lower left sketch of figure 6; the length of the apicule varies.

Notogaster with anterior end completely fused to cephaloprothorax; adalar porose areas oval, sometimes accompanied by a supernumerary insertion or pseudoforamen. This is the only species known to me in which this porose area is anterior to the pteromorphal groove. Mesonotal porose areas small, the lateral one the smaller, far posterolaterad of the mesal one; insertions as in figure 5; postadalar insertion usually accompanied by a second which is always faint and slender; anterolateral mesonotal insertion varies in position as indicated by dotted line in figure 5; a cluster of pseudoforamenlike clear spots on each side of median plane between adalar porose areas (more common in the American individuals); a small median porose area is usually present, varying in position from considerably anterior to mesonotal porose areas to posterior to them (European specimens usually have a cluster of irregular porose arealike structures rather far back on the median line and no anterior cluster of small pseudoforamina). Pteromorphae smooth, veining sparse, groove long, slender, curved, flanked by broad ribs, insertion rather distant from groove, large, with a long channel, pivot close to angle.

Ventral plate wings slender, anterior end rounded; tectopedia II visible laterad and posteriad of wings (figure 5); tectopedia III slender, fairly long, curved, posterior angle obliquely cut off; tectopedia IV with lateral edge convex, apex somewhat drawn out; apodemata I bent at an obtuse angle, the mesal half slightly undulate; apodemata II–III rather short, with long ceriphs; apodemata IV curved, with short ceriph; lacunae well developed; bristles as in figure 5; genital aperture with anterior edge rather flattened, posterior edge undulate, sides strongly converging; cover bristles 1 may be near the edge or on the edge, bristles 4 represented by channel, bristles 2 and 3 much nearer median than lateral edge, distant from each other; paramesal bristles midway between apertures, more approximate than diameter of genital aperture; anal aperture with sides slightly undulate; pseudofissurae very faint, to prominent but short, at center of sides; cover bristles subequally approximate, the anterior not near anterior edge of covers; postanal bristles not subequally spaced, the mesal pair nearer the lateral than to each other, lateral pair not near corner of aperture, the mesal pair more remote than cover bristles.

Legs I (figures 7–9) with all bristles well developed. Tarsi with dorsoproximal quartette close to proximal end of segment, closely approximated (figure 9), the proximal bristle laterad of center, fine, quite erect (figure 7), fourth bristle mesad of center, very long, bent parallel to segment, reaching well over hooks of unguis, bristles 2 and 3 crowded about the fourth, lacking or not discernible; other bristles not specially displaced (figure 7); ventral face bristles with seven to nine cilia. Tibiae short but high, major bristle very long, other bristles fairly long, the ventrodistal multiciliate; dorsodistal bristle curved (figure 9). Genuals nearly as long as their tibiae, well formed; dorsal bristle quite long, extending to tarsi (foreshortened in figure 7); other bristles as usual. The femoro-genual joint is shown in figure 8, to illustrate the connecting membrane and the anchoring of the genual chitin by means of projecting points. Such a membrane is to be found under each joint. In the case of the tibio-tarsal it is shown folded back (figure 7).

Major bristle of tarsi III and IV well developed, inserted more proximad in tarsi IV than in Zetes, yet reaching hooks of unguis.

The subspecies differs from the species in its strikingly situated adalar porose areas (evident even in the original figure); much broader pseudostigmatic organ head, and much smaller mesonotal porose areas.

A cotype kindly sent me by Dr. H. E. Ewing shows the specific characters distinctly. In the original figure the adalar porose areas are correctly situated near anterior corner of pteromorphae. The two pairs of posterior circles are insertions and not porose areas. The pair of insertions posterior to the lateral mesonotal porose areas are usually not discernible.

G. coleoptratum occidentale (10, p. 32) is a synonym. The name coleoptratum was used under the impression that *G. coleoptratum* was an earlier term for *G. lanceatum* (12, p. 160) when, as a matter of fact, it was merely referred to that species during an earlier concept of the group.

From fourteen lots of moss secured in and about Strasbourg, 170 specimens of Galumninae were found representing four species. One hundred and sixty of these, or ninety-four percent, were *G. lanceatum octopunctatum.* I therefore regard this form as the *Notaspis alatus* of Hermann (8, p. 92) and therefore *type of the genus Galumna.* As *Galumna alatum* is preoccupied (14, p. 214, no. 2688) by an amphibious species (as already pointed out, 15, p. 175, footnote under *G. alatum*) common in Bavaria (see below under *G. alatum*), Hermann's species will have to be known as *G. lanceatum octopunctatum,* for the Europeans have never discovered this species, so common in moss about Strasbourg.

Oribates emarginatus (3, p. 125, pl. 1, fig. 14) is this form, as a glance at the adalar porose areas of the figure, if at nothing else, will show. Ewing, who had described this species five years before, sent Berlese the wrong specimens!

Dimensions: of smallest male, average of six males, average of eight females, largest female, from Strasbourg on the Rhine are presented:

Total length of body	493	527	576	629
Breadth of same	336	363	408	431
Length of pteromorphae	316	300	312	328
Interlamellar bristle span	91	97	104	119
Median length of ventral plate	328	368	408	443
Camerostome to genit. apert.	82	87	88	90
Length of genital aperture	66	67	79	82
Breadth of same	70	76	90	99
Genital aperture to anal apert.	85	90	97	107
Length of anal aperture	86	91	101	111
Breadth of same	98	101	109	116

A smallest male had a pteromorphal length of 277 which is an abnormality as the other body measurements were standard for the species. The total length of Connecticut specimens were: total length of an average male 558, breadth 390; of an average female 616, breadth 431, height 370.

Material examined: Strasbourg on the Rhine: Fourteen specimens from moss from base of large trees in English section of Orangerie Park (north edge of city); taken September 5th, slide 3155o2. Sixty-eight specimens from epigeous moss, central cemetery (west of city); taken September 14th, slide 3171o6. One specimen from moss on sandstone blocks forming low wall along road bordering the Rhine, northeast of city; taken September 2nd, slide 3154o. Twenty-six specimens from epigeous moss and moss on roots of spruce trees (a small patch) beside dike near the Strom Wärter; taken September 8th, slide 3157o4. Five specimens from epigeous moss, pine woods, southwest of Stephansfeld (nine kilometers northwest of the city); taken September 12th, slide 3162o1. Forty-six specimens from epigeous moss and moss on foot of trees, spruce and deciduous woods of Neuhof (south of Strasbourg); taken September 14th, slide 3170ao1.

America, Connecticut: One specimen from epigeous moss and old stump moss under Rhododendron, roadside below falls of Wachocastinook Creek (below burn), Riga Mt. in Salisbury; taken August 6th, slide 3237o1. East Village, Monroe: nineteen specimens from cushion moss, upland swamp; taken March 23rd 1919, slides 1913o1, and o2 (*cotypes of G. l. occidentale*). Sixty-six specimens from cushion moss (grey-green and hair cap) growing on earth clumps, stones, etc. (no wood), woods of upland swamp; taken July 9th 1932, slides 3227o1 and o2. Two specimens from old fence rails, branches and chips, old apple orchard; taken August 4th 1932, slide 3229o4. Thirty-eight specimens from moss clump, thicket, edge of swampy woods; taken January 18th 1932, slides 322o2 and 323o. Thirty specimens from *Selaginella apus* and epigeous moss on earth clumps, upland swamp; taken July 17th 1932, slide 3226o2. One specimen from prostrate-mat moss; taken March 23rd 1919, slide 1914o2. One specimen, same; taken May 3rd 1919, slide 1932o1. One specimen from lower side of stone of wet meadow; taken April 23rd 1920, slide 204o3. Coscob headland: four specimens from fallen hickory shag, foot of hickory, dump lot; taken April 12th 1932, slide 3210o1.

New York state: Five specimens from sphagnum moss, Black Swamp, Roslyn, Long Island; taken by Banks (1a, p. 129, which also included five *Z. emarginatus*), slide 26B41. One specimen from among fallen leaves, more especially twigs among them, brush pile, etc., Cayuga Heights, Ithaca; taken March 31st 1917, slide 172o2. Nineteen specimens from under side of stones, bark of trees, and boards, Taughannock Ravine; taken April 21st 1917, slides 178o1 and 178o2.

Virginia: Three specimens from Great Falls; Banks, slides 26B70a and 26B99a.

Florida: Nineteen specimens from moss on trunk of cabbage palm (*Magnesia* sp.), Gainesville; taken December 10th 1928 by J. R. Watson, slides 28W12/10, 28W12/10–1 and –2.

Type locality: Homer, Illinois.

The stomach of this species is often packed with what appears to be algae.

Habitat: Preferably moss, especially those forming clumps and mats; forest floor.

Easily mistaken for *G. virginiensis* in dorsolateral aspect as the lamellae stand out unusually from the sides though not nearly as much as in *G. virginiensis.* In this aspect it may be easily differentiated by the large glary mandible retractor scars, the unusual position of the adalar porose areas (if visible), the small mesonotal porose areas, and the broad pseudostigmatic organ head.

Galumna banksi (10, p. 29)
Figures 11–12

Diagnostic characters: Notogaster with median pseudoforamen; adalar porose areas short cuneiform; cephaloprothoracic bristles medium long, rather fine; lamellar bristles peripheral; pseudostigmatic organs (figures 12) straight, head small, with rounded distal end and few long barbs; tectopedia II very narrowly exposed; genital cover bristles 1 and 4 on anterior and posterior edges respectively; paranal bristles near posterior corners; anal pseudofissurae distinct, short, parallel to median plane.

Description: Size medium (0.53×0.36 mm.); color reddish-amber; form ovate; outline of cephaloprothorax barely interrupted by very flat lamellae; rostrum distinct; rostral bristles arching to almost touch, inserted near base of rostrum; lamellar bristles, as seen in dorso/ventral aspects, barely surpassing insertion of rostral; lamellae strongly angular at insertion of bristle, extending more mesad than usual, a secondary lamellar ridge posteriad (in addition to the tectopedial); interlamellar bristles stouter than preceding, appearing curved in dorsal aspect, straight in lateral, as short as lamellar, inserted some distance from the slender, laterally tapering anterior porose areas; muscle scars small; pseudostigmatic organs see above, only four or five bristles in longitudinal series.

Notogaster with a fine line at position of juncture with cephaloprothorax, but faint and below chitin; adalar porose areas not constant in shape, that is, the anterior and posterior bulges not always developed; mesonotal porose areas small; insertions as in figure 11; pteromorphae faintly undulate, smooth, veining indistinct, pseudofissura strongly developed, groove slender, curved, with distinct ribs, insertion and channel distinct, pivot at angle.

Ventral plate wings broad, exposing tectopedia as a slender posterolateral crescent; tectopedia III small, squarish; tectopedia IV short; apodemata I angular, without ceriph; apodemata II–III quite long, undulate, with short anterior and long posterior ceriphs, there seems to be an ental continuation with short ceriphs; apodemata IV very angular, fairly close to II–III, ceriph long, its mesal end reaching near to distal end of that of II–III; bristles as in figure 11, that is, quite anterior; lucunae small; genital aperture with anterior and posterior edges undulate, sides slightly undulate not strongly converging; cover bristles 4 represented by a channel; bristles 2 and 3 nearer lateral than median edges of cover, distant from each other; paramesal bristles as distant from aperture as smallest diameter of a cover; subanal muscle plate oval; anal aperture with rather sharp posterior angle, posterior edge strongly bent; anterior cover bristles near anterior margin, slightly nearer lateral than median edge, posterior cover bristles more approximate than anterior; postanal bristles grouped in pairs, mesal bristles as approximate as posterior cover bristles, lateral bristles distant from posterior corners of aperture.

A lateral aspect has already been published (11, p. 21) figuring lateral aspect of legs. (The midthoracic suture should not have been drawn in, as it does not exist.) The bristles are very similar to those of *G. lanceatum octopunctatum* but the major bristle of tibiae IV is short for the genus. Dorsal bristle of genuals I very long.

Material examined: New York: Seven specimens from leaf mould, rotten wood and bark slabs, woods, Glen Cove, Long Island; taken May 8th 1920, slides 208o2, 209o1, 209n1, 2010o1 (*cotypes*). One specimen from sticks, hollow behind golf links, Forest Park, Brooklyn, L. I.; taken March 8th 1919, slide 197o1. One specimen from decaying or charred stick among dead leaves, burnt over land, Hollis Hills, L. I.; taken April 28th 1919, slide 1927o1. One specimen from Sea Cliff, L. I.; taken by Banks, slide 26B39a. *Conn.:* Two specimens from two decorticated sticks, dry woods (one stick was soft in spots with hairy fungus growth; the other with three-eighths inch pith tube open from end to end), East Village, Monroe; taken August 18th 1925, slides 2519o1, 2519n1. Three specimens from scrapings of bark of healthy hophornbeam (*Ostrya virginiana*) bole, four feet up; upland swamp, East Village, Monroe; taken February 13th 1932, slide 326o1. One specimen from Falls Church, *Va.;* Banks, slide 26B70.

Thus the species is uncommon, and partial to decayed twigs and such, from Connecticut to Virginia. One specimen has many fungal spores of two or three different kinds in its stomach. It evidently is an Austral species.

Eggs: The females bear four eggs with very large cytoplasmic area. This small number may account for the uncommonness of the species, coupled with what may be arboreal habits.

The three preceding species (*G. virginiensis, G. lanceatum octopunctatum, G. banksi*) form a closely related group by possession of short, single adalar porose areas, long interlamellar bristles, well developed lamellae, median pseudoforamen or porose area, and posterior paranal bristles. *G. banksi* is more advanced in the anterior position of the bristle usually found off apodemata II–III, the anterior position of the paramesal bristles, and the large ventral plate wings.

Galumna alatum (14, p. 214, no. 2688)
Figures 13

Diagnostic characters: Lamellae completely merged to cephaloprothorax; two adalar porose areas; pseudostigmatic organ head broader than pedicel; interlamellar bristles minute; mesal adalar insertion far posteriad of its usual position (on longitudinal axis of adalar areas); no median pseudoforamen; apodemata IV so oblique and extended as to meet ceriph of II–III; paranal bristles anterior to center of anal aperture; cephaloprothorax with steep front; rostrum distinct, pointed.

Description: Size fairly large (0.63×0.49 mm.); shape broadly ovate, high; cephaloprothorax rather narrow, very steep, broadly rounded; rostrum prominent, well set off, bluntly pointed; rostral bristles fine, rather short, apices remote; lamellar bristles curved, medium long, seen from above, surpassing insertion of rostral; lamellae not distinguishable; interlamellar bristles a little more remote than lamellar, distinct from tectopedial shadow; anterior porose areas slender, oblique, only the mesal end behind interlamellar bristles; muscle scars small, not in elongate series but congregated in a subcircular mass; pseudostigmatic organs fairly long, bent so as to form two distinct angles, one at base of pedicel though not as near base as in other species (see figure 14), and near head which is fusiform, about three times diameter of pedicel and drawn out into a long, slender apicule or point (figures 13).

Notogaster quite fused to cephaloprothorax, rarely with a cross-line below the chitin; adalar porose areas double, the two subequal in size, the lateral with long axis parallel to hinge of pteromorphae, mesal one with long axis at right angles to pteromorphal hinge; mesonotal porose areas rather small, the mesal irregular, angular; insertions compound, that is, composed of usually three pseudoforamina of various sizes, shapes and arrangement; second posterior adalar insertion very small, single; a minute pseudofissura between mesal adalar and anterior mesonotal insertions; face of pteromorphae slightly undulate, veining sparse, weak, pseudofissura small, groove not strongly developed, open anteriorly, insertion distinct, pivot near angle.

Ventral plate wings fairly broad but tectopedia II so much broader as to be broadly exposed at sides of wings (see figure 14); tectopedia III small, semicrescentic; tectopedia IV fairly well developed, posterior edge quite oblique; apodemata I with small, knob-like anterior ceriph; apodemata II–III straight, with straight anterior and strongly curved posterior ceriph; apodemata IV very oblique, as seen in ventral aspect, with central knob, mesal end reaching to or nearly to ceriph of II–III. Although this appears to be the case in several of the preceding species when viewed ventrolaterally, it is the only one in which it appears so in ventral aspect. Furthermore these two apodemata (II–III and IV) appear to have their mesal ends united by a basal plate. This plate has a faint beginning in the preceding species but it is here developed as a well chitinized, quite definite structure. The three pairs of sternal bristles present!

1 and 3 minute (see figure 14), the other pair well developed; other bristles as usual; genital aperture with anterior edge gently bowed, posterior edge undulate, sides rather strongly converging; cover bristles 1 on or close to anterior edge, cover bristles 4 on posterior edge, bristles 2 and 3 nearer median than lateral edge, rather near each other; paramesal bristles distant from aperture, more remote than diameter of genital aperture!; anal aperture without definite subanal muscle plate; anterior edge simple, posterior edge well rounded, angles well rounded; pseudofissurae small, near anterior angle of aperture, distant from sides, very oblique; paranal bristles posterior to pseudofissurae; anterior cover bristles equidistant from three edges; posterior cover bristles more approximate than anterior; postanal bristles grouped in pairs, lateral bristles quite near corner of aperture, as remote as greatest diameter of aperture!, mesal bristles near center of posterior edge of cover.

This species is strikingly primitive in its small porose areas; presence of bristles on notogaster and pteromorphae (in the American subspecies); presence of bristles on sternal area; position of paranal and lateral postanal bristles. It is highly specialized in complete absence of lamellae, reduction of cephaloprothoracic bristles especially the interlamellar, position of apodemata IV, position of anterior and posterior genital cover bristles.

Dimensions of the smallest male, average of six males, average of nine females, largest female from Regensburg, Bavaria, are given. Then follows the average of six females from Virginia.

Total length of body	544	591	648	682	614
Breadth of same	434	449	496	536	459
Length of pteromorphae	326	348	386	371	327
Interlamellar bristle span	102	114	120	143	140
Median length of ventral plate	412	448	507	536	469
Camerostome of genit. apert.	86	88	93	115	84
Length of genital aperture	74	78	87	94	88
Breadth of same	85	87	99	102	93
Genital apert. to anal apert.	110	122	145	164	126
Length of anal aperture	112	127	135	152	130
Breadth of same	127	131	145	156	149

From the above it will be seen that the breadth of the genital aperture of the males is proportionally much less than in the females, and the space between the apertures is relatively much shorter in the males.

Eggs: This species bears six to eight, even nine or ten eggs. An American specimen bears twelve.

Material examined: From *Regensburg, Bavaria:* Twenty-six specimens from sides and foot of tussock sedge in half dried swampy pool in woodland of tableland behind Befreiungshalle; taken August 3rd, slides 3129o1 and 3130o1. These were either under water or at the water-line when the pool was half full. One hundred seventeen specimens from moss (chiefly sphagnum) from sides of drainage ditch and water holes in marsh (formerly wooded), also from base of sedge tussocks, Hoher Gebraching woods; taken August 24th, slides 3146o1, – o3 and 3147o1. Again next to the water line of a wet area.

Thus this species might well be found on flotsam and debris on the water surface and I do not doubt it is Schrank's species (as also DeGeer's—nonbinomial). It is not Hermann's species (21, p. 92) because he collected from moss, and *G. lanceatum octopunctatum* is the outstanding moss species of Hermann's collecting ground.

America: Fourteen specimens from leaf mould, top (north side) of Wachusett Mt., *Mass.;* taken October 29th 1932 by Cyrus R. Crosby, slide 3297–1. *Conn.:* one specimen from under rotten log, Mt. Carmel; taken April 18th 1920 by Philip Garman, slide 26G4. Fourteen specimens from drifted oak and maple leaves in dry uplands woods, East Village, Monroe; taken June 19th 1926, slides 2610o1, –o2 and 2611o1. One specimen from old fence rails, branches and wood chips, old apple orchard, East Village, Monroe; taken August 4th 1932, slide 3229o4. One specimen from oak leaves, helmlock gorge, Sandy Hook; taken June 21st 1926, slide 2612o2. Two specimens from leaf mould from hemlock gorge, Sandy Hook; taken June 25th 1926, slide 2614o3. Five specimens from leaf mould, old hemlock grove, Miamus ravine, Conn.-N. Y.; taken in April slide 261o1. *New York:* One specimen from under face of old board or bark, Enfield Gorge, Tompkins County; taken April 5th 1917, slide 174o1.

Three specimens from leaf mould, small gully along road up from lake between Myers and Norton, near Ithaca; taken December 5th 1932 by C. R. Crosby, slides 32111o1 and 32112o1. *Ohio:* One specimen from under fence rail, bluegrass meadow, Lyndon; taken April 12th 1924 by A. E. Miller, slide 20 (Miller Coll.). One specimen from under a stone, Austin; taken April 12th 1924 by Miller, slide 21 (Miller coll.). Two specimens from moist, under side of board in open pasture, Mt. Vernon, *Illinois;* taken August 6th 1927 by Miller, slide 0–23.1–27 (Miller coll.).

These American specimens, at least from Connecticut, average smaller than the European, specifically: the males average 545, the females 595 microns in length.

The Bavarian specimens differ from the American in that the mesal mesonotal insertions are very nearly as approximate as the mesal adalar, these four clear dots thus forming a rectangle in dorsal aspect. Furthermore the median porose area and cluster of pseudoforamina are represented by a cluster of irregular porose areas posteriad of the mesonotal porose areas (on median line). I do not think the third pair of insertions of Ewing's figure exist in the Bavarian specimens. As the characters of the pseudostigmatic organs and ventral plate are the same, I do not regard these differences sufficient to warrant the use of a nomenclatorial name. It would only be a form of the subspecies. In all other cases known to me subspecies show differences in the ventral plate and pseudostigmatic organs.

In Europe there seem to be racial differences (15, p. 177, under *G. tenuiclavum*) and further it is figured (15, p. 177) as having the lamellar bristles much more approximate and having much smaller anterior porose areas than my Bavarian examples. The type locality for the species is Bavaria.

Habitat: The ecological niche in America is thus seen to be fallen leaves of the forest floor. That it is not recently introduced seems to be evident from its presence in gorges remote from towns. However, there is always a possibility that the Oribatoidea have been spread among the farms on the bulbs of *Scilla sibirica, Hemerocallis,* tiger lilies, daffodils, narcissi, tulips, onions, and other European importations, and that from these they have been spread by birds (in nesting material) and by rain wash.

Galumna alatum binadalare (10, p. 30)
Figures 14–15

Diagnostic characters: Pseudostigmatic organ head much wider, obovate but flattened on one face, short apiculate, with very few barbs about distal portion (figures 15) ; lateral adalar porose areas smaller than the mesal; mesal mesonotal porose areas much larger than any other, subcircular; lateral mesonotal rather close to mesal; pteromorphal insertion with a minute bristle; I certainly saw a minute bristle emerge from the posterior adalar insertion; I also saw minute bristles stand out from the posterior end of the notogaster; paranal bristles anterior to the pseudofissurae which are more posteriorly situated, as though these two structures had changed places! (figure 14).

Dimensions of six females presented under the species, show this form to average smaller than the Bavarian, and to have relatively shorter wings, a larger interlamellar bristle span (which is very variable), smaller space between camerostome and genital aperture, and a broader anal aperture.

Material examined: From Falls Church, *Va.;* Banks, 14 specimens, slide 26B78 (*cotypes*).

Galumna longipluma (1, p. 30)
Figures 16–19

Diagnostic characters: Pseudostigmatic organs tapering to a point, faintly few barbed (figures 17 and 18) ; interlamellar bristles well developed; no lamellae; two adalar porose areas, the mesal the larger; genital cover bristles not in a straight line; paranal bristles at center of aperture.

Description: Size rather large (0.72 × 0.55 mm.) ; shape ovate, with tapering cephaloprothorax; rostrum rather distinct, somewhat elongate (for the group) ; sides of cephaloprothorax smooth, as there are no lamellae (figure 18) ; bristles of cephaloprothorax, like the pseudostigmatic organs, compressed, relatively wide at base, rostral bristles fairly long, their distal ends touching, strongly barbed to ciliate; lamellar bristles longer, nearly touching beyond rostral, weakly barbed, inserted above rostrum but considerably more remote than rostral (their position is too approximate in Willmann's figure (15, p. 174) correct in Oudemans' (13, p. 63). Interlamellar bristles stouter, bilaterally barbed, inserted some distance from tectopedial shadow, slightly more remote than lamellar; anterior porose areas large, irregularly ovate (figures 16 and 19); muscle scars small, linearly arranged; pseudostigmatic organs reaching back of pteromorphal groove.

Notogaster completely fused to cephaloprothorax except laterad of mandible retractor muscle scars (figure 16). Berlese's figure (3, pl. 1, fig. 9) has it drawn as continuous. Had he focused carefully with a four millimeter objective he would have found this line to be internal. It is, of course, possible that rare individuals may have the suture complete as a reversion in the same way that three bristles rarely appear on an anal cover. Lateral adalar porose areas have a characteristic shape, specifically, with posterior face obliquely truncate (figures 16 and 19), larger than the subcircular mesal; second posterior adalar insertion between the two areas, nearer to the mesal; mesonotal porose areas medium in size, the lateral one smaller, elongate; insertions as in figures 16 and 19; males with a conspicuous cluster of pseudoforamen on median line posterior to transverse plane of mesonotal porose areas; pteromorphae with short, interrupted veining, groove distinct, open anteriorly, posterior rib distinct but slender, pseudofissura, insertion, and channel distinct, pivot slender, at angle, notch well formed.

Ventral plate wings slender broadening posteriad but not enough to cover the very broad tectopedia II which form a distinct angle at center of sides of ventral plate wings which are bent dorsad along their central axis; tectopedia III small, posterior corner lacking; tectopedia IV well developed; apodemata I straight with short anterior ceriph; apodemata II–III sinuous, with two heads, the mesal one internal, each head with two well-developed ceriphs, those of the mesal head longest, especially the posterior one which curves back toward the sides of the body; apodemata IV angular, with well formed, stout posterior ceriph; insertions of sternal bristles present!; bristle of parasterna III long; genital aperture with anterior and posterior edges undulate, the anterior corner well rounded out, frame slender; cover bristles 1 some distance from anterior edge, midway between median and lateral edges; cover bristles 4 marginal, only the channel distinct; bristles 2 nearer median edge of cover, bristles 3 near lateral edge. Thus the genital cover bristles of this species present an unusually ragged arrangement; paramesal bristles as distant from aperture as diameter of a genital cover; anal aperture with anterior corners very much reduced so that the anterior end is rather conical, posterior edge very rounded; anterior cover bristles quite near anterolateral edge, posterior cover bristles as remote as anterior; pseudofissurae at center of sides of aperture, short; paranal bristles usually slightly anterior to pseudofissurae; lateral postanal bristles distant from posterior corners of aperture, mesal pair as approximate as cover bristles.

Bristles of tarsi I not as highly developed as those of preceding species of the genus. Major bristles long; genual major also long.

Dimensions for the average of six females from Regensburg in Bavaria are given: Total length of body 725, breadth of same 550, length of pteromorphae 393, interlamellar bristle span 137, median length of ventral plate 560, camerostome to genital aperture 125, length of genital aperture 108, breadth of same 118, genital aperture to anal aperture 133, length of anal aperture 163, breadth of same 165. The distance between the apertures was found to be quite variable. The only male measurable was included by the female measurements which were unusually similar in size. The average length of Glen Cove, Long Island, N. Y., females is 765 microns.

Eggs: The largest number of eggs observed was five.

Material examined: Regensburg, Bavaria: Twenty-two specimens from stump moss, Dechbetten woods; taken July 27th, slides 3119o2 and 3121o4. One specimen from deep moss from north facing, wet terrace along road between Thur and Taxis and Dechbetten; taken July 30th, slide 3122o3. One specimen from fallen branch (or stone), fairly heavy oak and pine woods at Walhalla; taken August 6th, slide 3131o5. Five specimens from spruce needle litter, foot of spruce in woods east of Walhalla; taken August 8th, slides 3134o1 and 3133o1. One specimen from moss from sides of drainage ditch cut through marsh (old spruce swamp) and base of sedge tussocks, Hoher Gebraching woods; taken August 24th, slide 3147o1.

America: Thirty-two specimens from rotten wood and bark slabs in deciduous woodland, Glen Cove, Long Island, *New York;* taken May 8th 1920, slides 208o1 and 209o1. *Connecticut:* One specimen from fallen hickory shag, foot of hickory, dump lot, Coscob headland; taken April 12th 1932, slide 3212o1. One specimen from under face of boards, Experiment Station grounds, New Haven; taken September 25th 1932 by P. Garman, slide 3268o. Two specimens from under face of wood, woodland margin, foot of Indian Hill, along Forest Road, New Haven; taken August 25th 1932, slide 3247o2. One specimen from under rotten log, Mt. Carmel; taken April 18th 1920 by P. Garman, slide 26G4.

This extremely restricted distribution in America, especially in long inhabited regions and the margins of cities, coupled with its being found in three instances with the European *Z. nervosus* and once with *G. alatum* (of Europe), indicates with certainty that it is an *introduced species.* It is widely distributed in Europe.

This species has already been recorded from under rotting boards, New Haven, Conn., under the name *O. setiformis* (7, p. 506, fig. 163). My copy of this paper bears manuscript corrections of the length as 0.64–0.68 mm. All of the size records in this paper are wrong.

Habitat: From the above *G. longipluma* is seen to be a member of the decaying wood fauna. Its rarity in the many moss samples shows it not to belong to this niche of the forest floor except by accident.

Galumna flagelliferum (10, p. 31)
Figures 23–25

Diagnostic characters: Cephaloprothoracic bristles very much reduced, rostral usually eclipsed, lamellar frontal, interlamellar lacking; pseudostigmatic organs bristlelike, apparently smooth to very finely, fewburred, rather short, curved posteriad; porose areas large, only one adalar, distant from pteromorphae, genital cover bristles nearer lateral than median edge of covers; paranal bristles distant from aperture, posterior in position; pseudofissurae of anal aperture very fine, barely discernible.

Description: Size fairly large (0.71 × 52 mm.); shape ovate, somewhat long, cephaloprothorax broad, short (figure 23), high, with steep front; rostrum distinct, short, rounded, blunt, the rim constricted so that rostral bristles are quite overhung by it; pseudofenestration along rim of camerostome, bounded by a denticle which extends beyond rim (figure 23, lower half); lamellar bristles short, fine, inserted halfway between the projecting lamellae and rostrum; lamellae extend close to sides of cephaloprothorax (not toward interlamellar bristle); interlamellar bristle insertions distant from tectopedial shadow; pseudostigmata distinct! projecting beyond surface of cephaloprothorax in both lateral and dorsal aspects; anterior porose areas rather large, elongateovate to oval; muscle scars arranged in linear series.

Notogaster apparently completely fused to cephaloprothorax; adalar porose areas large, oval, distant from pteromorphae; lateral mesonotal porose areas elongate, diagonal, the mesal one lacking, see position of bristle insertions (figure 23); pteromorphae with ventral edge not sharply angled, the angles broadly rounded, groove distinct, its anterior rib short, pseudofissura slender, insertion large, veining fairly well developed, pivot slender, at angle.

Ventral plate wings broad, their anterior end undulate; tectopedia II so broad as to project laterad of wings; tectopedia III slender; apodemata I long, bowed, with short diverging ceriphs; apodemata II–III bent, with short ceriphs; apodemata IV with long, oblique ceriph pointing toward lateral end of apodemata I; lacunae small; sternal bristles sometimes present; genital aperture with anterior and posterior edges undulate, sides strongly converging; cover bristles I on or close to edge, cover bristles 4 on posterior edge, bristles 2 much nearer lateral than median edge of covers, bristles 3 less so; paramesal bristles smallest diameter of a genital cover distant from aperture; anal aperture with anterior end very narrow, sides thus very converging, frame distinct; paranal bristles unusually far posteriad and laterad of pseudofissurae; anterior cover bristles close to anterior corner, posterior bristles more remote than anterior; postanal bristles approximated in two pairs, the lateral distant from corner.

Palps much as usual but the four terminal bristles developed as erect spines opposed by the curved dorsal style to form a clutching hand (figure 25).

Eggs: As many as eight eggs are borne at once by the female.

Material examined: Four specimens from nest of *Eciton caecum,* Austin, *Texas;* C. T. Brues, slide 26B85 (*cotypes*). *Florida:* Two specimens from Punta Gorda, Banks coll., slide 26B27a and b. One specimen from lichens on oak trunk, Sugarfoot Hammock, Gainesville; taken September 8th 1929 by J. R. Watson, slide 29W9/8–1. One specimen from Spanish moss rotting on ground, Sugarfoot Hammock, Gainesville; taken August 25th, 1929 by Watson, slide 29W8/25–1. Two specimens from dry leaves on north facing slope, Devil's Mill Hopper, Gainesville; taken March 4th, 1929 by Watson, slide 29W3/4. Two specimens from Falls Church, *Virginia;* taken December 7th, by Nathan Banks, slide 26B13. Five specimens from under leaves of *Opuntia opuntia* Plummer's Id., *Maryland;* taken March 2nd 1924 by A. E. Miller, slide 2 (Miller coll.). Four specimens from Sea Cliff, Long Island, *New York;* Banks, slide 26B39c. *Ohio:* Eight, five, five and six specimens from one square foot of bluegrass sod, Mt. Logan, Chillicothe; taken April 20th, May 25th, July 13th, August 3rd, 1925 by Miller, slides 32M9o1 and –o2, 32M69o1, 32M15o and 32M18o1 respectively. Two specimens from lawn (of Mr. Service) Wayne Avenue, Dayton; taken August 22nd 1925 by Miller, slide 32M19. *Illinois:* Two specimens from lower side of boards and logs lying on ground in more open part of Dodson's Woods, Urbana; taken May 24th 1927 by Miller, slide 32M122o. One specimen from lower side of 2″ × 6″ piece of walnut in open bluegrass pasture, three miles north of Rossville; taken August 18th 1927 by Miller, slide 0–15.1–27 (Miller coll.). One hundred and twelve specimens from a neighboring, 6″ × 8″ boards, slides 0–14.1–27 to 0–14.4–27 (Miller coll.).

Geographical Distribution: Carolinian zone southward.

Habitat: Chiefly a floor species, averaging half a dozen per square foot of sod. The last lot listed seems to be an unusual concentration (or aggregation).

In the nymph the interlamellar bristles are present but very short, the pseudostigmatic organs are clavate and densely bristled (ciliate) in four rows (figure 24). The palps are as in the adult.

Galumna curvum (5, p. 113, figs. 5, 6)
Figures 26–34

Diagnostic characters: Body small (0.38 mm. long); notogaster and pteromorphae with fine bristles at insertions; porose areas small, roundish; interlamellar bristles short, fine; lamellar bristles frontal, far anterior to lamellae; rostral bristles invisible from above; pseudostigmatic organs long, with a broad, compressed, semioval head on a long filiform pedicel (figures 26, 28, 29, 32); apodemata with long ceriphs; genital cover bristles 1 and 4 on edge of covers; paranal bristles rather distant from aperture.

Description: This is our smallest Galumna, by a wide margin. Shape, seen from above (figure 26), broadly ovate, seen from side, high arched with angular posterior margin; cephaloprothorax short, broad, steep, lamellae forming only a slight ridge; rostrum broad, rounding smoothly into cephaloprothorax; edge of camerostome thickened in the form of a band (figure 32, shaded in figure 31); interlamellar bristles short (not minute) and fine; lamellar bristles longer; rostral bristles still longer but inserted below the bulge of the rostrum and far back near edge of camerostome, thus being invisible from above (figures 27, 31, 32). It might be thought that the bristle closest to the ventral edge of the lamellar band is the lamellar bristle but a study of the migration of this bristle (in this subfamily) namely away from the lamellae, and the fact that its position is, in all other known cases, dorsad of the rostral bristles, makes it quite evident that the most ventrad of these three, as usual, is the rostral bristle which, with the shortening of the rostrum has thus been carried far backward (figure 32). Pseudostigmata inconspicuous, represented dorsad by a low rim, the posterior border of which is produced as the anterior articulation of the pteromorphae; organ (figures 26, 28, 29, 32) long, erect, curving backward like a pennant on a slender, flexible wand, the head somewhat compressed, about one third the length of the very slender pedicel, viewed from the side semioval, produced behind in a point, at times with two or three points on posterior margin (figure 28), lower margin usually very slightly convex, occasionally appearing coarsely granular if only partially dehydrated; viewed from in front the head appears lenticular, thus all variations in shape (due to its compression) between lenticular and semioval may be seen depending on angle of vision, also it may appear broadly semioval if the angle of vision is from somewhat behind, so as to foreshorten its appearance.

Notogaster (figure 26 upper half only), broadly oval, posteriorly so depressed as to form an angle when seen in lateral aspect; center sometimes appears finely granular (the area indicated in figure 26 by a dotted line), these granulations, extending down the sides in irregular rays and spangles, are probably due to a fine deposit of foreign particles; porose areas small, distinct, roundish to oval, the anterior (figures 26 and 32) situated between interlamellar bristles and pseudostigmata, that is, much more lateral than usual, rather attenuate at ends, adalar ovate, unusually distant from pteromorphae, mesonotal rather close together, subequal, posterior more approximate than mesonotal, between them two groups of muscle scars. The insertions about the mesonotal porose areas are elongate so as to resemble pseudofissurae; pteromorphae (figures 26 and 32) anteriorly subtruncate, posteriorly extremely oblique, ventrally conspicuously emarginate, not as usual in this genus (that is, with the ventrodistal margin rectangularly incised to fit about tectopedium II) but with a more acute incision, leaving a strongly developed ventrodistal lobe, making the ventral margin subequally bilobed, pivot very slender, near angle, at right angles to margin (usually oblique to margin), anterior margin of pteromorphae thickened for a short distance below the pivot (darkened in figure 32), veining obsolete, groove shallow, fairly definite, insertion with a bristle which varies in length to as long as interlamellar bristle so as to extend beyond lateral margin of pteromorphae, pseudofissura long, distinct.

Ventral plate (figure 27 upper half only) deep, so that distance from anal aperture to notogastral plate viewed from side is equal to greatest breadth of an anal cover, wings broad, narrowly exposing tectopedia II posterolaterally, longitudinally bent dorsad along their middle; tectopedia III with oblique posterior corner; tectopedia IV short triangular, almost equilateral; lacunae long, conspicuous; apodemata I descending and widening at apex, sometimes the anterior sometimes the posterior ceriph the longest; apodemata II long and slender, anterior ceriph very long, directed laterad almost parallel with the apodeme, posterior ceriph fairly long, strongly curved; apodemata III diagonal; gular bristles remote; bristle off apodemata II–III lacking!; genital aperture with anterior margin slightly undulate, posterior edge strongly so, sides strongly converging; cover bristles 2 much nearer median than lateral margin, bristles 3 subequally distant between these two margins, thus the pattern of these four cover bristles is jagged due to the mesal position of bristles 2; paramesal bristles as distant from genital aperture as smallest diameter of a genital cover; subanal muscle plate slenderly oval; anal aperture with short anterior margin, broadly rounding into sides, posterior margin curved; pseudofissurae at center of, quite close to, and slightly diverging anteriorly from lateral margin; paranal bristles posterolaterad of pseudofissurae; lateral postanal bristles some distance from corners of aperture, grouped with mesal two in pairs; anterior cover bristles close to anterior margin, posterior pair as remote as mesal postanals; median edge of anal covers strongly ridged (figure 33); a median porose area on median line of ventral plate close to posterior edge (figure 30).

Camerostome (figure 31, which is a ventral view from somewhat in front) with descending median lip; labium with emarginate apex, bristles fairly long (foreshortened in figure 31), rather remote and distant from distal end of plate; mandibles chelate, lower or articulated ramus with broad, molariform, slightly emarginate distal cusp, widely separated from the well developed, middle cusp which in turn is broadly separated from the equally large proximal cusp, other ramus similar, thus mandibles differ from most species by their broad, molariform, distal cusps and large, well developed middle cusps.

Legs with triheterohamate unguis; segments short, robust, major bristles on all four legs. Legs I (figure 34) with tarsi nearly pyriform, with five slender bristles on dorsal face, second dorsal much the longer, decurved; a lateral and a mesal bristle present; ventral face with three ciliate bristles, each bearing but three or four stout cilia; apex with about four or five fine bristles. Tibiae more than half as wide as long, dorsal face concave, rapidly contracted to pedunculate base, dorsodistal edge produced as a small thumb; major bristle strongly developed, its process quite broad, bearing a short bristle on distal edge; ventral face with but one ciliate bristle; lateral side with a long, slender bristle. Genuals as long as width of tibia, distinctly curved; bearing two distal bristles: a long slender, decurved, dorsal (surpassing the tibia), and a short, slender, ventral. Femora broad, curved, with very slender pedicel, and crenate ventral face, armed with but three barbed bristles: a rather stout, decurved, ventral one inserted at center of article, and two curved, slightly barbed dorsal bristles of which the anterior is the shorter, inserted close to distal end, the posterior inserted at center.

Legs II very similar to legs I but tibiae only very slightly wider than tarsi; genual bristle still longer!; femora longer, more slender and more curved, with ventroproximal bristle inserted far proximad of center.

Legs III similar to legs IV but shorter. Tarsi shorter and stouter; bristles similar but with an additional lateral one near proximal end. Tibiae broader and shorter, with major bristle more distally inserted (less than diameter of base of tarsus), ventral face with only the posterior ciliate bristle. Genuals shorter, like femora and coxae, with usual bristles or insertions. Femora pyriform. Trochanters more oblique.

Legs IV the longest and slenderest. Tarsi with only two ciliate bristles on ventral face, remote from each other; two simple bristles on dorsal face, more approximate, the proximal one remote from proximal margin; a lateral bristle; several bristles about apex. Tibiae with two ciliate bristles on ventral face, the distal one close to distal end, major bristle on transverse plane of proximal ciliate bristle, a lateral bristle inserted on transverse plane between ventral bristles. Genuals with a barbed lateral bristle, as long as genual. Femora and trochanters with the usual bristles. Femora with low hump just anterior to center, tapering gently in each direction, broader at distal than at proximal end. Trochanters casquelike.

Ovipositor similar to that of *Z. emarginatus* but lateral bristles subopposite in the lateral fingers. Fingers considerably shorter than distal segment.

Dimensions: Fourteen specimens were measured, seven from Monroe, Conn., and seven from Shantung, China, either about the Tsingtao hills and nursery or the Laushan hills (twenty miles to the east). The smallest, average and maximum for Connecticut and for Shantung are presented respectively.

Total length of body	355	386	390	325	387	410
Breadth of same	245	265	280	210	256	280
Length of pteromorphae	195	205	210	170	199	205
Interlamellar bristle span	50	75	76	55	74	80
Median length of ventral plate	265	275	290	246	287	307
Camerostome to genital apert.	55	59	65	55	59	65
Length of genital aperture	45	48	55	45	52	55
Breadth of same	60	63	65	55	65	70
Genital apert. to anal apert.	65	72	80	60	75	85
Length of anal aperture	63	68	70	60	72	85
Breadth of same	70	75	83	65	81	90

From this table it is evident that the species averages the same on both sides of the world. No sex differentiation whatever was found.

Material examined: East Village, Monroe, Conn.: Two specimens from cushion moss, upland swamp; taken March 23rd 1919, slide 1913o1. One specimen from same; taken May 31st 1919, slide 1931o4. Three females from creeping moss on north side of boulder, same swamp; taken May 30th 1920, slide 2014o1. One specimen from clump of sphagnum standing out of the water, further in same swamp; taken May 30th 1920, slide 2016o2. One specimen from dead, overhanging leaves of *Carex stricta* clump, same swamp; taken August 10th 1925, slide 2514o1. Twenty-five specimens from core cut out of top of same clump; taken August 22nd 1925, slides 2525o1 and 2528o1. Two specimens from lower face of old rail in apple orchard, among crevices of the wood; taken August 22nd 1925, slide 2527o1. Ten specimens from dead, drooping leaves of *Carex stricta*, marsh northeast of village; taken August 28th 1925, slide 2532o1. Sixteen specimens from scrapings from sides of a near clump; taken August 29th 1925, slide 2533o1. Four specimens from old, decaying, wettish grass from foot of old haystack on hillside meadow; taken September 1st 1925, slide 2534o1. One only from dry grass, a foot higher up on north side of same stack; taken September 3rd 1925, slide 2535o1. Two specimens from fallen leaves in woods, edge of upland swamp; taken September 9th 1925, slide 2538o1. One specimen from a fern frond in sprout woodland, hillside; taken at 4.30 P. M., August 23rd 1932, slide 3242o. Fifty-two specimens from *Selaginella apus* and epigeous moss of earth clumps, upland swamp; taken July 7th 1932, slides 3226o1 and –o2. Twenty-three specimens from moss clump, thicket, edge of swampy woods; taken January 18th 1932, slides 322o1 and –o3. Two specimens from fallen hickory shag about hickory, dump lot, Coscob headland, Conn.; taken April 12th 1932, slide 321o1.

Ithaca, N. Y. One specimen from under stone or board or bark of twig, up Six Mile Creek; taken April 14th 1917, slide 176o4. One specimen from sphagnum about stump in swale below road, below wooded ridge of Connecticut Hill, Newfield, Tompkins Co.; taken November 25th 1932, slide 32106o1. Fifteen specimens from leaf mould, small gully along road up from lake between Myers and Norton, near Ithaca; taken December 5th 1932 by Cyrus R. Crosby, slides 32111o1 and 32112o1.

Chillicothe, Ohio: Seventy-three, five, one, and eight specimens from bluegrass sod, Mt. Logan; taken April 20th, May 25th, July 13th, August 3rd 1925 by A. E. Miller, slides 32M9o1 and – o3, 32M69o1, 32M15o, 32M18o1, respectively.

Urbana, Illinois: One specimen from lower side of board or log lying in more open part of Dodson's Woods; taken May 24th 1927 by Miller, slide 32M122o. One specimen from under side of moist board lying in Orchard, Dodson Farm; taken August 24th 1927 by Miller, slide 0–5–27 (Miller coll.).

Falls Church, Va.; one specimen taken in April by Nathan Banks, slide 26B68b.

Somerset, D. C.; one specimen taken in April by Banks, slide 26B65a.

Florida: Twelve specimens from fallen leaves, half inch mulch, high, dry land under hickory, Pinkoson Springs near Gainesville; taken March 4th, 1928, by E. F. Grossman, slides G33G1, –G4 and –G5. Three specimens from fallen leaves in oak woods off state road one mile west of Green Cove Springs; taken April 29th, 1928, by Grossman, slides G80G2 and –G4.

These Florida specimens have notogastral bristles twice as long as most of the northern specimens while the interlamellar and pteromorphal bristles are as long as pseudostigmatic organ head. The ventral plate bristles remain the same. I see no other differences. This difference in length of notogastral bristles will probably be found to be a relative character when material from the intervening states is studied.

Columbia, Mo., Washington, D. C., and Florida are Berlese's records for his synonym *O. tantillus* (3, p. 120). The type locality is North America (2, p. 7).

Habitat: From the above records it is quite evident that this species is common in the large clumps of *Carex stricta* so characteristic of some of our swamps, in sod, and, under certain conditions, in moss and dead leaves. It is not an habitué of decaying wood. From its presence on a fern frond in broad daylight and its abundance in sod in April and greatly diminished numbers in later months, I suspect it is a common ascender of vegetation.

Eggs: A maximum of two was found, each egg, as in *Z. minutus,* occupying a half of the abdomen. They do not occur frequently or throughout the season, yet the species seems to be common.

Galumna curvum ventralis (16, p. 283, figs. 67, 68)
Figures 26, 27 (lower half)

Diagnostic characters: Mesonotal porose areas usually markedly unequal, the lateral considerably smaller than the mesal; arrangement of mesonotal pseudofissuræ and bristles differing as illustrated (figure 26); gular bristles much closer to each other; distal ends of apodemata I and II–III differing as in figure 27; ventral plate wings broader, covering almost all of tectopedia II.

These characters are based on specimens from North China. It is impossible to make exact comparisons with Willmann's unfinished drawings. Moreover, he misinterprets various structures. His midthoracic suture (anterior end of notogaster) is some internal tissue. If the suture existed it would pass through the anterior porose areas and terminate at base of pseudostigmata. His lamellæ are in part the shadow of tectopedia I. He overlooks the rostral bristles and calls the lamellar bristles rostral. I have never seen the pseudostigmatic organs under the pteromorphæ in this species. The description of the ventral plate leaves much to be desired, the bristle insertions and other details are replaced by coarse stippling. The ventral plate wings seem to be depicted as much narrower than tectopedia II, but how can one rely on such workmanship? The ventral edge of the pteromorpha is most unusual.

Material examined: Tsingtao, Shantung, China: One female from decaying pieces of pine on "woodland" floor, north shoulder of Signal Hill; taken July 29th 1922, slide 2270n3. Two females from grass (by sweeping) under pines, same locality; taken August 1st 1922, slide 2272o1. One female from pine needles, pine cone or fragment from base of a pine tree, same locality; taken August 3rd 1922, slide 2274o2. Five specimens from herbs (by sweeping) in "woods," on hill north of Japanese Soldier's Monument; taken August 8th 1922, slide 2278o2. *Laushan region* (twenty miles east of Tsingtao): Fourteen specimens from moss on rocks about spring on road up to the Inn near Liushu tai; taken August 18th 1922, slide 2283o1. Thirty-eight specimens from pine needles and *Selaginella mongolica,* same locality, east of Inn; taken August 18th 1922, slide 2285o2. Eighty-five specimens from thick cushion moss by road up to Inn, same locality; taken same date, slide 2286o1. Thirty-six specimens from clump of Scirpus with creeping moss among culms, cliff spring marsh, gully west of sanitorium, Bai Djiou Shui Miao; taken June 9th 1928, slide 2811o1. One specimen from moss from spring, Lingen Sšu Temple, Western Shantung; taken November 4th 1927, slide 2811o1.

Habitat: It is particularly interesting to find this form abundant where (in cushion moss) in America it was very sparingly found. In North China there is nothing at all comparable to a swamp, all wet land having for centuries been converted into rice paddies, lotus pans, and such. The absence of this species from Europe marks it as another example of the east American and east Asian biota.

Addenda

Oribates cribriger (4, p. 306) is a Galumna from decayed leaves from Columbia, Missouri. The sculpturing of the pteromorphæ, I consider to be the veining because it is transverse, while sculpturing is parallel to ventral edge (longitudinal). The real lamellæ seem to be extremely reduced. The porose areas seem to make it *G. flagelliferum* but the pseudostigmatic organs are recorded as fairly long and the heavy sprinkling of pseudoforamina, giving it the name of "the sieve cover," makes it appear different. Only intensive collecting about the type locality will make it possible to determine if *G. flagelliferum* is a subspecies or a synonym.

Galumna paucisetosum (10, p. 32) seems to be a Chinese species under a wrong catalogue number.

Key to Species

1. Pseudostigmatic organs tapering to a point....2
1. Pseudostigmatic organs becoming broader distally....3
2. Interlamellar bristles long....*G. longiplumum*
2. Interlamellar bristles shorter than diameter of tarsi....*G. flagelliferum*
3. Size minute (about 0.3 mm.); rostral bristles not visible in dorsal aspect; lamellar bristles frontal; interlamellar bristles rather short; notogaster with small bristles....*G. curvum*
3. Size larger (over 0.4 mm.); rostral bristles visible in dorsal aspect....4
4. Interlamellar bristles longer than diameter of tibiæ....5
4. Interlamellar bristles short....7
5. Mesal edge of lamellae directed diagonally across frons; pseudostigmatic organ head very slender (two or three times diameter of pedicel). *G. virginiensis*
5. Mesal edge of lamellae directed posteriad toward interlamellar bristle....6
6. Pseudostigmatic organ head decurrent, with blunt distal end, only four or five barbules in linear series; adalar porose areas between proximal end of groove of pteromorphae....*G. banksi*
6. Pseudostigmatic organ head distinct, with apicule, many barbules; adalar porose areas anterior to pteromorphal groove. *G. lanceatum octopunctatum*
7. Paranal bristles anterior to pseudofissurae; pseudostigmatic organ head slender, with tapering distal end and long apicule....8
7. Paranal bristles posterior to pseudofissurae; pseudostigmatic organ head

fairly broad, with rather abrupt distal end and short to no apicule......9

8. Pseudostigmatic organ head smooth or with only four or five barbules. *G. alatum*

8. Pseudostigmatic organ head abrupt, with only four or five barbules; Carolinian........................*G. a. binadalare*

LITERATURE CITED

1a. BANKS, NATHAN, 1895 (Sept.), Some Acarians from a Sphagnum Swamp, JOUR. N. Y. ENT. SOC., vol. 3, pp. 128–130.

1b. BERLESE, ANTONIO, 1904 (July), Acari nuovi, Manipulus III, Redia, vol. 2, pp. 10–32, pls. 1–2.

2. Same, 1908 (Aug. 5), Elenco di Generi e Specie nuove di Acari, Redia, vol. 5, pp. 1–15.

3. Same, 1914 (Dec. 31), Acari nuovi, Manipulus IX; Redia, vol. 10, pp. 113–150, pls. 1–4.

4. Same, 1916 (Dec.), Centuria Terza di Acari nuovi, Redia, vol. 12, pp. 289–338.

5. EWING, HENRY ELLSWORTH, 1907 (Dec.), New Oribatidae, Psyche, vol. 14, pp. 111–115, pl. 3.

6. Same, 1909 (Sept.), The Oribatoidea of Illinois, Bull. Ill. State Lab. Nat. Hist., vol. 7, pp. 337–390, pls. 33–35, 5 txt. figs.

7. HALL, HARRY VICTOR MALAN, 1911 (May), Studies in Acarina I, Pomona Jour. of Ent., vol. 3, pp. 504–510, txt. figs. 161–165.

8. HERMANN, JEAN-FRÉDERIC, 1804, Mémoire Aptérologique, Strasbourg, 152 pp., 9 pls.

9. HEYDEN, CARL HEINRICH GEORGES, 1825 (Sept. 19), Versuch einer systematischen Eintheilung der Acariden, Isis von Oken, vol. 18 (1826), col. 608–613.

10. JACOT, A. P., 1929 (Jan.), American Oribatid Mites of the Subfamily Galumninae, Bull. Mus. Comparative Zoöl., vol. 69, pp. 3–37, pls. 1–6, 1 txt. fig.

11. Same, 1932 (April), Moss Mites, Bull. Bost. Soc. Nat. Hist., no. 63, pp. 17–22, 4 txt. figs.

12. OUDEMANS, ANTHONIE CORNELIS, 1900, New List of Dutch Acari, Tijdschrift voor Entomologie, vol. 43, pp. 150–171, pl. 8.

13. Same, 1919 (June), Notizen über Acari, 26 Reihe (Oribatidea, Gruppe der Galumnae), Archiv für Naturg., vol. 83, abt. A, heft 4, pp. 1–84, 114 text. figs.

14. SCHRANK, FRANZ VON PAULA, 1803, Fauna Boica; Durchgedachte Geschichte der in Baiern einheimischen und zahmen Thiere; Ingolstadt, vol. 3, abt. 1.

15. WILLMANN, CARL, 1931, Moosmilben oder Oribatiden (Oribatei), in: Dahl, Friedrich, Die Tierwelt Deutschlands, teil 22, pp. 80–200, 364 txt. figs.

16. Same, 1931, Oribatei (Acari), gesammelt von der Deutschen Limnologischen Sunda-Expedition, Archiv für Hydrobiologie, Suppl. vol. 9, ''Tropische Binnengewässer,'' vol 2, pp. 240–305, 81 txt. figs.

PLATE X

Galumna virginiensis (10, p. 33), adult

Figure 1. Dorso/ventral aspects, mouth parts and legs omitted; ratio ×120.

Figure 2. Pseudostigmatic organs; ratio ×440.

Figure 3. Cephaloprothorax, dorsolateral aspect, showing mesal edge of lamella extending across frons and its continuation with the lamellæ under pteromorpha to join with ventral plate wing (broken line). The edge of camerostome and tectopedia II show as a dotted line, on a more distant plane; ratio ×150.

Figure 4. Same, dorsocephalic aspect; showing oblique juncture of mesal edge of lamellæ; ratio ×150.

Galumna lanceatum octopunctatum (6, p. 356), adult

Figure 5. Dorso/ventral aspects, mouth parts and legs omitted; ratio ×120.

Figure 6. Pseudostigmatic organs; ratio ×440.

Figure 7. Legs I, lateral aspect, one hook lost; ratio ×200.

Figure 8. Femoro-genual hinge of legs I; ratio ×440.

Figure 9. Legs I, dorsal aspect, showing pattern of dorsoproximal quartette of tarsi; ratio ×200.

Figure 10. Interlamellar bristle base; ratio ×440.

Galumna banksi (10, p. 29), adult

Figure 11. Dorso/ventral aspects, mouth parts and legs omitted; ratio ×120.

Figure 12. Pseudostigmatic organs; ratio ×440.

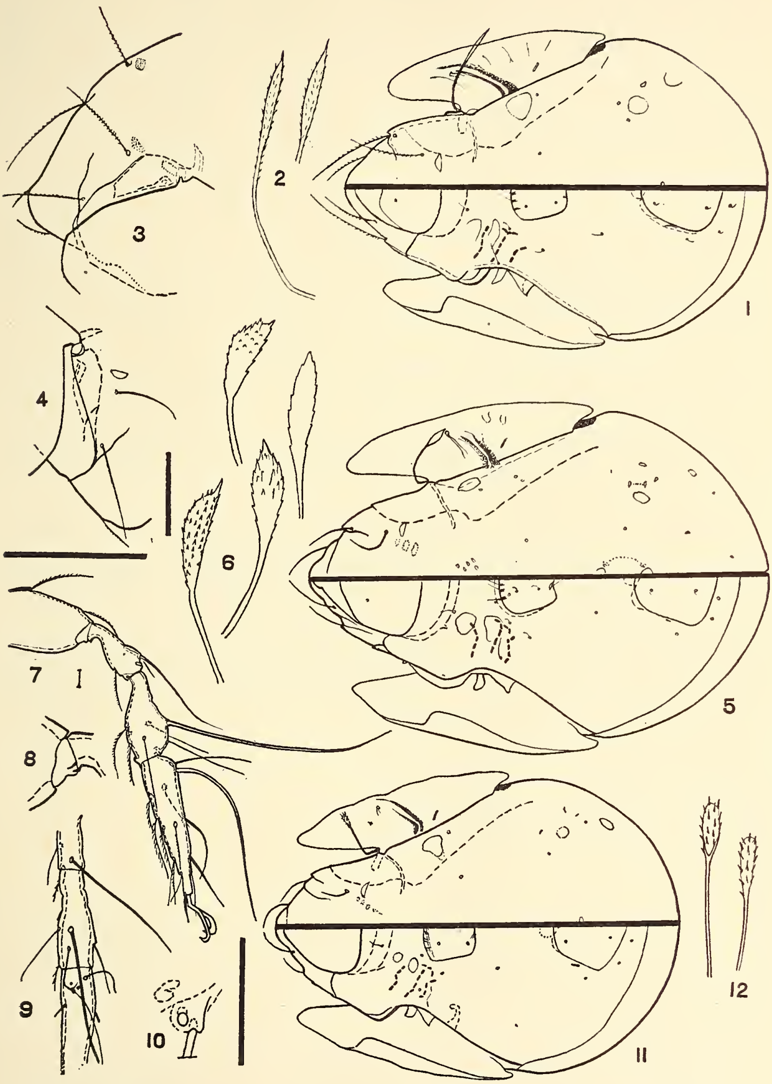

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PLATE XI

Galumna alatum (14, p. 214, no. 2688), adult

Figure 13. Pseudostigmatic organs, various aspects; ratio × 440.

Galumna alatum binadalare (10, p. 30), adult

Figure 14. Dorso/ventral aspects, mouth parts and legs omitted; ratio × 100.

Figure 15. Pseudostigmatic organs, various aspects, figure below numeral is foreshortened; ratio × 440.

Galumna longipluma (16, p. 30), adult

Figure 16. Dorso/ventral aspects, mouth parts and legs omitted; ratio × 100.

Figure 17. A pseudostigmatic organ; ratio × 200.

Figure 18. Distal end of same pseudostigmatic organ; ratio × 440.

Figure 19. Dorsolateral aspect, showing tectopedia I, porose areas and insertions; ratio × 100.

* * * *

Figure 20. Sketch of a ciliate bristle.

Figure 21. Sketch of a barbed bristle.

Figure 22. Sketch of a burred bristle.

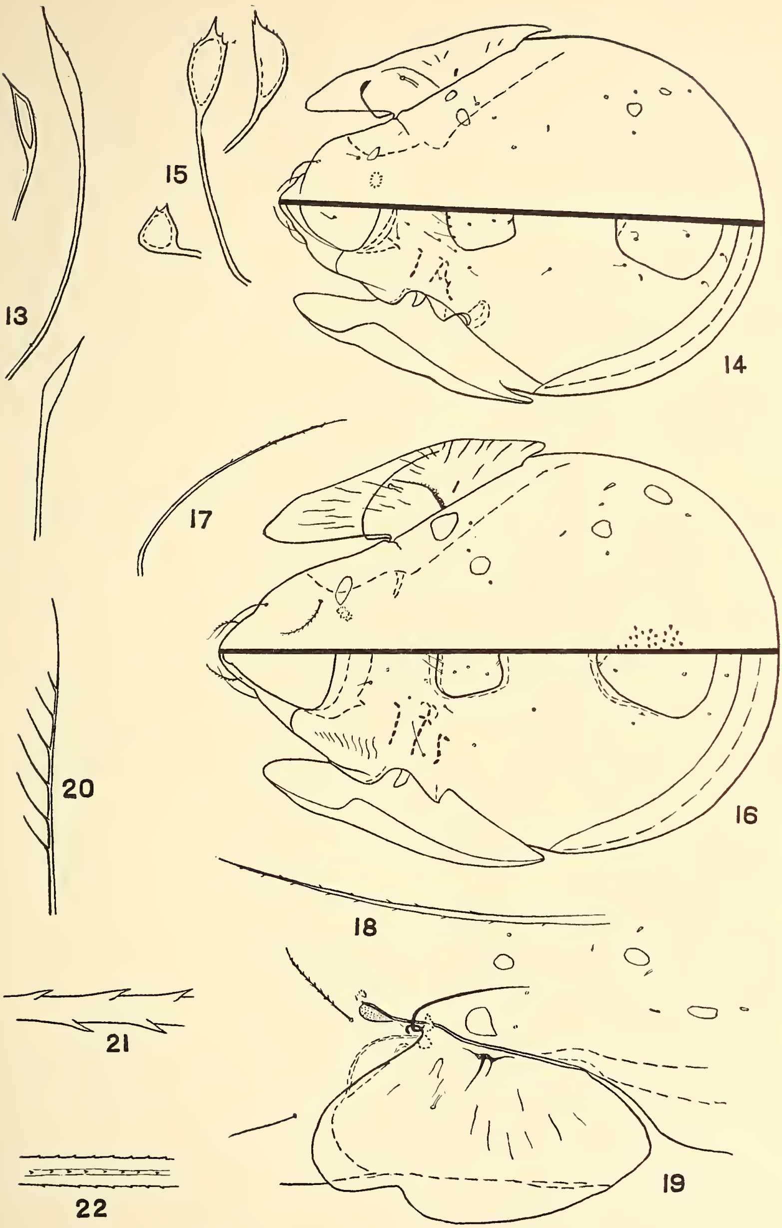
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PLATE XII

Galumna flagelliferum (10, p. 31), adult and nymph

Figure 23. Dorso/ventral aspects, mouth parts and legs omitted; ratio ×100.

Figure 24. Pseudostigmatic organs of nymph; ratio ×440.

Figure 25. Palp, distal two segments; ratio ×440.

Galumna curvum (5, p. 113), adult

Figure 26. Dorsal aspect, upper half of figure only, mouth parts and legs omitted; ratio ×120.

Figure 27. Ventral aspect, upper half of figure only, mouth parts and legs omitted; ratio ×150.

Figure 28. Pseudostigmatic organs, lateral aspect; ratio ×440.

Figure 29. Pseudostigmatic organs, dorsal aspect; ratio ×440.

Figure 30. Posterior aspect; ratio ×120.

Figure 31. Camerostome and adjacent bristles, ventrocephalic aspect; ratio ×120.

Figure 32. Lateral aspect, anterior end, mouth parts and legs omitted; ratio ×200.

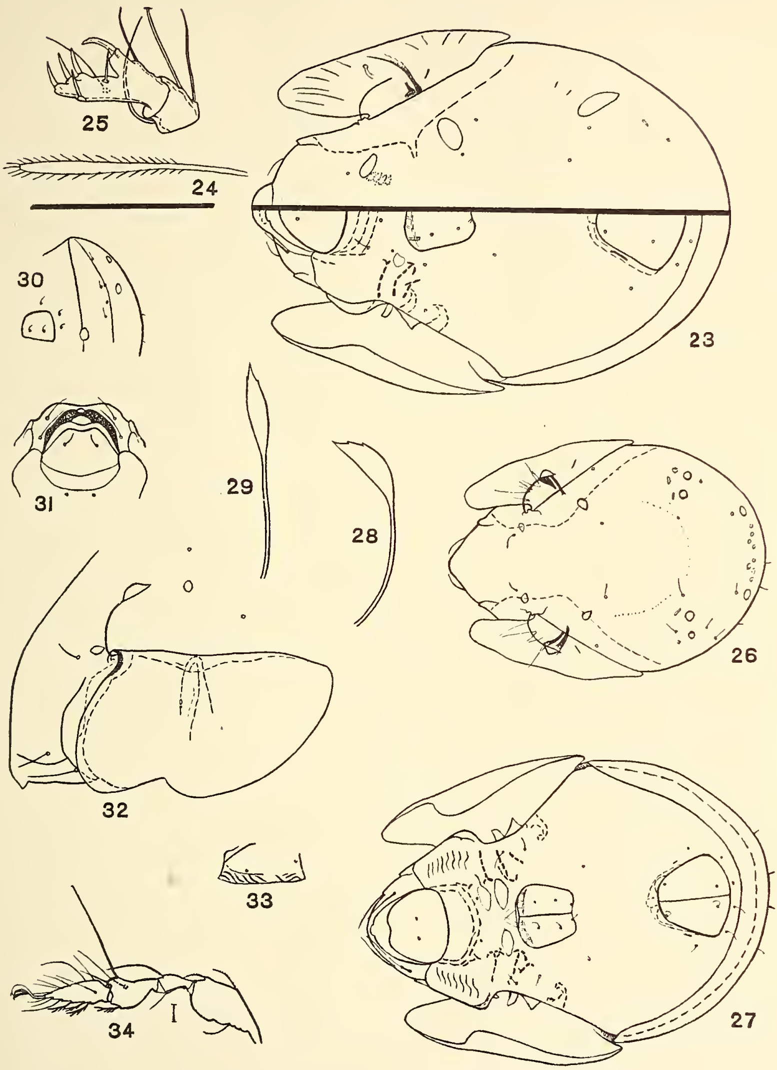
Figure 33. An anal cover, showing ridged margin; ratio ×200.

Figure 34. Legs I; ratio ×200.

Galumna curvum ventralis (16, p. 283, figs. 67, 68)

Figure 26. Dorsal aspect, lower half of figure only; ratio ×120.

Figure 27. Ventral aspect, lower half of figure only; ratio ×150.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HOW MEGARHYSSA DEPOSITS HER EGGS

By Cyril E. Abbott
Morgan Park, Ill.

Considering the conspicuous size and form of *Megarhyssa lunator*,[1] it is rather strange that the study of this insect has been neglected. It is true that in 1888 C. V. Riley published in ''Insect Life'' a very full and interesting account of the biology of *Megarhyssa* (then called *Thalessa*). But Riley's description of the drilling process which accompanies oviposition, although detailed, is superficial; it fails even to mention the action of the plates to which the drilling organ is attached. Mention is made of the ''powerful muscles'' of the abdomen without giving any evidence that the author was aware of their relationship to the ovipositor.

Henneguy (p. 283) states that: ''Les Ephialtes, les Rhyssa, deposent leurs œufs dans les larves des Longicornes qui vivent dans des galeries situees souvent a grande prefondeur a l'interieur du bois.'' But this tells us nothing of the mechanisms involved. The nearest approach to a solution is found in a paper by Baumann (1924). This, although it deals with an European species, *Thalessa leucographa*, does give a rather careful description of the ''Plattenapparates.'' Through dissection Baumann arrived at the same conclusion I reached through observation of the living insect, namely that: ''Den gleichzeitig mit der dorsalen Membran kommt auch die ventral Blasmembran sur Entfaltung so dasz sich der Blase aus einem auszeren dorsalen und einem inneren ventralen Anteil zusammensetzt.'' The musculature of the organs was not described.

Original Studies

The abdomen of the adult female *Megarhyssa* consists of eight externally visible segments and the propodeum, which, as far

[1] *Megarhyssa* obviously comes from the Greek *megas*, large and *hrysos*, wrinkle. Lunator means ''moonlike''; so the English equivalent of the name is ''lunar large-wrinkle.'' This is mentioned because it doubtless refers to the stretching of membranes to be described hereafter.

as this study is concerned, may be ignored. The penultimate segment extends forward on either side in the form of a narrow plate ending just beneath the posterior margin of the sixth segment (Fig. 1). The terminal segment bears corresponding

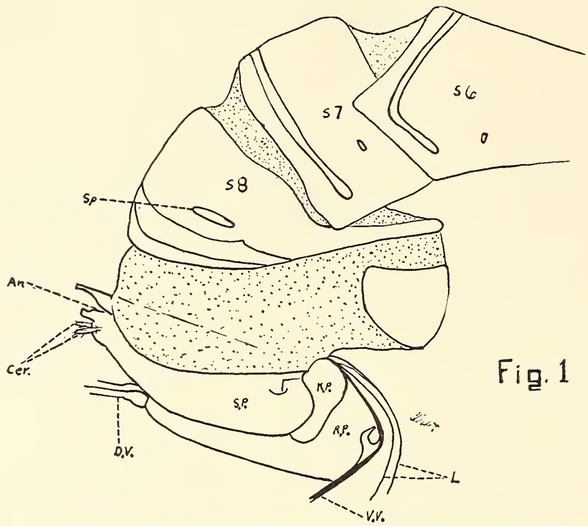


Figure 1. Right lateral aspect of distal part of abdomen with drilling organ extruded.
An., anus
Cer., cerci
D.V., dorsal valves
V.V., ventral valves
L., lancets
R.P., "runner" plate
K.P., "kidney" plate
S.P., "sled" plate
Sp., spiracle
S6, S7, S8, abdominal segments

lateral extensions which are even larger; suggesting in outline the runner of an old-fashioned "cutter." For this reason I have designated each of these as a "sled plate." Each terminates anteriorly in a horny point which articulates with the plate next anterior. The latter, which excepting for its contiguity with surrounding membranes is free, is more or less reniform. Its long axis is vertical and its convex margin anterior. At its base a hinge joint attaches it to a third and more anterior plate which is runner-shaped, with its recurved anterior in the body cavity. From below this ''runner'' plate is visible to its posterior angle, at which point the corresponding *dorsal valve* is attached. Anterior to the runner plate is a small plate which, with the corresponding plate on the opposite side of the insect, covers the base of the drilling organ. The relationship of these various parts are best shown in Figure 2.

The drill proper is composed of three parts. Of these the most conspicuous really consists of the two fused *ventral valves.*

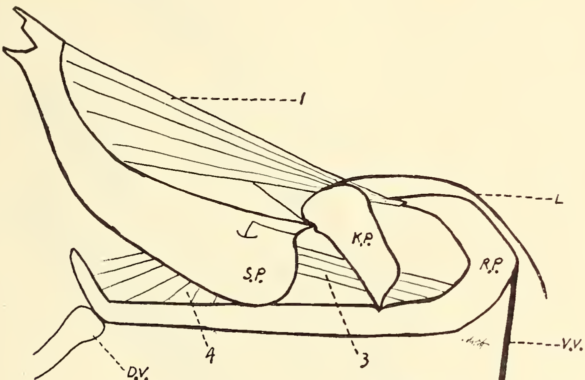


Fig. 2

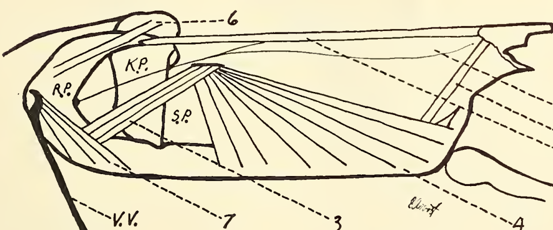
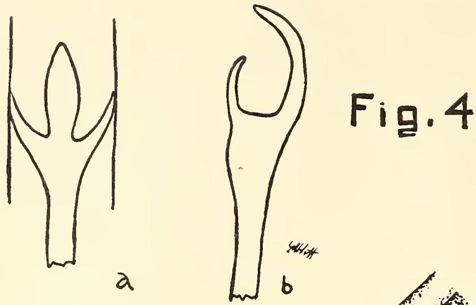


Fig. 3

Figure 2. Right lateral aspect of drilling organs removed from insect. For labels see Figures 1 and 3.

Figure 3. Ental aspect of drilling organs removed from insect.
1, 2, 3, and 6, extensor muscles of lancet
4, retractor muscle of lancet
5, posterior dorso-ventral muscle
7, retractor of ventral valves



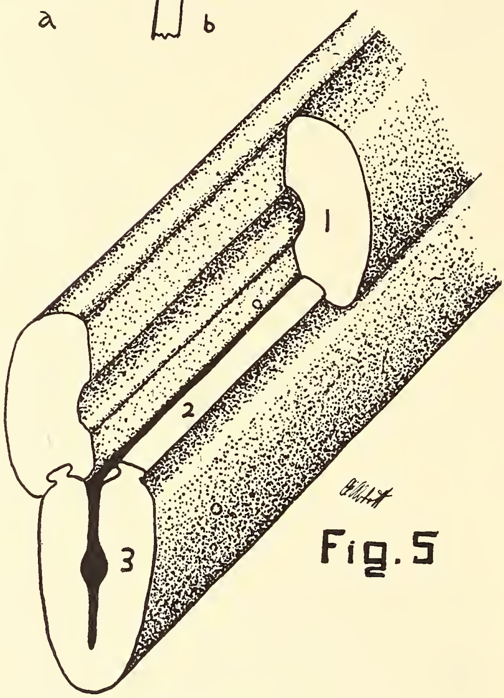


Figure 4. Proximal part of ventral valves
a, frontal aspect
b, lateral aspect

Figure 5. Diagrammatic representation of a section of the drill.
1, partially retracted lancet
2, T-ridge of ventral valve, upon which lancet rides
3, ventral valve

It is attached to the anterior angle of the "runner" plates. At this point it is trident in form; each lateral extension articulating with the corresponding plate, while the median tine curves inward between them, its convex posterior surface attached by muscles with the basal margins of the plates (Fig. 4). The remaining parts of the drill are the two *lancets,* each of which is attached to the dorsal margin of its corresponding "kidney" plate.

The lancets are so closely adherent to the ventral valves that the two are separated with difficulty. Riley was well aware of the reason for this: that each ventral valve is equipped with a T-shaped ridge which fits a corresponding cavity running the length of the lancet (Fig. 5). Riley's one mistake was in assuming that the valves are *dorsal* to the lancets when in actuality they are *ventral.* The dorsal valves or *guides* seem to be sensory in function, and take no part in the mechanics of drilling.

The muscles which operate the ovipositor, since they are concerned chiefly with the functioning of the lancets, are paired. Those on the right side may be seen by removing the penultimate segments and separating the halves of the body. They are as follows (1) a muscle having its origin on the posterior and interior margin of the "sled" plate and its insertion on the recurved termination of the "runner" plate; (2) a muscle having its origin near the posterior margin of the "sled" plate and its insertion on the concave inner margin of the "runner" plate; (3) a muscle having its origin on a sloping ridge at the anterior of the "runner" plate and its insertion on the ridge near and parallel to the dorsal margin of the "sled" plate; (4) a muscle having its origin on the posterior half of the ventral part of the "runner" plate and its insertion on the horny ridge near the dorsal margin of the "sled" plate; (5) a dorso-ventral muscle which connects the "runner" and "sled" plates posteriorly; (6) a small muscle connecting the anterior of the "runner" plate with the dorsal margin of the "kidney" plate. These muscles, with their attachments, are shown in Figures 2 and 3. Their enumeration follows that in the text. A few intersegmental muscles connect the penultimate with the terminal segment.

Observations made on living insects indicate that the "sled" and "runner" plates describe a rhythmic, lateral motion which rotates the "kidney" plate forward and back. The process can be simulated in the dead insect under the binocular magnifier, when it becomes evident that each lancet, since it is attached to the dorsal margin of its corresponding ''kidney'' plate, is alternately extended and retracted by this action (see Figures 2 and 3). The action of the muscles is as follows: 1, 2, and 3, by drawing the ''sled'' and ''runner'' plates together, rotate the ''kidney'' plate and thus extend the lancet; muscle 6 aids in the process by drawing the ''kidney'' plate forward; muscle 4, by drawing the ''sled'' plate *back,* has the opposite effect. The function of muscle 5 seems to be to keep the two larger plates from separating posteriorly. The paired muscles (Figures 2 and 3) attached to the mid-tine of the ventral valves appear to throw the latter forward, thus aiding in the ''looping'' of the ovipositor.

Since the ''runner'' plates are attached to each other anteriorly through their articulations with the ventral valves, and since the ''sled'' plates are merely extensions of the terminal segment, it follows that the degree of extension of either lancet can at no time be very great. Moreover, the action of the plates gives a partial rotation to the whole ovipositor; this, however, may be an advantage.

When about to deposit an egg, the insect elevates her abdomen, looping the ovipositor within the intersegmental membranes, while the two terminal segments are folded against the belly of the abdomen. The plates of the drilling mechanism are forced back into the membranes in an *inverted* position. This inversion is of no consequence to the drilling action, which depends upon the interrelationship of the drill plates and not upon their position with respect to the body of the insect. The exposed portion of the ovipositor, with its distal end directed against the tree, lies throughout most of its length upon the ventral surface of the abdomen. Drilling begins with the alternate action of the lancets. As the instrument penetrates the tree its parts are slowly withdrawn from the body membranes, the drill plates are everted, and the abdomen assumes the position of an inverted U. For a few seconds action is suspended. Then the ovipositor is withdrawn; the actions described above being duplicated in reverse order.

During the "looping" of the ovipositor the ventral membrane is forced in against the dorsal membrane, which in turn is extended dorsally until both membranes become stretched and transparent.

Riley's account is none too clear concerning the way in which the egg passes through the ovipositor. It is probable that the ovum passes through the tube formed by the lancets. Three facts seem to indicate that such is the case: (1) the vagina opens between the lancets, (2) the action of these parts would tend to work the egg through the ovipositor, and (3) eggs are sometimes accidentally extruded between the lancets.

LITERATURE CITED

BAUMANN, C. 1924.
Über den Bau des Abdomen und die Funktion des Legeapparates von *Thalessa leucographa.* Zool. Anz., 58, 149–161.

HENNEGUY, F. 1904.
Les Insectes.

RILEY, C. V. 1888.
The habits of *Thalessa* and of *Tremex.* Insect Life, 1, No. 6.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF JANUARY 19, 1932

A regular meeting of the New York Entomological Society was held on January 19, 1932, in the American Museum of Natural History; President Andrew J. Mutchler in the chair with twenty-one members and thirty-seven visitors present.

The minutes of the preceding meeting were approved as read and corrected.

In the absence of Mr. Hall, Mr. Bell read the treasurer's report for 1931.

On hand December, 1930	$ 1676.21
On hand December, 1931	1754.76
Received	2550.37
Expenses	2471.82
Gain during 1931	78.55

The report was accepted with thanks and placed on file.

The program committee reported Dr. Creighton and Dr. Driggers as the speakers for the next meeting.

Dr. Byrley F. Driggers, of the New Jersey Experiment Station at New Brunswick, was proposed for membership in the society.

Dr. William Moore read his paper on "Chemical Stimuli and Receptors," the second in the Biology of Insects series. Odors as chemical stimuli are stronger than taste. Certain odors, such as ethyl acetate, sugars, etc., are responsible for a food grasping reaction, others such as ammonia cause the reaction of oviposition, and the odor of eugenol is attractive to the male only. The organs that detect these odors are receptors or sense cells. They are found in the antennæ or all over the body, scientists not agreeing as to their location. It is difficult to ascertain the reactions caused by taste. Minnich has carried on several experiments to prove the sensitivity of the red admiral butterfly to cider in which he found taste receptors in the legs of the butterfly.

Professor C. L. Fluke, of the University of Wisconsin, then spoke on "Some Fly Friends and Enemies in Wisconsin," the Syrphidæ being the friends and the apple maggots the enemies. The syrphid larvæ, *Allograpta obliqua, Syrphus torvus,* and *Mesogramma geminata* live on a diet of plant lice and pea aphids. These larvæ have been observed to increase after an aphid attack. If the aphid food is missing in their diet, they complete their development more quickly but are undersized when they emerge. Dr. Fluke also mentioned the great numbers of aphids devoured by Chrysopa and the Coccinellidæ. Dr. Fluke showed a series of slides on the life history and the habits of the syrphid larvæ and also on the damage done by the apple maggot and the measures taken to rid the Wisconsin orchards of this pest. The greatest success had been obtained by spraying the orchards with arsenate of lead between the seventeenth and twentieth of July, this being the time of emergence. One application was found to be sufficient during a dry summer.

Dr. Leonard spoke of the work being done by the Experiment Stations in Porto Rico. Among those entomologists who are at the various Experiment Stations are the Doctors Wolcott, Danforth, Sein, and Osborn. Dr. Leonard said that the formal projects on the insect pest activities on the island were progressing, particularly the work on the bean aphids.

ELIZABETH SHERMAN, *Secretary*

MEETING OF FEBRUARY 2, 1932

A regular meeting of the New York Entomological Society was held on February 2, 1932, in the American Museum of Natural History; President Andrew J. Mutchler in the chair with sixteen members and seventeen visitors present.

The minutes of the preceding meeting were read.

The program committee reported Dr. Copeland and Dr. Hartzell as the speakers for the next meeting.

Dr. Byrley F. Driggers was elected to membership in the Society.

The resignations of Mr. Maydell and Dr. Gehring were accepted with regret.

Mr. Curran announced that Dr. Creighton had been called out of town and would be unable to give his paper at this time.

Dr. Driggers spoke on "Cocoon Parasites of the Oriental Fruit Moth." His paper will appear in the JOURNAL of the Society.

There followed a discussion of Dr. Driggers' paper concerning the methods of scientific control and the results obtained from the research which had been done in this field of parasitism.

Dr. Filmer and Dr. Pepper both said a few words of greeting, to the Society, expressing their pleasure in being able to attend the meeting.

Mr. Safro spoke at some length on the importance of odors which may affect insect migration. He likened perfumes to musical compositions in that they are all symphonies of various odors, which when happily combined are pleasing to the very imperfect sense of smell in man. It is possible to combine odors and get a zero result or no odor at all. There is every reasons to believe that odor detection in insects is much more highly specialized than in man. Because of this innate human inability in detecting odors it is hopeless to attempt to describe odors on the basis of human perception.

Dr. Moore spoke of a test given at the recent meetings in New Orleans to determine the exact taste of some small capsules. Here again the human mechanism proved to be very inaccurate, the majority indicating the taste to be a bitter one, while some declared that the capsules had no taste; and various others said that they were sour or had various other peculiar tastes.

Mr. Curran spoke in defense of those entomologists who name insects, stating that up to 1924 the Oriental peach moth was not known to exist in Canada. At that time, however, a shipment of fruit was found to be infested with this pest. Upon investigation it was ascertained that the Oriental peach moth had been present in Canada for some time but the inexpert authorities had been calling it Curculio.

ELIZABETH SHERMAN, *Secretary*

MEETING OF FEBRUARY 16, 1932

A regular meeting of the New York Entomological Society was held on February 16, 1932, in the American Museum of Natural History; President Andrew J. Mutchler in the chair with twenty-seven members and thirty-seven visitors present.

The minutes of the preceding meeting were read and approved.

The program committee announced Dr. Melander and Mr. J. C. Crawford as the speakers for the next meeting.

Dr. Herman Spieth, of the College of the City of New York, was proposed for membership in the Society.

Mr. Sherman exhibited the new book by Drs. Brues and Melander—"Classification of Insects"—a key to the known families of Insects and other terrestrial Arthropods, both in their adult and immature stages and covering the entire world. He called attention especially to the 107 pages of bibliographies of various orders, and to the index of some 8,000 family and generic names, and mentioned that, in the text, all scientific names are properly accented. The book is the complete volume 73 of the Bulletin of Comparative Zoology, at Harvard University and is sold by the University, bound at $6.50.

Dr. Janvrin exhibited a small light perforated aluminum container for naphthaline in insect boxes, which his wife had invented.

Mr. Copeland spoke on "Insect Coloration," his paper being one of the series on Biology of Insects.

Mr. Safros humorously cited the insect known always as the "Pink and Green Aphis" the names of the colors being blended just as the words "ham and eggs" and the dual personalities of "Brues and Melander!"

Dr. Hartzell spoke on "The Physiological Action of Pyrethrum in Insects," as follows:

"The use of pyrethrum flowers as an insecticide dates back to the 16th century in Oriental countries. However, the chemical nature of the active principles has only recently been determined by Staudinger and coworkers.

"Many questions such as their stability, keeping qualities, compatibility with soap, and the accuracy of the analytical methods are still in dispute.

"The following was performed in order to throw light on some of these points. This work was done in cooperation with Dr. Frank Wilcoxon, a chemist.

"The relation between pyrethrin content and toxicity was determined by testing a series of dilutions of known content on the bean aphis (*Aphis* *rumicis*). It was found that whenever two samples showed a significant difference in toxicity by the biological test the analytical result confirmed this fact.

"Pyrethrum concentrates are toxic to insects and a whole series of cold blooded animals including frogs and earthworms. These concentrates were found to be toxic when applied externally to the integument, even when not in the immediate vicinity of vital organs.

"The anterior end of a tomato worm was found to be more susceptible to these extracts than the posterior end.

"The temperature at the time a pyrethrum spray is applied is an important factor. The process of death and recovery are both accelerated depending upon the dose applied."

In reply to Dr. Moore's question he stated that the solvent used in the experiments cited in his paper was acetone and stated also that the same effects resulted if the pyrethrum were used direct.

Mr. Curran mentioning, that adult beetles were seldom found parasitized by flies—such cases occurring unusually in the family Chrysomelidæ—exhibited a specimen of Carabus sent from British Columbia, the abdomen of which contained four pupal cases and also the new species of tachinid fly, with unusual characters, reared from one of these pupæ.

Mr. Angell exhibited two lucanid beetles, one being a new race of *Lucanus dama* from Arkansas.

Dr. Melander exhibited a closely packed box of insects collected in southern Florida during a trip of four weeks in January and February.

President Mutchler exhibited a specimen of *Prionus laticollis* from the Slosson collection, with three tarsi springing from the left hind tibia.

Mr. Bell reported taking the fly *Syrphus torvus O.S.* at Flushing on February 7th.

Mr. Curran announced that Mr. Frank M. Jones would speak at one of the April meetings.

Mr. Cooper reported taking many Staphylinidæ this winter from rotten cabbage.

Mr. Beckwith, of the Cranberry Experiment Station, stated that he was very glad he had driven 80 miles from Pemberton, N. J., in order to attend the meeting.

JOHN D. SHERMAN, JR., *Secretary—Pro tempore*

MEETING OF MARCH 1, 1932

A regular meeting of the New York Entomological Society was held in the American Museum of Natural History on March 1, 1932, at 8: 15 P. M.; President Andrew J. Mutchler in the chair with twenty-seven members and nineteen visitors present.

The minutes of the preceding meeting were approved as read.

The program committee announced that Dr. Kendall and Dr. Pollard would be the speakers at the next meeting.

Dr. Herman Spieth, The College of the City of New York, was elected an active member of the Society.

J. Douglas Hood, of the University of Rochester, Rochester, New York, was proposed for membership in the Society.

Dr. Melander spoke on ''Host Selection and Biological Races,'' the fifth talk in the Biological Series. The behavior of an insect, that is its instincts or tropisms, is a manifestation of the insect's urge for ''self-preservation'' and ''race perpetuation.'' This biological urge, which is found throughout the animal kingdom, leads the insect to selective food habits and selective egg-laying habits. The various species of the same family may differ in these selective habits, thus we have ''orange honey'' and ''apple honey''; upper-surface leaf miners while members of the same species are lower-surface leaf miners. In the case of those insects which have been found to have more than one host, this fact has been capitalized for purposes of saving a crop from too serious infestation where total destruction of the insects is not possible. Thus, the strawberry farmer places a mixture of dried apples and magnesium arsenate near his strawberry patch which proves to be more attractive to the strawberry root weevil than strawberries and is therefore termed ''weevil lure.'' In using repellents it is necessary to get ''the worm's eye point of view'' for successful results. Host selection may be different during the various stages of development of an insect, thus showing that an insect, as an adult, has no memory of what it did as a larva. The adult moth does not eat cabbage as does the larva. Also it is necessary for the adult to select the appropriate food on which to lay its eggs, for, given the wrong food, an insect will live, but with a free choice it continues to select the same food or host from generation to generation.

Mr. Crawford read a paper on ''The Observations on Peculiarities of Bees, Wasps, Ants, etc.'' He spoke of the various hymenopterous parasites; the ink that the medievals derived from large wood galls; the alternation of generations; the necessity of the fig insect, which lays its eggs in the blossom of the wild fig, for pollinating the Smyrna figs in this country. Mr. Crawford then showed some very interesting slides, among which were views of the nests of Harvester ants, mud daubers, potter wasps, paper-making wasps, and also diagrams showing the types of legs necessary for collecting honey.

ELIZABETH SHERMAN, *Secretary*

MEETING OF MARCH 15, 1932

A regular meeting of the New York Entomological Society was held on March 15, 1932, in the American Museum of Natural History, at 8:15 o'clock; President Andrew J. Mutchler in the chair with twenty members and twenty-two visitors present.

The minutes of the preceding meeting were approved as read and corrected.

The program committee announced that Dr. Creighton and Dr. Jones would be the speakers at the next meeting.

It was moved and seconded that the secretary cast a vote unanimously electing J. Douglas Hood, of the University of Rochester, an active member of the Society.

Mr. George Sanders, 981 Seneca Ave., Brooklyn, N. Y., was proposed as an active member of the Society.

Mr. Davis exhibited the Bulletin 157 of the United States National Museum, a monograph on ''The Butterflies of the District of Columbia and Vicinity,'' by Austin H. Clark, and commented on the excellence of the text and the 64 plates.

Circulars concerning the Fifth International Congress of Entomologists in Paris, 1932, were distributed.

An article ''Three Hundred Years of Tom Thumb,'' by Mr. Harry B. Weiss, appearing in Scientific Monthly was shown. Its entomological interest was contained in a figure representing the spider, his web, and the butterfly.

Dr. James Kendall, the sixth speaker in the series on Biology of Insects, gave a paper on ''Gall Insects.'' He reviewed the work of Cuzens and of Lutz on the starch digestion of the cynipid gall and of the aphid gall as a possible explanation of gall growth. An induced chemical does produce growth but this does not explain gall growth. Galls are caused by a complexity of factors due to the quantity of sap in the plant, the nature of the secretion of the insects, and the organisms present in the plant tissue. They are the manifestation of the effort on the part of the plant to localize the effect of irritation at the point of infestation.

Dr. C. L. Pollard read a paper on ''Psychic Genera.'' Quoting a statement made some years ago by the botanist Dr. Edward Lee Greene, Dr. Pollard said that he was convinced that there exist in nature perfectly valid genera which may be indistinguishable from their nearest allies; also that characteristic genera of this type should not be divided on insufficient characters. He cited Ornithoptera as an example of the first type, and Argynnis as one of the second claiming that both were natural genera; and as in these cases the differentiation is partly intuitive, he used the phrase ''psychic genera'' to define them.

Dr. Spieth gave a very lucid account of the work he has been doing on the wing venation of Mayflies. In 1922 Lameere advanced the theory of regular alternation of veins, that is, one vein alternates behind another in Mayflies, resulting in the convex veins on the upper surface and the concave veins on the lower surface of both the hind and fore wings. A cross-vein may take the place of an old attachment of a concave vein. There is, however, too much variation in wing venation to make a stable classification therefrom.

Mr. Curran stated that in the higher order, the upper and lower surfaces are united, while in the lower orders the light is reflected from this alternation of veins.

Mr. Coates exhibited some moth cocoons collected from Rio Negro on Andros Island. These white cocoons closely resemble lizard eggs. The only insect found was a very large Megacoma over 3 inches in length and a perfect specimen.

Mr. Curran exhibited a mosquito and its eggs perfectly mounted by pressure on a sheet of paper. He also showed a cocoon of a cecropid moth containing hymenopterous parasites around which the cecropia was fitted. Also, he exhibited a tomato Sphinx caterpillar to which were attached many small, white braconid cocoons.

ELIZABETH SHERMAN, *Secretary*

MEETING OF APRIL 5, 1932

A regular meeting of the Society was held on April 5, 1932, at the American Museum of Natural History at 8: 15 o'clock; President Andrew J. Mutchler in the chair with twenty-six members and twenty-five visitors present.

In the absence of the secretary, Mr. John D. Sherman, Jr., was appointed secretary pro tempore.

The program committee announced that Dr. Moore and Dr. Johnson would be the speakers at the next regular meeting.

George E. Sanders was elected to active membership in the Society.

Dr. William S. Creighton, of the College of the City of New York, read a paper on ''Chordontal Organs and Insect Communication,'' one of the series on the Biology of Insects. He stated that the structure of these organs, defined as organs containing scolopales or ''auditory rods,'' has been well known for a long time, but that their real functions are still quite obscure, and that many different conclusions have been drawn as to their real use. Dr. Creighton spoke also on Insect Communications, mentioning the rhythmic circling movements of bees returning from their expeditions after food as observed by von Frisch who took fine moving pictures of them. Also he mentioned the similar movements of harvesting ants as studied by Hingston.

Dr. F. M. Jones, speaking on ''Insect Coloration and the Relative Acceptability of Insects to Birds,'' gave a very interesting account, with slides, ''of a long series of experiments with wild birds, entirely unconfined, and involving insects of more than two hundred species. The results were interpreted to signify a definite discrimination by the birds against certain types of insect coloration, these in some instances correlated with chemical factors whose deterrent character was proven in other experiments in which coloration was eliminated. If some types of coloration are to be considered protective, that protection is not complete, but at most relative and partial.''

Dr. Jones spoke also of the conclusions of Heikertinger and McAtee and others on the subject of protective coloration, etc.

Dr. Jones' paper was discussed by Dr. Mayr and Dr. Creighton at some length.

JOHN D. SHERMAN,
Secretary-Pro tempore

MEETING OF APRIL 19, 1932

A regular meeting of the New York Entomological Society was held on April 19, 1932, in the American Museum of Natural History at 8: 15 o'clock; President Andrew J. Mutchler in the chair, with twenty-four members and seventeen visitors.

The minutes of the two preceding meetings were approved as read and corrected.

The program committee announced that Dr. Biddle would speak on parthenogenesis at the next regular meeting.

Mr. Davis spoke of the recent death of the Rev. C. J. S. Bethune at the age of 93 years. Mr. Davis commented on the excellent work of Rev. Bethune as editor of the *Canadian Entomologist.*

Dr. Herbert Johnson spoke on "Polyembryony," the seventh paper in the Biology of Insects series. (See statement at end of minutes.)

Dr. William Moore spoke on "Resistant Scale Insects," saying that it was a problem not yet begun and one that he was going to California to attempt to solve. In Southern California there are three scale insects injurious to citrus, that have developed, by natural selection, a resistance to hydrocyanic acid in a dosage sufficient to kill. These scales are the *citrocollis* scale, a hot weather insect, the black scale, very abundant in the coastal regions, and the red scale, also found in the coastal regions. In appearance, the resistant individuals are identical with the non-resistant. Dr. Moore is particularly concerned with the distribution of these resistant strains and also with the development of an efficient method of fumigation which will break down the resistance already developed by these scales. He is anxious to receive suggestions along these lines. It is believed that climatic conditions, when unfavorable, will develop a resistant race. For example, *citrocollis* is resistant only when found in cooler regions where, Dr. Moore said, the insects seem suddenly to have put on gas masks.

Mr. Safro stressed the importance of suggestions that might be received by Dr. Moore. He stated that chemists and entomologists had two years in which to solve this problem of resistant scale insects, and that its solution would mean millions of dollars to the citrus growers.

Dr. Melander spoke on his work with the San Jose scale in the state of Washington. In 1906 the lime sulphur spraying was not proving effective in Snake River County. The Clarkson County scales were harder to kill than any other but it was found that they were 100 per cent susceptible to an oil spray. Dr. Melander found that there were decided physiological differences of heredity variability in the scale insects as they occur in Washington.

Dr. Felt mentioned the advantage of using more than one gas in fumigation.

Mr. Safro discussed Dr. Felt's suggestion, saying that better results might be had by the mixture not of two toxic gases but by the mixture of one toxic gas with a non-toxic gas. For instance, toxic gas with oxygen, which would increase the metabolic rate of the insect and thereby lower the resistance.

ELIZABETH SHERMAN, *Secretary*

POLYEMBRYONY (Abstract)

By H. HERBERT JOHNSON, Department of Biology, College of the City of New York.

Polyembryony, the development of many embryos from one egg, has arisen independently in five groups of insects: Strepsiptera, Serphoidea, Chalcidoidea, Ichneumonoidea, and Vespoidea. Polyembryony may be induced experimentally in certain invertebrates, and occurs exceptionally in vertebrates, as exemplified by identical twinning in man. It is the rule in the Armadillo, which forms four embryos from one fertilized egg.

Three species of *Platygaster,* a genus of parasitic Hymenoptera, exhibit a series of steps in the development of polyembryony. *Platygaster herriki* is monoembryonic in development, but has a specialized type of egg. The egg lacks the customary chitinized envelope, and also is deficient in yolk. The polar-bodies, produced by the maturation of the egg, fail to degenerate, but, by division, form a nutritive membrane, the *trophamnion,* which has the property of absorbing food from the host tissues and transmitting it to the embryo. Not confined by a chitinized shell, the embryo increases its area considerably during its development. *P. hiemalis* develops either monoembryonically, or the embryonic mass may divide once, producing twins. *P. vernalis* always develops by polyembryony.

The process becomes very complicated in certain Chalcidoidea, which may produce 2,500 young from one egg. Multiplication takes place in three ways. The first sixteen cells of the embryo may disjoin from one another to form separate embryonic growing centers or germs. Each of these may divide one or more times into smaller germs. Eventually a germ produces a compact mass of cells, the morula, but this may also divide by fission into two morulas, each of which produces a larva.

Dr. Johnson suggested that polyembryony in insects seems to be the first step in the development of an alternation of generations, as in certain Annelids and Coelenterates, in which the sexual phase is invariably followed by an asexual larva the body of which divides by fission.

The view of Marchal and Imms, that polyembryony results from a division of the embryonic mass brought about by osmotic pressures in the surrounding fluids, was criticised as perhaps inadequate to account for all of the facts. Stockard has shown that fish embryos divide to form Siamese twins if the metabolic rate is lowered beyond the normal. The lack of yolk in the polyembryonic insect egg, coupled with the difficulty of effecting proper contact between the embryonic body and the host tissues, introduces a factor which probably results in a lowered metabolic rate during the crucial early formative period. This factor alone, on the basis of Stockard's theory, may account for the fission of the embryonic mass, perhaps assisted by the osmotic pressures hypothecated by Marchal and Imms.

The New York Entomological Society

Organized June 29, 1892—Incorporated June 7, 1893

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Columbus Avenue.

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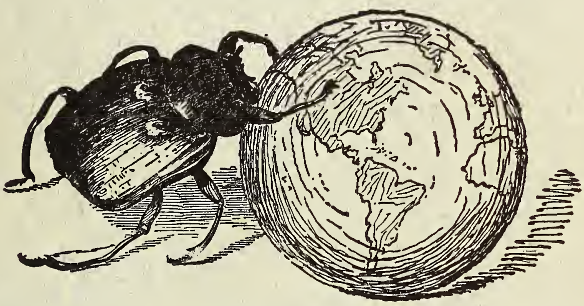

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PRELIMINARY NOTE OF MORPHOLOGICAL VARIATIONS OCCURRING IN X-RAYED STOCK OF THE ATTACINE MOTH CALLOSAMIA PROMETHEA DRU

BY C. P. HASKINS

In the course of a series of investigations now in progress on the effects of x-rays on living material, it was thought of interest to undertake some work with the Lepidoptera, both because of the surprising and conspicuous morphological variability of the order, and because relatively few x-ray investigations have been made with it—a situation which, considering the adaptability of such material to this end, particularly in the non-feeding Heterocera, should certainly be remedied. The most conspicuous work which has been done in the field is probably that of Hasebroeck.[1] Bordier[2] and Hastings, Beckton and Wedd[3] worked with the genus *Bombyx* and obtained some interesting variations, notably retardations and nanisms. All of this work, however, was done before the advent of the Coolidge hot-cathode x-ray tube, and long before the perfection of the ionization-chamber method of measurement of x-ray dosage. It was an extremely difficult task even to duplicate physical conditions in parallel experiments with cold-cathode tubes, while measurements of incident energy, except of a crude sort, were out of the question. Work of this period, moreover, was prosecuted before the present beautiful technique of cytological staining, which has culminated in Belling's isolation of single chromomeres, had been developed, and

[1] Fortschr. Roentgenstr., Hamburg, 12, pp. 277–81. 1909. Ent. Zs., Stuttgart, 22, pp. 182–183. 1909. Congr. internat. Ent. Mem. Bruxelles, 1, pp. 195–198. 1911.

[2] Le radium. II, p. 410. 1905.

[3] Arch. Middlesex Hosp., 11th Cancer Report. 1912.

at a time when even the modern theory of genetics was in a much less developed condition. It was therefore thought that a study, reinforced by cytological investigation, of the genetic behavior of certain of our American Saturniidæ when exposed to high concentrations of ionizing radiation might be of interest and of some value. The present report is of the most preliminary character, and merely summarizes certain morphological variations which have been encountered in the first year of work. However, considering the present widespread interest in biological effects of x-rays in general, and the extensive knowledge of the normal behavior of the moth we have chosen possessed by great numbers of entomologists, it has been deemed justifiable to publish it at this time.

MATERIAL USED

The Attacine moth *Callosamia promethea,* described by Drury in 1773, was selected for experiment for several reasons. It is extremely common in New York State, so that large numbers of wild individuals can be obtained whenever desired. It has so long been well-known, and so widely and extensively studied, that excellent records of its normal genetic behavior are available in the literature. No less valuable are such complete and interesting ethological studies on the species as those of Mayer.[4] A somewhat incomplete survey of the literature indicated that *C. promethea* may be normally more stable than some other Saturniids. There are many more teratological notes of *Samia cecropia, Telea polyphemus, Actias luna,* and *Automeris io,* for example.[5] Such complete studies of variability as those of Crampton[6] and Andre[7] for the genus *Philosamia* are apparently wanting. Most important of all, however, is the pronounced sexual dimorphism, involving a sex-linked factor or factor-series for melanism in the male, which *C. promethea* exhibits, and in which it is peculiar among our native Attacinæ. Grote[8] and Mayer[9] have

[4] Psyche ix, pp. 15–20.

[5] Psyche xi, p. 113, pl. x. Ent. News 24, pp. 337–8. Proc. Acad. Sci. Phila., p. 26, 1885.

[6] Biometrika iii, pp. 113–30. Biol. Bull. vi, pp. 310–11.

[7] Bull. Soc. Nat. Acclim. 56, pp. 329–30, 1909.

[8] Canad. Ent. xxxiv, p. 314.

[9] Bull. Mus. Comp. Zoöl. (Harvard) XXX, pp. 178–80, 1897.

shown that this melanism is apparently a rather recent mutation, differentiating the species from the older and more generalized *C. angulifera,* and have suggested that the stemming of the cocoon, which is wanting in *angulifera,* is another relatively recent character. Changes in either of these characteristics under x-radiation would be particularly interesting. No trace of such change has yet been observed in the first. There is some indication of modification in the second, but confirmation is needed.

SOURCE AND CHARACTER OF RADIATION

The source of x-rays used was a standard Victor deep-therapy outfit, composing a high tension transformer with cross-arm mechanical rectifier of the Snook type as the high voltage generator and a standard Coolidge water-cooled tungsten-target tube, of the thick-walled type, as the source of radiation. The voltage wave-form delivered by such a generator is very nearly sinusoidal.

The tube was operated at 200 kilovolts peak, with 30 milliamperes of current. The focal distance at which the material was exposed was 50 cm. The shortest wavelength theoretically obtainable at such a voltage is 0.062 Angstroms. No metal filter was used, but the glass of the thick-walled tube interposes a filtering action equivalent to about 0.10 mm. of copper. At 0.70 A the intensity of emergent radiation from the tube is only about 0.03 per cent of that impinging on the inner surface, as calculated from the mass absorption coefficient of copper, and this may be considered the cut-off point. Substantially all of the primary radiation incident was included in these limits. The greatest intensity of radiation lay in the neighborhood of the K^{a1} line of tungsten, at about 0.21 A. The K^{b1} line, at about 0.18 A, also figures prominently in this region, but general radiation at this voltage is very considerable. The second and third order lines are also present, but, of greatly diminished intensity. It is to be remembered that, although a fairly accurate picture can be drawn of the incident radiation, which is rather "hard," no picture whatever can be had of the actual radiation within and around the living material, due to the heterogeneous Compton scattering both within the material and from surrounding supporting objects. This secondary radiation will be considerably softer than the primary whose spectrum has been roughly delimited above. Under the conditions of irradiation described, the incident dosage totaled 300 rontgen units per minute, as measured by a Victoreen dosimeter calibrated against a Failla radium-compensated ionization chamber.

Procedure

Sixty cocoons, collected over quite a wide area, were obtained of *C. promethea.* Thirty of these were exposed in midwinter to the conditions of radiation described above for 1, 2, 4, 8, 16, and 32 minutes, corresponding to doses of 300, 600, 1200, 2400, 4800, and 9600 rontgens. The variation in dose was necessary because of ignorance of the tolerance of x-rays of the insect at this, or indeed at any, stage. All these pupæ may safely be assumed to have been in the period of ''pupal elimination'' of Crampton—essentially a resting stage—at the time of irradiation. Five cocoons were treated, but a few days before emergence, for 16 and 32 minutes. It is highly probable that the rapid and deep-seated physiological changes preceding eclosion had begun, although the pupæ were not removed and examined.

In addition to this material, 48 eggs laid by untreated females and fertilized by gametes of untreated males were exposed under the same conditions rather early in the embryonic period, but quite certainly after the formation of the blastoderm. They were given treatments of 4, 8, 16, and 32 minutes. Fifty eggs, also from control stock, were treated for 2, 4, 8, 16, and 32 minutes after the embryo was so fully developed that its color was visible through the shell, and but a day or two before hatching.

Some 30 young larvæ from control stock were exposed for 2, 4, 8, 16, and 32 minutes at the mid-period of the first instar. Nine were subjected to 64 minutes and at the mid-period of the second instar, in an effort to exceed the lethal dose. Twenty were given treatments of 4 and 32 minutes in the fourth instar.

The treated eggs, treated larvæ, and eggs from known crosses of the moths irradiated as pupæ were placed in separate nets on wild cherry (*Prunus serotina*) growing under relatively shaded, open forest conditions. It was thus possible to eliminate the influence of abnormal conditions of humidity and temperature, unusually high CO_2 concentration, lack of the full solar spectrum, and lack of sufficient leaf material properly placed to permit normal spinning and stemming of the cocoon, all of which, as Pictet,[10] Linden,[11] and others have indicated in part, may contribute quite markedly to the production of physiological abnormalities. The most unnatural condition present was the high concentration of individuals in a relatively small volume, a defect which it is hoped to remedy in the future by the enclosure of a much larger leaf area. In addition to the field material, sample groups subjected to the same x-ray treatment were propagated in glass jars. Abnormalities shown by this lot paralleled those appearing in the field group, and neither showed any variations not exhibited by the other. It was necessary in several cases to resort to progressive feeding in the nets toward the end of the larval period. Care was taken, however, to insert branches with attached leaves in each case. Ichneumonid parasites were attracted to the nets in large numbers, as might be expected, and a small proportion of the larvæ, resting near enough to the nets to be punctured, fell victim to them. It was of course easy to distinguish this cause of death from others, because of the mature larvæ or pupæ of the parasites associated with the hosts.

EFFECTS NOTICED

Lethal Dosage.

But one moth of the thirty given a treatment as high as 32 minutes as young pupæ failed to emerge, although one extreme pathological case will be mentioned below. There were no failures of eclosion among the five individuals given 16- and 32-minute treatments shortly before maturity. It may be concluded fairly certainly that, even at this surprisingly high energy input, the lethal limit for pupæ had not been reached. It might seem probable that this very considerable resistance was due principally to the relative transparency of the pupæ to such "hard" radiation, consequent upon the low density of the material and the fact that it is composed of elements of low atomic number. A relatively small proportion of the incident energy quanta would thus be utilized in the liberation of electrons within the tissues of the pupæ, the majority passing through unfiltered. Parallel experiments with certain bulbous plants, however, have fixed the limit of tolerance under identical conditions at nearly

10 Arch. Sci. Phys. Nat. xvii, pp. 110–12.

11 C. R. Ac. Sci., cxli, pp. 1258–60.

one-eighth the maximum energy here applied, so that other phenomena are believed to be involved.

Of the eggs rayed early in embryonic development for 4 minutes, 90 per cent hatched. At 8 minutes, the hatched eggs totaled 80 per cent; at 16 minutes, 80 per cent; and at 32 minutes, 50 per cent. Of the eggs rayed when nearly mature, 80 per cent eclosed at 4 minutes, 90 per cent at 8 minutes, 100 per cent at 16 minutes, and 80 per cent at 32 minutes. Here again it must be concluded that the limit of tolerance was by no means reached. It is believed, however, that a delayed destructive action was present, due probably to injury to imaginal generative cells and even to earlier developmental centers. Thus 20 per cent of the larvæ from eggs rayed for 4 minutes in the early period failed at the first moult, while 30 per cent of those given higher dosage failed at this time. Usually the skin was never shed. Occasionally a moult was completed, but the resulting individual was diminished and imperfectly marked, and usually perished without ridding itself of the mask.

The young larvæ given treatments of 2, 4, 8, 16, and 32 minutes in the first instar, though suffering some losses, survived and pupated in sufficient numbers to indicate that the limit of tolerance was not exceeded. All of the larvæ irradiated for 64 minutes in the second instar perished within ten days of treatment, mostly failing at the third moult. The lethal limit may have been exceeded, but this result should be confirmed.

Adult females were given exposures as high as 64 minutes without apparent immediate injury. An 8-minute dose, however, though neither delaying fertilization nor apparently shortening the life of the individual, completely inhibited laying.

Sterility.

All of the females rayed for 16 and 32 minutes shortly before emergence proved sterile. Of 629 eggs deposited by three females rayed for 16 minutes and one for 32 minutes, all failed to hatch, and no trace of embryonic development was seen in those examined. On the other hand, but one female of those rayed as young pupæ proved sterile in this way. In this case also the eggs, 150 in number, showed no trace of development. All of these individuals appeared perfectly normal, and all were mated to wild males. It is interesting that males rayed as young pupæ were found fertile, so far as tested. Thus of 723 eggs fertilized by gametes from four males treated to high exposures as young pupæ, 572 enclosed perfect young larvæ, while 34 developed to the point of emergence but were unable to escape from the shell —a condition obtaining likewise in a certain proportion of the control ova.

Abnormal Development of Tubercles in Larvæ

A curious effect, which appeared rather commonly in x-rayed material, but foreign to the writer's experience with normal larvæ and of which no mention has been found in a rather incomplete literature search, may be mentioned. Normally, in the next to last instar of the larva of *C. promethea* (fourth or fifth stage, the moult number being variable), two pairs of tubercles, on the second and third body segments, and a single one medianly located on the eleventh segment, are specialized to considerable size, the remainder being reduced. The color of the specialized structures is usually bright yellow, ringed with black at the base, but, especially if the number of instars is five, the anterior ones may be orange. The reduced tubercles are black. In the final moult, the specialized tubercles become bright red in color on the thorax, and of a brighter yellow on the abdomen. The black rings at the base become deepened, and the length is increased, approximating 3.2 to 4.0 mm. The remaining tubercles are very markedly reduced, becoming mere black dots, scarcely raised above the level of the blue-green integument.

Among the larvæ hatching from eggs which had been treated for 2 minutes a short time before emergence were two which in the final instar bore another pair of specialized "horns" on the fourth body segment, symmetrically placed with the normal thoracic group, of the same form but slightly shorter. They were of the orange color sometimes assumed by the thoracic tubercles in the instar before the last, and ringed with black. Clearly the normal reductional development of setæ had been reversed, and at larval maturity these tubercles were in a condition corresponding to that of the normal thoracic appendages at the penultimate instar. Two larvæ were found among those arising from eggs rayed for 32 minutes just before hatching which at maturity bore extra enlarged tubercles of the bright yellow color normally shown by the abdominal horn, and likewise ringed with black. One individual bore a single extra pair of these, symmetrically placed behind the red ones, considerably smaller, and not entirely yellow. The other bore six supernumary horns, the largest pair being nearly the size of the red ones and symmetrically placed behind them, the remainder being distributed laterally on the thoracic segments. All were of bright yellow color, ringed at the base.

It is very interesting that the same modification was found among larvæ whose parents were irradiated as pupæ, and one such modification was found in a mature larva one of whose parents was treated as a larva in the first instar, but had not itself shown the peculiarity. In this case the specialization of the extra pair took place in the moult before the last, so that the insect bore a total of seven horns, all equally yellow. In the final moult, however, only the normal four thoracic tubercles became red. Whether this modification is of genetic significance or represents merely a somatic change remains to be tested.

Pupation without Cocoon, and the Formation of Microcephalic Pupæ

A considerable number of larvæ, at the close of the last instar, attempted to pupate naked. A certain proportion was successful, but the greater number failed. All those which succeeded formed abnormal pupæ, varying in degree of deformity. Certain abnormalities, notably a sticking of the larval skin and displacement of the appendages, seemed clearly to be purely a mechanical result of the lack of cocoon, paralleling the deformities commonly seen in untreated pupating Saturniid larvæ when removed from cocoons. A uniform tendency to microcephaly, with reduction of the antennæ, was evident, which suggested the phthisergate pupæ of the ant *Pheidole instabilis* described by Wheeler[12] as due to the parasitism of *Orasema viridis,* and recalled Zang's[13] note of a Lepidopterous pupa with a larval head. It was at first thought to be mechanically correlated with the lack of cocoon, but the discovery of a perfectly cocooned pupa showing the same character suggested it to be a result of de-

[12] Ants, Their Structure, Development, and Behavior, p. 416.
[13] Allg. Zeitschr. Ent., ix, p. 224.

ficiency of formative material in the larva. The viability of such pupæ is on the whole poor, but a sufficiently large number will probably survive to investigate the matter further.

Several of the larvæ which pupated naked spun no cocoon. A single individual, supplied with an abundance of suitable leaves, was carefully watched to be certain that an unsuitable environment was not responsible for the modification. The insect ceased feeding, wandered normally, and selected a leaf for spinning. The leaf was covered with a thin layer of silk, and the stem normally enclosed. At this point the sericteries were obviously exhausted, and although the larva attempted to continue spinning for several days, it was unable to do so. It then remained quiet, gradually contracted, and finally fell to the ground. A number of such slight attempts at cocoons were found in nets containing naked pupæ. In these cases the difficulty was clearly merely a lack of available silk, and might be guessed to be purely pathological, although an attempt will be made to check the inheritance of the character.

Another set of cases, yielding the same final result, was not so clear. Here a perfect, though usually rather thin, cocoon was spun enclosing the larva. Later the larva, while still able to move, escaped from the case, wandered off, and finally pupated. It is possible that this represents a more significant change of habit rather than structure. It may be correlated with certain apparently stemless cocoons which were found but of which little can be said at the moment. That peculiarities of cocoon structure may be heritable factors is strongly indicated by the work of Sasaki[14] and Kellogg[15] with *Bombyx.* That Saturniid moths may occasionally pupate without cocoon, as described by Paravicini[16] for *Saturnia pyri* is well known, but the attending circumstances do not seem to be well worked out.

Miscellaneous Variations.

There are included here several variations which are believed to be purely pathological, but on which inheritance tests will be made, and which seem worth inclusion.

A rounding of the wing apices, associated with markedly de-

[14] Tokyo Ni. Sanshi. Kw. Ho., pp. 887–8, 1917.
[15] Sci., May 19, 1911.
[16] Boll. Scient., xxi, pp. 75–9.

ficient scaling, was noticeable in two females irradiated as early pupæ. One of these lacked the discal spots of the primaries normally present in the female, the antemedial line being carried out abnormally far to include this area. Deficient scaling in the Saturniidæ is not an uncommon occurrence normally, although its frequency is of course far below that indicated in this popupation. The condition was carried to an extreme not normally seen in one case, however. A female, heavily treated as a young pupa, emerged considerably later than the normals practically devoid of scales, so that the predominating color on both body and wings was the yellow of soft chitinous tissue. The antennæ were abnormally large and one pair of legs entirely functionless. The wings were partially expanded shortly after emergence, strongly suggesting the Sphingidæ in their shape. Throughout life the insect continued to attempt to emerge from the cocoon which it had already escaped, the primary wings being moved so as to bring the costal margins into position for forcing open the valve, accompanied by a repeated peristaltic action of the abdomen. Nevertheless the insect attracted a wild male from a considerable distance and was outcrossed to wild stock. It failed to lay, however. A male was eclosed from stock one of whose parents had been x-rayed as a first-instar larva, which was perfectly normal except for the fact that one-half of the apical ''ocellus'' marking of the primaries was uncolored, the area being perfectly defined but white. Such abnormalities of eyespot pigmentation are not rare among Saturniids, and appear to be somatic modifications.[17]

It is planned to investigate several of these variations both genetically and cytologically, in addition to which irradiation work will be continued in the hope of producing further interesting modifications, especially in relation to male coloration. It is hoped to investigate the nature of this character and to check gross chromosome deformities such as deletion and non-disjunction in *C. promethea–C. angulifera* crosses. It is further planned to include *Actias luna* in the work as excellent material which, though highly variable individually, shows little evidence of sexual dimorphism in wing coloration.

[17] Ent. News 24, pp. 337–8. Ent. 42, p. 224. Bateson—Materials for the Study of Variation, pp. 26, 289, 301, 302.

THE LOCALITIES OF T. L. MEAD'S COLLECTION OF BUTTERFLIES FROM COLORADO IN 1871

BY F. MARTIN BROWN

During the summer of 1871, Theodore L. Mead accompanied the Denver party of the Wheeler Survey as a collector. The material he gathered was determined and described by his father-in-law William H. Edwards and by Samuel H. Scudder. Most of the original descriptions give the type localities merely as "Colorado." At the present state of taxonomy it is necessary to have more precise localities in a state that varies as much as Colorado—ranging from Sonoran to Alpine fauna. One of the tasks before us is to determine more accurately, if possible, the localities visited and the species collected by these early collectors in this state.

After thoroughly studying Mead's report and the reports of the various officers for the year of 1871, I find that it is possible to designate with accuracy the localities for Edwards' types in all cases but three, *Argynnis alcestris, Phyciodes camillus* and *Phyciodes emissa.* In the case of four species, *Anthocharis julia, Argynnis meadi, Cercyonis charon* and *Cercyonis meadi* Edwards states the type localities precisely. For the remaining seventeen species I have been able to allocate type localities. In order to do so, it has been necessary to arrange a schedule of Mead's travels for the summer, map the old stage routes and know the present ranges of the various species in the region traversed by Mead. Nowhere have I been able to find an itinerary of Mead in published form. I have built my schedule of his travels from his notes under the various species in his reports. In these he gives definite localities for thirty-odd days between June 1st and September 20th. Knowing approximately how fast he could travel in a day, it has been not a difficult task to map his progress with some measure of accuracy.

Apparently Mead collected around Denver during the first few days in June, probably leaving there June 5th and travelling about twenty miles to the junction of Turkey Creek and South

Turkey Creek, where he collected on June 5th and 6th. The next definite date is the tenth at Fairplay, about 65 miles southwest. Since half of the route lay through the rugged foothills, it is probable that the journey took two and a half to three days. In the saddle it could be done in two days of steady riding. He probably arrived in Fairplay sometime on the ninth. Here he stayed about 10 days, dividing the time between collecting in the vicinity of Fairplay and South Park. On June 20th he collected in the latter locality, and on the twenty-third was back at Turkey Creek Junction, where he collected on that day and the succeeding ones. He then turned back toward Fairplay and collected at Kenosha House on the twenty-ninth. This is about two days' ride from Turkey Creek Junction, so that he must have left there no later than the morning of the twenty-seventh. It may be that between the twenty-fourth and the twenty-seventh he journeyed to headquarters (Denver) and back again. He had ample time to do so. The next place and date that we have is the divide between the Arkansas and the South Platte on July 8th. At that time there were two routes over the divide toward Twin Lakes, the next stop. One via Western Pass, the other via Mosquito Pass. Each crosses the Mosquito Range or, as it is sometimes called, the South Park Range. They are about ten miles apart. A lead in the discussion under *Colias meadi* makes it certain that the journey was made over Mosquito Pass. Mead states that he collected the specimens on the divide between Fairplay and California Gulch. California Gulch is at the west foot of Mosquito Pass and Western Gulch at the west foot of the pass bearing that name. He spent the next 10 days in the vicinity of Twin Lakes collecting there, on the prairies to the south and east, and on La Plata Peak and Mt. Elbert. Though he does not name these mountains his descriptions are sufficient to clinch their identities. As a matter of fact, at that time I believe they were nameless. On the nineteenth or twentieth he left this region and went back over the same pass, collecting at the summit on July 21st and 22d. From there he went back to Denver, arriving there at the close of the month. Although there is nothing said about a return to Denver, he next journeyed to Georgetown. The most feasible route there led through Denver.

It is probable that before leaving the Fairplay region he climbed Mt. Lincoln and collected the Mt. Lincoln specimens about July 25th. From the fact that he first took *C. meadi* on Mosquito Pass and later on Mt. Lincoln eliminates his working that mountain at the earlier stay in Fairplay, and his next return was too late in the season for the species. His arrival at Denver may be set about the twenty-ninth or thirtieth. From there he set out for Georgetown via Central City and collected on August 3d in Apex Gulch south of the present mining town of Apex. He must have arrived at Georgetown on the fourth, since he climbed and collected on Grey's Peak the next day. He spent about 10 days in the region of Georgetown. On the sixteenth he collected on Clear Creek near Berthoud Pass, probably spending two days on that stream. The next definite point we have is Idaho Springs on the nineteenth. The following day he was near Denver, and we may take it that he visited that city for several days. He now turned back to the South Park region. Since he arrived at Bailey's Ranch on the twenty-sixth, he left Denver no later than the twenty-fourth. Here he stayed until September 2d. The next date we have is September 20th in Canon City. He may have

GAZETTEER

Locality	*County*	*Topographic Sheet*	*Latitude*	*Longitude*	*Altitude*
Apex Gulch	Gilpin	Central City	39 51′ N	105 34′ W	9200′–9900′
Bailey's Ranch	Park	Platte Cannon	39 25′ N	105 29′ W	7900′
Berthoud Pass	Clear Creek and Grand	Fraser	39 48′ N	105 45′ W	11200′
Beaver Creek	Park	Leadville	39 15′ N	106 00′ W	9500′–12000′
California Gulch	Lake	Leadville	39 14′ N	106 15′ W	10000′–11000′
Fairplay	Park	None	39 11′ N	105 55′ W	9500′
Georgetown	Clear Creek	Georgetown	39 42′ N	105 42′ W	8500′
Gray's Peaks	Summit and Clear Creek	None	39 24′ N	105 55′ W	14341′
Idaho Springs	Clear Creek	Georgetown	39 44′ N	105 31′ W	7600′
Kenosha (House)	Park	None	39 20′ N	105 45′ W	9000′
LaPlata Peak	Chaffee	Leadville	39 00′ N	106 25′ W	14332′
Mt. Elbert	Lake	Leadville	39 07′ N	106 26′ W	14430′
Mt. Lincoln	Park	Leadville	39 21′ N	106 07′ W	14297′
Mosquito Pass	Park and Lake	Leadville	39 17′ N	106 11′ W	13188′
Twin Lakes	Lake	Leadville	39 05′ N	106 20′ W	9300′
Turkey Creek Jct.	Jefferson	Denver Mt. Parks	39 36′ N	105 13′ W	6900′

gone back to Denver and down via Colorado Springs, but I believe not. He mentions that two weeks before the twentieth, frosts had stopped the collecting in South Park. That would indicate that he probably worked from Bailey's on into the Park and south through the present towns of Hartzel, Howbert and Cripple Creek to Canon City and Pueblo. I believe that Pueblo was the disbanding point for the year of 1871.

Although there is considerable surmise in the above itinerary, it is hung on a mesh of fact and an intimate knowledge of the region. Mead's personal journal, if in existence, could set its inaccuracies aright.

COLORADO TYPE LOCALITIES OF EDWARDS' SPECIES COLLECTED BY MEAD

Anthocharis Julia Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, pp. 61–63. Mead, Report of the Wheeler Survey V, Chap. VIII, p. 748, 1875.

Taken in the woods and on the banks of the Beaver Creek near Fairplay, Park Co., altitude 9500 feet, on June 12–14, 1871, according to Mead, or June 9–11, according to Edwards.

Colias meadi Edwards. Trans. Amer. Ent. Soc. III, March, 1871, pp. 267–268. Mead, Wheeler Survey, p. 750.

There is something curious about the date of publication of this description. The signature is dated March, 1871, on page 269. However, in the description of *A. olympia* on page 267, Edwards states that the specimen described was taken in April, 1871, and that the next specimen of *A. olympia* came from Texas. The March dating is rather puzzling unless the Transactions was post-dated by several months. If so, is the *meadi* material from the Wheeler Survey or not? I believe that the Wheeler Expedition was Mead's first Colorado collecting. Although Edwards does not acknowledge Mead as the collector of the type specimens, as he usually does, the fact that he used Mead's name is rather strong evidence that he was the collector. If the Wheeler Survey material is the type series, then the type locality is with very little doubt Mosquito Pass. Mead in his report states that it was collected first on July 8th on the Arkansas divide between

Fairplay and California Gulch. In addition, material was taken on Mt. Lincoln (July 25th?) and Grey's Peak August 5th.

Argynnis alcestis Edwards. Trans. Amer. Ent. Soc. V, December, 1876, pp. 289–291. Mead, Wheeler Survey, p. 752 (*A. aphrodite*).

Neither Edwards nor Mead gives us any light upon the precise locality of the Colorado types. They may have come from any of the localities below 9500 feet and above 6500 feet from data I have on its distribution.

Argynnis halcyone Edwards. Butt. N. A. 1, 81, p. 28. Mead, Wheeler Survey, p. 754.

Southern border of South Park, Park Co., probably early in September along the road from Hartzel east to Howbert. The altitude varies a few feet above 7600 feet. A great area of marsh lands that constitute the southwestern headwater of the South Platte. A female from Cañon City, Fremont County, September 20th, altitude about 5400 feet on the Arkansas River as it leaves the Royal Gorge. Cañon City is on the topographic sheet of the same name. No sheets have been issued of the South Park region.

Argynnis meadi Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, pp. 67–68. Mead, Wheeler Survey, p. 755.

Taken at Turkey Creek Junction, Colorado, June 6, 1871. There are several score Turkey Creeks in Colorado. By arranging a time table of the definite localities tied to definite dates, I have come to the conclusion that the stream in question is the Turkey Creek just south of Morrison, near Denver. The precise locality of the female type is probably the junction of South Turkey Creek with Turkey Creek, a few miles up in the foothills.

Argynnis eurynome Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, pp. 66–67. Mead, Wheeler Survey, pp. 755–756.

The type series came from Fairplay, South Park, Middle Park and California Gulch in 1871. From what I know of its distribution, I doubt if any of the specimens were taken much under 9000 feet, which centers the type locality about Fairplay, Leadville, and Dillon, covering both slopes of the Continental Divide in the vicinity of Hoosier Pass. Edwards broadly states that Mead found it common throughout Colorado; Mead restricts its range in his notes to the four localities mentioned and adds Twin Lakes for the season of 1873.

Argynnis artonis Edwards. Trans. Amer. Ent. Soc. IX, February, 1881, pp. 1–2. Mead, Wheeler Survey, pp. 755–756 (*eurynome* in part).

Mead mentions a single specimen of *eurynome* lacking the silvery spots from California Gulch, Lake Co. Edwards mentions that Mead took three or four specimens in 1872, of which Mead makes no mention. So California Gulch may be taken as the locality of the Colorado type.

Brenthis helena Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 268. Mead, Wheeler Survey, p. 757.

Although Mead gives no definite locality, several things that he states in his notes confine the type locality of this species to the same region as that of *Colias meadi*. Two statements are indicative: ''It inhabits the highest peaks,'' and ''until the first of August.'' From the schedule of his collecting it will be seen that during July he collected in the region of the range north and west of Fairplay and about Twin Lakes. He mentions climbing a mountain in the region of Twin Lakes that sounds very much like Mt. Elbert, the highest in the state. It is quite probable that his specimens come from Mt. Elbert, Mosquito Pass, Mt. Lincoln and Hoosier Pass.

Militea eurytion Edwards. MSS. Mead, Wheeler Survey, p. 759.

Mead does not give us anything definite about the localities in which he collected this species. He states that it was found with *nubigena*. That species he found common in the mountain areas during June and July. I have found the species in the mountains up to tree line (11,500–11,800) during these months. From this I should place the type localities as Twin Lakes, California Gulch, Fairplay and probably Kenosha. Probably not at Turkey Creek Junction.

Militea calydon Edwards. MSS. Mead, Wheeler Survey, p. 760. Turkey Creek Junction, Jefferson Co., 6900 feet, June 20–30, 1871.

Phyciodes camillus Edwards. Trans. Amer. Ent. Soc. III, March, 1871, pp. 268–269. Mead, Wheeler Survey, p. 764.

Nothing definite is possible concerning the type localities of this species.

Phyciodes emissa Edwards. Trans. Amer. Ent. Soc. III, March, 1871, pp. 269–270. Mead, Wheeler Survey, p. 763 (a note in the discussion of *P. mata* Reakirt).

The same as *P. camillus.*

Grapta hylas Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, pp. 68–69. Mead, Wheeler Survey, p. 768.

The first specimens were taken August 16, 1871, near Berthoud Pass, with little doubt on the southern slope. The others of the type series from a point about 20 miles from South Park on the South Park road, August 28, 1871. This would be about half way between the present towns of Bailey and Kenosha.

Satyrus charon Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, p. 69. Mead, Wheeler Survey, p. 773.

First taken near Twin Lakes, Lake Co., on July 9th. Later both in South and Middle Parks. The elevation given by Edwards, 8000 feet, is a little low. The topographic sheet shows Twin Lakes as 9300 feet and the surrounding plains to the Arkansas River drop to about 9000 feet.

Satyrus meadii Edwards. Trans. Amer. Ent. Soc. IV, March, 1872, p. 70. Mead, Wheeler Survey, p. 774.

The entire type series was collected at Bailey's Ranch on the South Park road. This is now the town of Bailey, Park Co.

Erebia rhodia Edwards. (*Erebia epipsodea* Butler). Trans. Amer. Ent. Soc. III, March, 1871, pp. 273–274. Mead, Wheeler Survey, p. 775.

Type locality Fairplay.

Erebia tyndarus callias Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 274. Mead, Wheeler Survey, pp. 775–776.

The type localities for this race appear to be the same as for *Colias meadi,* and in addition probably Mt. Elbert and LaPlata Peak just to the south of it.

Thecla ninus Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 270. Mead, Wheeler Survey, p. 778.

"Taken on willow blossoms on the South Park road four miles from the park on the seventeenth of June," 1871. This places the type locality near Kenosha.

Chrysophanus sirius Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 270. Mead, Wheeler Survey, p. 781.

Twin Lakes is the locality of the major portion of the type series. They were taken July 12 and 13, 1871. Three other localities are mentioned, Mt. Lincoln, South Park and Middle Park.

Lycæna melissa Edwards. Trans. Amer. Ent. Soc. V, 1873, pp. 347–348. Mead, Wheeler Survey, p. 783, Plate 36, Figs. 5–8.

Edwards states that the type series from Colorado were taken during 1871. Mead gives Fairplay as the probable locality for the 1871 series.

Lycæna daunia Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 272. Mead, Wheeler Survey, p. 785.

Turkey Creek, Jefferson Co., Colorado, last week in June, 1871.

Lycæna alce Edwards. Trans. Amer. Ent. Soc. III, March, 1871, pp. 272–273. Mead, Wheeler Survey, p. 783 (*L. isola* Reakirt).

Turkey Creek, Jefferson Co., late in June, and Georgetown, Clear Creek Co., middle of August.

Polites draco Edwards. Trans. Amer. Ent. Soc. III, March, 1871, pp. 274–275. Mead, Wheeler Survey, p. 790.

Mead mentions three localities from which *draco* was taken by the Wheeler Survey. Of them, only one is in Colorado—Twin Lakes. Edwards' original description mentions only Colorado. So the type locality is definitely fixed as Twin Lakes, Lake Co., Colorado.

Thymeticus hylax Edwards. Trans. Amer. Ent. Soc. III, March, 1871, p. 274. Mead, Wheeler Survey, p. 788 (*Oarisma garita*).

Mead's material was taken in South Park and at Twin Lakes, Colorado.

Two manuscript names of Edwards, *M. eurytion* and *M. calydon,* are used by Mead. Edwards does not list either of them in his catalogue of February, 1877.

NOTES ON AMERICAN NEMESTRINIDAE, SECOND PAPER

By J. Bequaert
Department of Tropical Medicine, Harvard University Medical School, Boston, Mass.

Subfamily **Nemestrininae**

Neorhynchocephalus Lichtwardt, 1909

The discussion of this genus in my earlier paper (1930, Psyche, XXXVII, pp. 286–289) followed common usage in regarding *Rhynchocephalus tauscheri* Fischer as the genotype of *Rhynchocephalus* Fischer. I have shown since (1932, Zool. Anz., C, p. 20) that this is erroneous. It had been overlooked that *Rhynchocephalus* was proposed by Fischer von Waldheim as a monotypic genus for *Rhynchocephalus caucasicus* Fischer, in the first edition of the "Mémoires de la Société Impériale des Naturalistes de Moscou" (vol. I), published in 1806. In the second edition of this same volume, which appeared in 1812 or 1813 (although the title-page is dated 1811), we find for the first time the description of *Rhynchocephalus tauscheri.* Obviously, the name *Rhynchocephalus* must be used for any group containing *R. caucasicus,* a species which is now placed in *Nemestrinus* Latreille. I have proposed retaining *Rhynchocephalus* for a subgenus containing species allied to *caucasicus.*

The next available name for the so-called "*Rhynchocephalus*" of authors is *Neorhynchocephalus* Lichtwardt, 1909 (genotype as designated by me in 1930: *Rhynchocephalus volaticus* Williston, 1883). After studying all the known species of this group, I feel there is no justification for separating, even subgenerically, the North American *N. volaticus* from the European *N. tauscheri.* I include both, as well as their relatives, in *Neorhynchocephalus,* as listed below. The distribution is conspicuously discontinuous; but it is noteworthy that as yet no species are known from South Africa and Australia.

1. *N. mendozanus* (Lichtwardt). South America.
2. *N. sackenii* (Williston). North America.

3. *N. sulphureus* (Wiedemann). South America.

4. *N. tauscheri* (Fischer) (= *Rhynchocephalus tauscheri* Fischer, 1812 or 1813; *Volucella taurica* Pallas, 1818; *Rhynchocephalus lativentris* Portschinsky, 1887). I have seen this species from southern Russia, northern Persia, the island of Rhodus, Tunis, and southern Spain.

5. *N. vitripennis* (Wiedemann). South America.

6. *N. volaticus* (Williston). North America.

The only reliable characters separating *Neorhynchocephalus* (as here delimited) from all species of *Nemestrinus* Latreille are the flattened or slightly convex face (in *Nemestrinus* always considerably swollen and often snout-like) and the long, sabre-shaped ovipositor of two slender curved valves (in *Nemestrinus* the ovipositor is telescope-shaped, of several retractile segments, the two terminal valves short and broad). Neither the venation of the wing, nor the direction assumed by the proboscis are diagnostic. Some species of *Nemestrinus* (of the subgenus *Rhynchocephalus* Fischer; type, *N. caucasicus*) have the venation exactly as in *N. volaticus*. In most specimens of *Neorhynchocephalus* the proboscis is either directed downward or slanting backward; but I have seen many specimens of *N. volaticus* in which it slants forward. On the other hand, I have seen examples of *Nemestrinus fasciatus* (Olivier), in which the proboscis is directed vertically downward. In *Neorhynchocephalus* the frons below the ocelli is always considerably narrower in the male than in the female; the eyes being almost holoptic in the males of certain species. Although in most species of *Nemestrinus* the frons is not conspicuously narrowed in the male, in others, such as *N. hirtus* Lichtwardt and *N. ruficaudis* (Lichtwardt), the frons of the male is relatively as narrow as in certain *Neorhynchocephalus*.

The following, revised key separates the six known species of *Neorhynchocephalus*.

1. Palearctic species. Base of fourth posterior cell broad, touching the anal cell over a long stretch, the lower margin running nearly parallel with the upper margin; diagonal vein as a rule not extending beyond the second and fourth posterior cells. Frons of female about half as wide at vertex as at insertion of antennæ; of male distinct below the ocelli where it is about one-eighth as wide as at antennæ. Fringes of pale yellow hairs forming distinct apical bands on the tergites of the abdomen. Length, 11 to 14 mm. .... *N. tauscheri* (Fischer).

American species. Base of fourth posterior cell either stalked or very narrow and barely touching the anal cell .... 2.

2. Two branches of fourth longitudinal vein as a rule united far from the costa, the second posterior cell closed and connected with the margin by means of a stalk (exceptionally closed just as margin or narrowly open); diagonal vein almost always extending beyond the second and fourth posterior cells, usually reaching the hind margin. Frons of female slightly narrowed above, about two-thirds as wide at vertex as at insertion of antennæ; linear below the ocelli in the male. Integument of abdomen wholly black. Length, 6 to 10 mm. (North America) .... *N. sackenii* (Williston).

Two branches of fourth longitudinal vein usually ending freely in the costa, some distance from each other (exceptionally meeting in one point; or upper branch of fourth united with lower branch of third, so that the first posterior cell is closed) .... 3.

3. North and Central American species. Body covered with pale yellowish pile; abdomen black or blotched more or less extensively with yellowish red; tergites with more or less distinct, white apical fringes; small tufts of black hair on the sides of third and fourth tergites .... 4.

South American species (south of the Equator). Legs uniformly pale colored, dirty yellow to reddish yellow. Abdominal tergites without distinct, white apical fringes .... 5.

4. Frons of female much narrowed above, about half as wide at vertex as at insertion of antennæ; of male linear, the inner orbits nearly touching over some length below the ocelli. Diagonal vein almost always extended beyond second and fourth posterior cells, usually reaching the hind margin. Legs pale yellowish to brownish, tibiæ and tarsi (especially of hind legs) darker than femora. Length, 8.5 to 14 mm. .... *N. volaticus* (Williston).

Frons of female slightly narrowed above, at vertex about five-sevenths of the width at insertion of antennæ. Diagonal vein extended only as a stump beyond second and fourth posterior cells, not reaching hind margin. Legs yellowish brown, femora mostly black. Length, 11 mm. (Male unknown) .... *N. mexicanus* J. Bequaert.

5. Diagonal vein not extending beyond the second and fourth posterior cells. Frons broad in both sexes; in the female scarcely narrowed toward the vertex where it is wider than an eye; in the male nearly two-thirds as wide below the ocelli as at the insertion of the antennæ; ocelli in a flattened triangle, the hind ocelli more than twice as far apart as their distance from inner orbits. Head, thorax, legs and abdomen densely covered with long, bright sulphur yellow pile; no or very few black hairs on the sides of the tergites. Length, 8 mm.
N. mendozanus (Lichtwardt).

Diagonal vein always extended beyond the second and fourth posterior cells, usually reaching the hind margin. Ocelli in an equilateral triangle in both sexes. Tufts of black hair on the sides of the abdominal tergites long and conspicuous .... 6.

6. Female: Head, thorax and legs densely covered with long bright sulphur yellow pile; vertex with black hairs. Wings distinctly infuscated at the extreme base. Frons slightly narrowed toward the vertex where it is over three-fourths as wide as at the insertion of the antennæ; posterior ocelli about as far apart as their distance from inner orbits. Length, 8 to 10 mm. .... *N. sulphureus* (Wiedemann).

Male: Head, thorax and legs covered with pale yellowish or white pile; vertex with black hairs. Wings sub-hyaline throughout, at most slightly yellowish at the base. Frons narrowed but distinct below the ocelli, where it is about one-fourth as wide as at the insertion of the antennæ. Length, 8 to 11 mm. . . . *N. vitripennis* (Wiedemann).

Neorhynchocephalus volaticus (Williston)

Text Figure 1 *E–G*

See Psyche, 1930, XXXVII, p. 290. Additional references:

Rhynchocephalus volaticus Hunter, 1914, Kansas Univ. Sci. Bull., VIII (1913), p. 19. Curran, 1931, Canad. Entom., LXIII, pp. 69 and 72.

Rhynchocephalus maculatus Curran, 1931, *Ibidem,* LXIII, p. 69 (♂ ♀; type locality: Lawrence, Kansas; also from Sumner Co. and Waubaunsee Co., Kansas).

Rhynchocephalus flavus Curran, 1931, *Ibidem,* LXIII, pp. 69 and 70 (♂ ♀; type locality of male, holotype: Harper Co., Kansas; of female, allotype: Sumner Co., Kansas; also from Bourbon Co., Cherokee Co., and Waubaunsee Co., Kansas).

ADDITIONAL SPECIMEN; EXAMINED.—KANSAS: Atchison Co., forty-one males and thirty-three females (R. H. Beamer), and one male (D. A. Wilbur); Morris Co., twenty-eight males and forty-three females (R. H. Beamer); Medicine Lodge, Barber Co., two females and one male (G. P.Engelhardt); Leavenworth Co., one female (R. H. Beamer); Onaga, Pottawatomie Co., one male (R. H. Beamer); Riley Co., two males and one female (R. H. Beamer); Cowley Co., 1114 ft., one female (R. H. Beamer); Doniphan Co., two males and two females (R. H. Beamer); Saline Co., one male (R. H. Beamer); Dickinson Co., one female (L. C. Woodruff); Manhattan, Riley Co., seven males and five females (R. H. Painter); Pottawatomie Co., one female and one male (R. H. Painter).—OKLAHOMA: Arbuckle Mts., Murray Co., one male (R. H. Beamer).—FLORIDA: Sanford, Seminole Co., one female (R. H. Beamer); Wildwood, Sumter Co., fourteen males and eleven females (Paul W. Oman and R. H. Beamer).—MISSOURI: Hollister, Taney Co., one female (G. P. Engelhardt).—ARIZONA: San Diego Canyon on the west side of the Baboquivari Mts., 25 miles southeast of Sells, Pima Co., seven specimens, including a female emerged from a pupal skin, August 1, 1932 (R. H. Painter).—TEXAS: Kingsville, Kleberg Co., one female (F. M. Hull.—M.C.Z.).

The female from Mexico City recorded in my former paper under *N. volaticus* represents an apparently distinct species and is described below as *N. mexicanus*. The Mexican specimens from Presidio River, Venodio, State of Colima, Matamoros, and Chichen Itza (Yucatan) are, however, true *N. volaticus*.

The series of over 250 specimens, collected throughout the wide range of this species, shows conclusively that it is impossible to split up this species, even into varieties or geographical races, on the basis of the characters used by Curran to separate *volaticus, maculatus* and *flavus*. ''Paratypes'' of *maculatus* and *flavus* were sent to me by the author several years ago; but I was unable to see in them anything but the very variable *N. volaticus*, and the specimens were recorded under that name in my earlier paper. Both these ''new species'' were described from Kansas and, in one case, found in the same locality. The characters invoked to separate them in Curran's key are of the ''more-or-less'' type. In the species before me it is possible to select specimens that agree with either ''*maculatus*'' or ''*flavus*''; but there are many others that combine the characters of these so-called ''species.''

Of what he calls ''*volaticus*'' Curran saw only one female type from Florida (in the Williston Collection at Kansas Univ.).[1]

[1] Williston described the species from two specimens and gave no more definite locality than ''Florida.'' Prof. H. B. Hungerford writes me that the type in Williston's collection is labelled ''Georgiana, Fla., Wm. Whitfeld,'' which is therefore the type locality. I agree with Curran that this specimen should be regarded as the holotype. The specimen marked as ''type'' at the U.S.N.M. may be the paratype, although it is only labelled ''Florida,'' while the same collection contains a specimen from Georgiana, not marked as type.

Over thirty specimens from four different localities in Florida (including the female from the type locality, Georgiana, at the U.S.N.M.), agree with specimens from Kansas, Texas, Mississippi, Mefflico, and Yucatan in the color of the pile of the second abdominal segment. The integument of the abdomen of the females of Kansas varies from wholly black to extensively reddish; and the difference in the color of the anterior four tarsi, whether "reddish" or "reddish brown" is of no practical value. If the pile of the second segment of the type of *volaticus* is actually as described by Curran ("tawny or fulvous with a reddish brown pilose band behind the middle"), it might well be abnormal, perhaps caused by some stain or dirt. At any rate, no other such specimen is known thus far, and until other specimens are collected in Florida showing this character of the type, I feel fully justified in my interpretation of *volaticus*.

N. volaticus is on the wing throughout June, July and the early part of August. The species is rather frequently seen mating. Professor R. H. Painter writes me that, in Kansas, he found most of his specimens hovering among fairly tall grass. On one occasion, in Pottawatomie Co., Kansas, a number were feeding at flowers of *Houstonia*.

The pupa found by Professor R. H. Painter, with a female emerging from it, is extremely similar to that of *Hirmoneura obscura* Wiedemann (as figured by Adam Handlirsch), of *H. exotica* Wiedemann (as seen by me at the Paris Museum), and of *Trichopsidea* (*Symmictus*) *costata* (Loew) (as figured by J. T. Potgieter, 1929, Science Bull. No. 82, Dept. of Agric., Union of South Africa, Fig. 6, *1b*). It is 25 mm. long and 5.5 mm. wide. Two slight protuberances are visible on the vertex, although they are not sharply pointed as in *H. obscura*. I can find no trace of the long protuberances ending in a curved hair, which are found on the face of the pupa of *H. obscura*; but the region between the antennal sheaths is markedly swollen. Smooth, shiny, protruding, coffee-bean-shaped spiracles protrude on each side at the limit between head and thorax, at the anterior margin of the first and about the middle of the second to seventh abdominal segments; the thoracic pair is briefly stalked, the abdominal spiracles are sessile. The abdominal segments 1 to 7 bear on each side, behind the spiracle, a transverse row of three very long, stiff setae, curved forward at their tips. In addition, dorsally and ventrally, each of these segments bears a transverse row of shorter and thinner setae placed in the posterior third on a slight ridge; many of these setae were evidently broken off while the pupa bored its way out of the soil. I can find no trace of setae on the eighth segment, but they may have been broken off on the dorsal and ventral side; certainly there are no curved setae on the sides. The ninth segment is divided into two long, conical, blunt, diverging protuberances, somewhat bent upward, but not forming hooks.

Professor R. H. Painter sends some interesting notes on finding this pupa: "I came upon this specimen about nine o'clock in the morning. The fly first attracted my attention as it was climbing up on a small weed. The wings had not yet spread and it evidently had come out of the pupa case which was lying on top of the ground just beneath the weed. The pupal case was only a foot or eighteen inches from the edge of a small stream which, I understand, was dry during a good share of the year. The locality which I have labeled '25 miles southeast of Sells, Ariz.' is in a small canyon locally known as San Diego Canyon, in the Baboquivari Mountains. The country about this locality is sparsely covered by scrub oak, mesquite, and various other chaparral plants. A few giant cacti were near by. Near the stream, the trees are somewhat larger and more plentiful. The specimen was placed in a bottle for the remainder of the morning to dry out."

Neorhynchocephalus sackenii (Williston)

See Psyche, 1930, XXXVII, p. 291. Additional references:

Neorhynchocephalus sackeni J. Bequaert, 1932, Zoolog. Anz., C, p. 33.

Rhynchocephalus sackeni Hunter, 1914, Kansas Univ. Sci. Bull., VIII (1913), p. 19. Robertson, 1928, Flowers and insects, p. 47. Curran, 1931, Canad. Entom., LXIII, pp. 69 and 72 (♀♂).

Rhynchocephalus subnitens Curran, 1931, Canad. Entom., LXIII, pp. 69 and 72 (♀).

ADDITIONAL SPECIMENS EXAMINED.—MICHIGAN: Douglas Lake, Cheboygan Co., one male (Charles Martin).—UTAH: Mt. Buncombe near Logan, Cache Co., 10,000 ft., one female (D. G. Hall).—OKLAHOMA: Lawton, Comanche Co., one male (R. H. Painter).—KANSAS: Manhattan, Riley Co., one female (R. H. Painter); Medora, Reno Co., sand hills, one male and one female (R. H. Beamer); Kiowa Co., one female (C. H. Martin); Scott Co., two males and three females (R. H. Beamer); Cheyenne Co., one male and one female (R. H. Beamer); Norton Co., one female (R. H. Beamer); McPherson Co., one female (R. H. Beamer).—ARKANSAS: Springdale, Washington Co., one female (F. M. Hull).—WASHINGTON STATE: Spanaway, Pierce Co., one female (J. Wilcox).—Mr. J. Wilcox writes me that he saw also specimens from Roy, Pierce Co., Washington; Corvallis, Oregon; and Salem, Marion Co., Oregon.—The holotype (♀) is in the Williston Collection at Kansas University.

Curran believes that *sackenii* and *subnitens* are distinguishable by the color of the hind femora and tarsi and of the style of the female. Unfortunately he does not mention the locality of the four females which he refers to *subnitens* (originally described from Kansas).[2] In the series from Kansas now before me, I find specimens that agree in these characters with some I have seen from Oregon and British Columbia.

Graham's (1932) discussion of the variation in color of the posterior tarsi and antennal style in *N. sackenii* must be disregarded, since, with one exception, all the specimens he studied were not that species, but *Trichopsidea* (*Parasymmictus*) *clausa* (Osten Sacken), as will be shown in the sequel. In my material of *N. sackenii* I find specimens with mostly black hind femora, others with the femora wholly yellowish, and some in which they are blackish in the basal half, yellowish apically; even in the darkest specimens the femora are never completely black.

Of the thirteen specimens listed above, eleven have the third submarginal cell broadly open at margin and the second posterior closed and stalked, as figured by Williston for the type. In one female from Scott Co., the right wing is normal; but in the left wing the second posterior cell is narrowly open at the margin. One male from Cheyenne Co. has the second posterior cell normally stalked in both wings; but, in addition, the third submar-

[2] Mr. Curran writes me he believes these specimens were from Colorado.

ginal cell in the left wing is considerably narrowed over its apical third, while in the right wing it ends in a long stalk.

Professor R. H. Beamer observed a female of *N. sackenii* in Scott Co., Kansas, for a half hour ovipositing in worm holes in dead Yucca. He found many eggs, which he says were in a loose mass, not adhesive. Most of the *N. sackenii* and *N. volaticus* were taken by him in meadows while hovering over flowers. It would be interesting to have a list made of the flowers visited by these flies. The only published flower record I can find is that by Robertson (1928), who took *N. sackenii* at *Achillea millefolium*, at Carlinville, Illinois.

Neorhynchocephalus mexicanus, new species
Text Figure 1 A–D

Female.—Medium-sized fly, similar in appearance to *N. volaticus.* Integument of body black. Antennæ, labrum and maxillæ of proboscis, halteres, coxæ, tibiæ and tarsi yellowish to clove brown; antennal style and apical segments of mid and hind tarsi somewhat infuscate; femora black, passing to yellowish brown in the apical fourth; apical half of claws black, basal half and pulvilli yellowish brown.

Body densely pilose, but more so ventrally than dorsally. Vertex and upper half of frons with a mixture of black and white erect hairs; remainder of head(including the beard) with white pile. Eyes bare. Dorsum of thorax mostly rubbed; the remaining hairs long, erect, pale yellowish; those at hind margin of scutellum partly black; pleura and pectus densely covered with long, erect, grayish white pile. Abdomen: first and second tergites mostly covered with long, erect, pale yellowish pile, shorter and somewhat matted down or curved back into indistinct fringes on the apical margins; on the following tergites the pile is much shorter, brighter yellow and appressed at the base as well as at the apical margin of each tergite, giving the abdomen a banded appearance; in the holotype the longer, erect pilosity of the third and succeeding tergites is very sparse (perhaps partly rubbed); extreme sides of third and fourth tergites with a small tuft of long, erect, black hairs close to base; venter completely covered with very dense, long, pale yellow, appressed hairs. The integument is entirely covered with a dull, ashy-gray pruinosity, except on the dorsum of the abdomen which is shiny.

Head (Fig. 1*C*) much flattened, much broader than the thorax, semi-elliptical in profile and from above; kidney-shaped seen in front, the height about two-thirds of the width. Frons flat and wide; inner orbits slightly converging from the insertion of the antennæ (where the frons is about as wide as an eye) to the occiput (where the frons measures about five-sevenths of the width at the antennæ). Ocellar protuberance low, flat, set off by saddle-like depressions from the inner orbits; ocelli placed in an equilateral triangle, the posterior ocelli about as far apart as their distance from the inner orbits (Fig. 1*B*). Antennæ very short (Fig. 1*D*), placed on the sides of the face a short distance from the lower orbits; basal segment slightly broader than long, truncate at apex; second slightly shorter and narrower than first; third from above subglobular and scarcely attenuated apically,

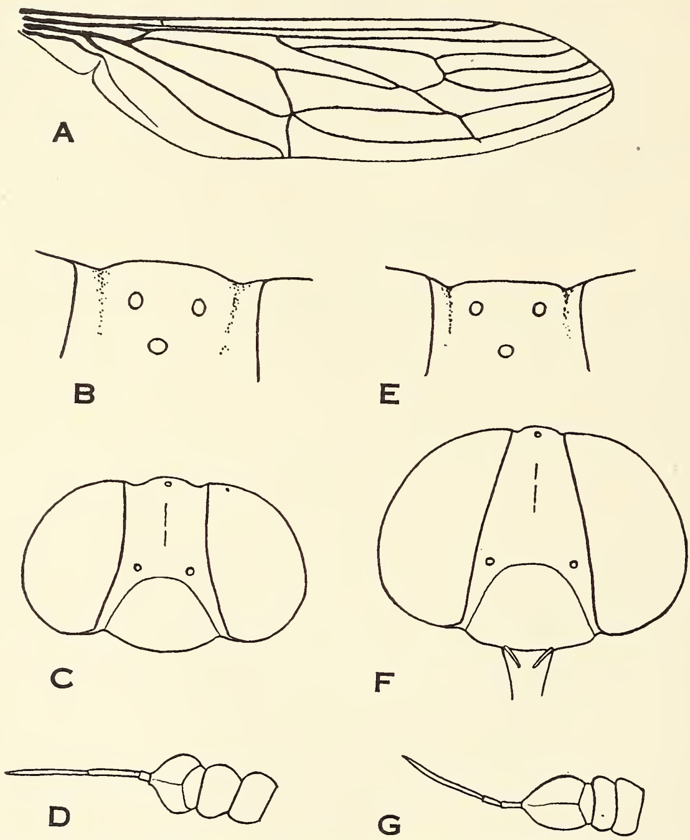

FIG. 1. *A–D, Neorhynchocephalus mexicanus* J. Bequaert, female: *A*, wing; *B*, vertex from above; *C*, head in front view; *D*, antenna. *E–G, volaticus* (Williston): *E*, vertex from above; *F*, head in front view; *G*, antenna.

somewhat flattened in profile, on the under side with a basal, transverse and a median, longitudinal groove; style short but decidedly longer than the antenna, three-jointed, the basal division very short, the second division about the length of the third. Face scarcely swollen, with a slight, median, longitudinal groove. Proboscis of medium length (flattened against pectus in holotype, the labella reaching barely beyond the hind coxæ), about one and one-third times the height of the head. Palpi short and very slender. Body very broad and thickset, somewhat flattened dorso-ventrally. Thorax distinctly broader than thick; dorsum slightly longer than wide; transverse suture marked on the sides over about one-fourth of the width of the dorsum. Scutellum large, semi-elliptical, cushion-shaped; the swollen hind margin sharply set off by a transverse, curved groove. Abdomen broad and convex dorsally, flattened ventrally. Valves of sabre-shaped ovipositor very narrow, barely widened apically, with bluntly rounded apex. Legs moderately long and stout; femora very slightly and gradually swollen in the basal two-thirds.

Wings about as long as the body, nearly four times as long as wide, hyaline throughout; veins pale yellowish brown. Venation (Fig. 1*A*) similar to that of *N. volaticus;* anal, second basal, discal, and fourth and fifth posterior cells all connected at one point; two branches of fourth longitudinal vein (M_1 and M_2) ending separately in costa, though quite close together (in right wing; left wing broken in holotype); costa very thin and in places absent along hind margin; diagonal vein not reaching hind margin, forming a very short stump beyond the lower margins of second and fourth posterior cells.

Length (not including ovipositor), 11 mm.; greatest width of abdomen, 6 mm.; length of labrum of proboscis, 3.5 mm.; length of wing, 11 mm.; width of wing, 2.8 mm.

Holotype female, Mexico City, MEXICO, August, 1918 (Juan Muller Collector.—U. S. National Museum).

This specimen was recorded in my former paper as *N. volaticus,* as it resembles that species exceedingly. However, in all the many females of *N. volaticus* I have seen the head is higher (height nearly three-quarters of the width, seen in front) and the frons is considerably narrowed toward the vertex, being there only about half as wide as at insertion of antennae (Fig. 1*E–F*); as a result the posterior ocelli are farther apart than their distance from the inner orbits. Whether the other differences mentioned in the key will stand after study of additional specimens of *N. mexicanus,* remains to be seen.

Neorhynchocephalus vitripennis (Wiedemann)

See Psyche, 1930, XXXVII, p. 294. Additional reference:

Neorhynchocephalus vitripennis J. Bequaert, 1932, Zoolog. Anz., C, p. 33 (♂).

ADDITIONAL SPECIMENS EXAMINED.—Two males, Bompland, Misiones Terr., ARGENTINA, January 13–14, 1927 (F. and M. Edwards.—British Museum).

I am by no means convinced that *vitripennis* and *sulphureus* are distinct species. It is rather puzzling that the four specimens I have seen of *sulphureus* are females, while the four specimens which agree with the description of *vitripennis* are all males. A large collection of both sexes from one locality could readily solve this problem.

Neorhynchocephalus sulphureus (Wiedemann)

See Psyche, XXXVII, 1930, p. 294. Additional reference:

Neorhynchocephalus sulphureus Lichtwardt, 1910, Ann. Mus. Nat. Hungarici, XVIII, p. 278.

ADDITIONAL SPECIMENS EXAMINED.—One female, ARGENTINA, 1904 (O. W. Thomas.—British Museum). One female, Estacion Araoz, Tucuman, ARGENTINA, January 8, 1927 (R. C. Shannon).

As indicated above, this is possibly not distinct from *N. vitripennis.*

Neorhynchocephalus mendozanus (Lichtwardt)

Rhynchocephalus mendozanus Lichtwardt, 1910, Deutsch. Ent. Zeitschr., p. 594 (♀ ♂; Mendoza Province, Argentina). Stuardo, 1930, Rev. Chilena Hist. Nat., XXXIV, p. 379 (♀ ♂) (*Ibidem,* XXXIII (1929), 1930, p. 162, fig. 30; without specific name).

SPECIMENS EXAMINED.—One female, Vila Ana, F. C. S. Fe, ARGENTINA, January, 1926 (K. J. Hayward.—British Museum). One male, Las Mercedes, Province Talca, CHILE (F. Ruiz.—Received from Professor C. Stuardo O.). One female, Angol, CHILE, November 23, 1931 (D. S. Bullock.—U.S.N.M.). One female, Colchagua Province, Chile (Edw. P. Reed).

These specimens have the wing venation exactly as figured by Professor Stuardo.

Subfamily **Hirmoneurinae**

Hirmoneura exotica Wiedemann

Hirmoneura exotica Wiedemann, 1824, Analecta Entom., p. 20 (♀; Montevideo, Uruguay); 1828, Aussereurop. Zweifl. Ins., I, p. 245 (♀). Latreille, 1825, Encyclop. Méthod., Insectes, X, p. 676. Macquart, 1834, Hist. Nat. Ins. Dipt., I,

p. 413 (♀). F. Lynch Arribalzage, 1878, Natural. Argent., I, p. 274. Brauer, 1883, Denkschr. Ak. Wiss. Wien, Math. Naturw. Kl., XLVII, Abt. 1, p. 26. Osten-Sacken, 1883, Wien. Ent. Zeitg., II, p. 114. Brèthes, 1907, An. Mus. Nac. Buenos Aires, XVI, p. 285. Lichtwardt, 1909, Deutsch. Ent. Zeitschr., p. 595 (♀). Bruch, 1917, Physis, III, p. 427, figs. 1–3 (♀). J. Bequaert, 1932, Zoolog. Anz., C. p. 16 (♀ ♂).

Hermoneura exotica Hunter, 1901, Trans. Amer. Ent. Soc., XXVII, p. 150. Kertész, 1909, Cat. Dipt., IV, p. 26.

SPECIMENS EXAMINED.—Two females in the V. v. Röder Collection, one labelled "Uruguay," the other "Brasilia." One female and one male taken *in copula*, Las Piedras near Montevideo, URUGUAY, January 19, 1903 (M. J. Nicoll.—Crawford Exp., British Museum). One female, La Plata, Prov. Buenos Aires, ARGENTINA, January 27, 1920, "en el patio de casa" (C. Bruch.—Shannon Coll.).

Whether this species actually occurs within the present political boundaries of Brazil is open to question. During the early quarter of the nineteenth century, the boundaries between Uruguay and Brazil were rather vague. The species appears to be common in northern Argentine and Uruguay.

This species belongs in the same group as the genotype, *H. obscura* Wiedemann, of Europe. First and second submarginal cells confluent (no cross-vein connecting second longitudinal vein and upper branch of third) ; no supernumerary cross-veins in the third submarginal and first and second posterior cells; alula well developed, very broad. Eyes pubescent, though with much shorter hairs than in *H. obscura*; distinctly separated in both sexes by a rather narrow frons. The species is well-known, but I have not found a description of the male.

Male (*undescribed*).—Agreeing in practically every respect with the female. Frons much narrower above, although distinctly separating the eyes; in the upper half it is nearly parallel-sided and measures at its narrowest point a little over one-third of its width at the antennæ; the inner orbits strongly divergent in the lower half of the frons (in the female, the inner orbits are very slightly diverging, the width of the frons at the antennæ being only about one and one-half times that of the upper part). Ocellar triangle slightly shorter than in the female. I find no appreciable difference in the shape of the palpi. Hypopygium small, inconspicuous.

The allotype is the male, at the British Museum, from Las Piedras near Montevideo, taken *in copula*.

H. exotica is one of the very few Nemestrinidae of which the life history is known to some extent. Carlos Bruch (1917) observed it ovipositing in deserted galleries of wood-boring insects in old fence posts. The eggs are laid fairly far inside, in groups, side by side. The further fate of the eggs was not observed. Many years ago, F. Lynch Arribalzaga (1878) claimed that *H. exotica* oviposits in the nests of a carpenter bee (*Xylocopa*); but, according to Bruch, there is no proof that this fly is a parasite of *Xylocopa*, although it may occasionally oviposit in empty burrows made by that bee. I have seen at the Paris Museum a beautiful pupal case of a *Hirmoneura* (most probably *H. exotica*) collected at Flores, Argentina, by Künckel d'Herculais. I am not aware that this entomologist ever published his observations on this insect. The pupa shows only minor differences from that of the European *H. obscura* Wiedemann.

Hirmoneura (Neohirmoneura) flavipes Williston

Hirmoneura flavipes Williston, 1886, Trans. Amer. Ent. Soc., XIII, p. 292 (♀; United States, without more definite locality). C. W. Johnson, 1895, Proc. Ac. Nat. Sci. Philadelphia, XLVII, p. 325. Aldrich, 1905, Cat. North Amer. Dipt., p. 218. Cockerell, 1908, Trans. Amer. Ent. Soc., XXXIV, pp. 251 and 252; 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 286. Lichtwardt, 1910, Deutsch. Ent. Zeitschr., p. 589. C. Schaeffer, 1912, Jl. New York Ent. Soc., XX, p. 296. C. W. Johnson, 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 54. Hunter, 1914, Kansas Univ. Sci. Bull., VIII (1913), p. 19.

Hermoneura flavipes Kertész, 1909, Cat. Dipt., IV, p. 26.

Hirmoneura (*Neohirmoneura*) *flavipes* J. Bequaert, 1920, Jl. New York Ent. Soc., XXVII (1919), p. 306 (♀♂).

SPECIMENS EXAMINED.—ARIZONA: Pinery Canyon, Chiricahua Mts., Cochise Co., 6,500 ft., one female, June 2, 1919 (Ac. Nat. Sci. Phila.); Post Creek Canyon, Pinaleno Mts., Fort Grant, Graham Co., 6,000 ft., one female, July 18, 1917 (R. C. Shannon); Huachuca Mts., Cochise Co., one male, allotype (C. Schaeffer).

The two females from Arizona fit Williston's excellent description to a nicety. The most characteristic feature of the species is the conspicuous cross-band of grayish-white pollen at the base of the second tergite, followed by a wider shiny black band, the posterior half of the tergite being covered with dull, yellowish brown pollen. On the following tergites, the short hairs are mostly yellowish gray, mixed with a few black ones. The female holotype, in the Williston Collection at Kansas University, bears no indication of locality, Professor H. B. Hungerford writes me. Johnson (1895 and 1913) included *H. flavipes* in his list of the Diptera of Florida, but without mention of a locality. It is not in his collection and I have never seen a specimen actually taken in Florida, where the occurrence of the species is open to question.

Male (*undescribed*).—Extremely similar to the female, the vertex and frons being about the same width in both sexes. Hind tarsi brownish yellow. A series of reddish brown spots on the sides of second, third and fourth tergites, largest on the second where they cover about one-fifth of the width of the tergite; sternites and hypopygium also pale yellowish-brown. (In the female the integument of the abdomen is uniformly black). Wings more hyaline than in female. Eyes bare.

Total length, 13 mm.; length of wing, 13 mm.; width of wing, 3 mm.

Hirmoneura (Neohirmoneura) psilotes Osten Sacken

Hirmoneura psilotes Osten Sacken, 1886, Biologia Centr.-Amer., Diptera, I, p. 74 (♀; Mexico). Aldrich, 1905; Cat. North Amer. Dipt., p. 218. Cockerell, 1908, Trans. Amer. Ent. Soc., XXXIV, pp. 251 and 252; 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 286. Lichtwardt, 1910, Deutsch. Ent. Zeitschr., p. 590.

Hermoneura psilotes Kertész, 1909, Cat. Dipt., IV, p. 27.

Hirmoneura (*Neohirmonueura*) *psilotes* J. Bequaert, 1920, Jl. New York Ent. Soc., XXVII (1919), p. 306 (♀).

SPECIMENS EXAMINED.—GUATEMALA: Two females, Pacayal near Pochuta, 1,000 m., February 10, 1931 (J. Bequaert).

Nothing much can be added to Osten Sacken's description, which is adequate in every respect. The species is exceedingly close to *H. flavipes* and I can detect no appreciable differences in structure. The two species may be differentiated by the color of the abdomen, which in *H. psilotes* is covered dorsally with a uniform brownish-yellow, dull pollen, with the faintest traces of darker cross-bands (the second tergite not conspicuously banded as in *H. flavipes*); posterior half of second and whole of third and fourth tergites beset with short, semi-erect black hairs only. The color of legs and antennae is much the same in the two species.

The two Guatemalan specimens were collected in the coffee-growing region on the Pacific slope of the central mountain range, in the morning hours (between 9 and 10 A. M.) along a roadway separating a cafetal from a pasture. One specimen was resting on a leaf of a coffee-bush, some 3 feet above the ground. The other was hovering at a height of 5 or 6 feet, among the branches of a low tree, making the high-pitched noise characteristic of all Nemestrinidae. A third specimen was seen, but escaped. The weather was bright, sunny and warm.

Hirmoneura (Hyrmophlaeba) texana Cockerell

Hirmoneura texana Cockerell, 1908, Trans. Amer. Ent. Soc., XXXIV, pp. 251 and 253 (♂; New Braunfels, Texas); 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 286. Lichtwardt, 1910, Deutsch. Ent. Zeitschr., p. 591.

Hirmoneura "B." Cockerell, 1908, Amer. Jl. Sci. (4), XXV, p. 311, fig. 1 (on p. 310).

Hyrmophlaeba texana J. Bequaert, 1920, Jl. New York Ent. Soc., XXVII (1919), p. 306.

SPECIMENS EXAMINED.—TEXAS: Helotes, Bexar Co., three males and three females, July 1, 1917 (J. Bequaert and R. C. Shannon); Nueces River, Uvalde Co., fifteen females and two males, one pair taken *in copula,* July 2, 1917 (J. Bequaert and J. C. Bradley); Sabinal River, Uvalde Co., one male, July 2, 1917 (J. Bequaert).—ARIZONA: Post Creek Canyon, Fort Grant in the Pinaleño Mts., Graham Co., five females, July 18, 1917 (J. Bequaert and R. C. Shannon).

Female (undescribed).—Integument of the body black, with the margins of the segments somewhat brownish or reddish, densely covered with ashy-gray pruinosity, more brownish on the dorsal face of the abdomen. Antennæ and palpi very dark brown or black; style black. Mouth-parts and legs pale yellowish brown; terminal segments of tarsi somewhat infuscated.

Body moderately hairy all over; the long pilosity of the dorsum of the abdomen very easily rubbed off and in most specimens almost entirely gone. Ocellar triangle and upper part of face with long, blackish hairs; lower part of face (near the mouth-parts), outer orbits, and occiput with white pilosity. Basal two segments of antennæ with long, erect, black hairs, more or less placed in tufts; third segment and style bare. Thorax entirely covered with long, white hairs, mixed with a few black ones along anterior margin of notum and on scutellum. Some long black hairs behind the base of each wing. First tergite of abdomen with similar long, white hairs. In well-preserved specimens the second, third and fourth tergites are mostly covered with erect, moderately long, black hairs which form more or less distinct tufts on the sides; in addition, each of these tergites bears a more or less distinct band of erect, white hairs at the base, also forming a tuft on each side; the sides of the abdomen thus bear alternating tufts of white and black hair; the basal band is most pronounced on the second tergite. (As noted above, this dorsal pilosity of the abdomen is often almost entirely rubbed off). Under side of abdomen with shorter, somewhat appressed, silvery white pilosity. Legs with white hairs; tarsi and hind tibiæ with many black hairs.

Head large, hemispherical in profile, very slightly wider than high, broader than the thorax. Frons extremely narrow, hardly over one-fifth the width of the eye at its broadest point near the insertion of the antennæ. Inner orbits gradually converging below, more rapidly above. The eyes practically touch each other along the inner orbits over the upper half of the frons, from below the anterior ocellus to midway its distance from the antennæ. The eyes are much more distinctly holoptic in this species than in *H. brevirostris*. Ocellar triangle flattened, about twice as long as wide at the vertex, not distinctly separated by a groove from the inner orbits. Eyes entirely covered with dense, erect, long, dark brown or black hairs. Antennæ small, crowded together; first segment about three times as long as the second, slightly swollen; second segment very short, transverse; third segment flattened, pear-shaped, much longer and broader than the second. Style much longer than the second and third antennal segments together. Body moderately broad; the structure of thorax, scutellum, abdomen and ovipositor as in *H. brevirostris*. Legs slender.

Wings long and comparatively narrow, about four times as long as wide, about the length of the body without the ovipositor; entirely hyaline. Costa distinctly developed along the entire hind margin and reached by the diagonal vein. The cross-vein which separates the first and second submarginal cells, reaches the third longitudinal beyond its branching. Third submarginal cell broadly truncate at the base and widely open at the apex on the costa. Anal cell broadly open.

Length (to apex of tergite 4): 9 to 11 mm.; length of wing: 10 to 11 mm.; width of wing: 2.7 to 3 mm.

The allotype is a female from Helotes, Texas (M. C. Z.).

Male.—Hardly different from the female, except in the secondary sexual peculiarities. The eyes are also holoptic and densely pilose. The pilosity of the abdomen is usually better preserved in the males than in the females.

Length: 11 mm.; length of wing, 10 mm.; width of wing, 2.8 mm.

Hirmoneura texana var. **arizonensis**, new variety

Male and Female.—Agree with typical *H. texana* in every detail of structure, color of integument and pilosity, but the wings are decidedly smoky throughout, slightly more toward the anterior margin. The size is the same as that of the typical form.

ARIZONA: San Diego Canyon on the west side of the Baboquivari Mts., 25 miles southeast of Sells, Pima Co., male holotype and fourteen male paratypes, August 2, 1932 (R. H. Painter.—Holotypes in Painter Collection; paratypes in the same collection and in that of the author); Pima Co., one male paratype, July 22, 1927 (R. H. Beamer.—Ks. Univ. Ent. Dept.); Baboquivari Mts., Pima Co., female allotype, one female paratype, and two male paratypes (F. H. Snow.—Ks. Univ. Ent. Dept.).

Professor Painter informs me that his specimens were all collected very early in the morning, before sunrise. I have made similar observations on typical *H. texana,* in Texas, during the Cornell Biological Expedition of 1917.

Subfamily **Trichopsideinae**

The Trichopsideinae are nemestrinids with the proboscis rudimentary or completely aborted. The palpi are either vestigial or well-developed, slender, and hidden in deep grooves on either side of the face. The venation is always rather simple, never reticulate. The alula of the wing is in most genera vestigial or absent (well-developed in *Nycterimyia* and *Ceyloniola*). The ovipositor of the female is long, sabre-shaped, composed of two slender, curved valves.

Of the five genera which I recognize in this subfamily, only one occurs in America.

Trichopsidea Westwood

Trichopsidea Westwood, 1839, Trans. Ent. Soc. London, II, pt. 3, p. 151 (monotypic for *Trichopsidea oestracea* Westwood, 1839).

Ocelli well-developed. Eyes bare, very broadly separated by frons and vertex in female, distinctly or very narrowly (barely) separated in the male. Third antennal segment bare or with very few hairs, the style slender or scarcely flattened. Wing of normal shape, not narrowed at the base; alula vestigial or absent; axillary cell of normal width, without additional axillary vein. Abdomen short and stubby. Legs normal, the femora and tibiae not appreciably swollen.

The four known species of *Trichopsidea* (as defined above) have thus far been placed in as many different genera. I have seen specimens of all. They are extremely similar in general appearance as well as in the essential structures. The characters separating them are slight and would be very unsatisfactory, were it not for the fact that each species occupies an area widely distant from the others. *T. oestracea* Westwood is found in Australia, Tasmania and New Guinea; *T. flavopilosa* (Bigot) occurs throughout the Mediterranean Subregion; *T. costata* (Loew) is South African; and *T. clausa* (Osten Sacken) is North American. The venation appears to be at least as variable as customary in the Nemestrinidae, so that the peculiarities used in the subjoined key are not of more than specific value. It seems questionable whether the names *Dicrotrypana* Bigot, *Symmictus* Loew, and *Parasymmictus* Bigot are worth retaining, even in a subgeneric sense.

1. North American species. Both third (R_{4+5}) and fourth (M_{1+2}) longitudinal veins divided into two branches which fuse far from the margin into a long stalk; second and third longitudinal veins connected by a cross-vein (three submarginal cells, the second open on the margin, the third closed; five posterior cells, the second closed). Eyes widely separated in both sexes, but the frons broader in the female. (Subgenus *Parasymmictus* Bigot) .... *T. clausa* (Osten Sacken).
   Old World species. Third longitudinal vein (R_{4+5}) not branched (two submarginal cells only) .... 2.
2. Australian and Papuan species. Third longitudinal vein ending freely in the margin, the second submarginal cell broadly open. Eyes widely separated in female, almost meeting below ocelli in male.
   T. oestracea Westwood.
   Third and fourth longitudinal veins fused some distance before the margin; the second submarginal cell closed and stalked at apex.......... 3.
3. Species of the Mediterranean Subregion. Dorsum of thorax uniformly covered with yellowish pile. Frons about as wide as an eye in female;

in male much narrowed toward vertex, where the eyes almost meet below the ocelli. (Subgenus *Dicrotrypana* Bigot).
T. flavopilosa (Bigot).

South African species. Dorsum of thorax with two narrow, longitudinal, silvery-white stripes. Frons much wider than an eye in female; very narrow, though still present below the ocelli in male. (Subgenus *Symmictus* Loew) .... *T. costata* (Loew).

Trichopsidea (Parasymmictus) clausa (Osten Sacken)

Hirmoneura clausa Osten Sacken, 1877, Bull. U. S. Geol. Survey, III, pt. 2, p. 225 (supposedly ♀, really ♂; Dallas, Texas); 1878, Smithson. Miscell. Coll., No. 270, pp. 85 and 237. Williston, 1883, Canad. Entom., XV, p. 70. Osten Sacken, 1898, Berlin. Ent. Zeitschr., XLII (1897), p. 148. Aldrich, 1905, Cat. North American Dipt., p. 218. Cockerell, 1908, Trans. Amer. Ent. Soc., XXXIV, p. 251; 1908, Amer. Jl. Sci. (4), XXV, p. 311, fig. (on p. 310).

Parasymmictus clausus Bigot, 1879, Ann. Soc. Ent. France (5), IX, Bull. Séances, p. lxvii; 1881, *Ibidem* (6), I, p. 15. Kertész, 1909, Cat. Dipt., IV, p. 31. Lichtwardt, 1910, Deutsch. Ent. Zeitschr., pp. 589 and 591. C. W. Johnson, 1913, Bull. Amer. Mus. Nat. Hist., XXXII, p. 54. J. Bequaert, 1920, Jl. New York Ent. Soc., XXVII (1919), p. 306. J. Comstock, 1924, Introduction to Entomology, p. 836, fig. 1077.

Hirmoneura (Parasymmictus) clausa Cockerell, 1910, Bull. Amer. Mus. Nat. Hist., XXVIII, p. 286.

Rhynchocephalus sackeni J. and A. Comstock, 1914, Manual Study of Insects, 12th Ed., p. 640, fig. 555. Spencer, 1931, Proc. Ent. Soc. Brit. Columbia, XXVIII, p. 21, figs.; 1932, *Ibidem,* XXIX, p. 25. Graham, 1932, Canad. Entom., LXIV, p. 167 (♀). Not of Williston.

Rhynchocephalus sp. J. Comstock, 1918, The Wings of Insects, p. 347, fig. 358.

SPECIMENS EXAMINED.—TEXAS: Dallas, male holotype (Boll. M.C.Z.); one female, without more definite locality (U. S. Nat. Mus.).—KANSAS: Medora, Reno Co., July 2, 1927, one male (L. D. Anderson.—Kansas Univ. Ent. Dept.).—FLORIDA: Beresford, Volusia Co., one male (G.D.H. in Coll. C. W. Johnson, now at M.C.Z.).—BRITISH COLUMBIA: Riske Creek, Chilcotin District, 51° 58′ N., 122° 30′ W., June 16, 1929, and June 9, 1931, ten females (G. J. Spencer); this appears to be the northernmost record of any species of Nemestrinidae; Chilcotin, June 11, 1920, one female (R. C. Treherne).

This unusually interesting and rare insect was the center of a controversy by Osten Sacken and Fr. Brauer (1883, Offenes Schreiben als Antwort auf Herrn Baron Osten Sacken's "Critical Review" meiner Arbeit über die Notacanthen. Vienna, pp. 8–9). Although the original description was clear enough, since it mentioned the peculiar wing venation and the aborted proboscis, Brauer was led to misidentify as this species six specimens from Colorado of *Neorhynchocephalus sackenii* (Williston). G. J. Spencer's and K. Graham's recent discussions of *N. sackenii* were based on a similar error of identification. The flies studied by these authors were *T.* (*P.*) *clausa* (Osten Sacken), as shown by specimens received from Professor Spencer. This explains Graham's finding in his series of 91 specimens, all except one, with the third submarginal cell (R_4) closed, for such is the normal condition in *T. clausa* and exceptional in *N. sackenii.*

In the fifteen specimens seen, the venation varies in many details, but the third submarginal and second posterior cells always end in a long stalk (in one female from Chilcotin, the second posterior cell is incomplete in the left wing, owing to the abnormal shortening of the lower branch of the fourth longitudinal vein). The third submarginal cell may be sessile, narrowly or broadly truncate, or stalked at the base. In the type there is an abnormal, supernumerary cross-vein in the first basal cell, placed close to the base in the right wing and about midway in the left wing. This is not present in any of the other specimens.

The well-developed frons of the male induced Osten Sacken to regard the type as "apparently a female," but it actually is a male. In the true female, readily recognizable by the sabre-shaped ovipositor (similar to that of *Neorhynchocephalus*), the frons is much wider than in the male, occupying at the vertex about one-half of the total width of the head and much more at the insertion of the antennae.

Spencer's (1931 and 1932) observations on oviposition, illustrated with three fine photographs, refer to *T.* (*P.*) *clausa,* not to *Neorhynchocephalus sackenii* (as shown above). At Riske Creek, in the Chilcotin, British Columbia, in June, 1929, 1930 and 1931, he observed many females of *T. clausa* laying eggs into cracks of weather-beaten telephone poles. The row of poles ran through an egg-bed of the grasshopper, *Camnula pellucida* Scudder. As many as thirty flies were assembled on a pole at once and the eggs were laid from 8 inches to 15 feet above the ground. Several females remained for over half an hour and one for nearly an hour in the ovipositing position. Misled by Williston's rather ambiguous statements about the known early stages of Nemestrinidae and by the occurrence in the poles of burrows made by cerambycid beetles, Spencer drew the inference that the larvae of *T. clausa* were parasitic upon the larvae of such beetles. This conclusion is, however, premature. Thus far the feeding habits of the larvae are known only for two species of Nemestrinidae. In Europe, the full-grown larva of *Hirmoneura obscura* Wiedemann has been found by Adam Handlirsch and F. Brauer in the pupae of a scarabeid beetle, *Rhizotrogus solstitialis,* which lives in the ground at roots (although *Hirmoneura obscura* oviposits in the old burrows made by wood-boring beetles in fences). In South Africa, the larva of *Trichopsidea* (*Symmictus*) *costata* (Loew) parasitizes the adults of the brown swarm grasshopper or locust, *Locustana pardalina* (the oviposition is unknown). From the very close relationship between *T. clausa* and *T. costata* and from the fact that grasshoppers were abundant in the area where Spenser made his observations, the surmise seems warranted that the larvae of *T. clausa* will eventually be found inside live grasshoppers. The early stage larva of *T. costata* possesses a conspicuous posterior tail, which, however, is shed shortly before the full-grown larva leaves the grasshopper and burrows into the soil to pupate.

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ESTERS AS REPELLENTS*

By WARREN MOORE
RESEARCH ASSISTANT, RUTGERS UNIVERSITY

Abstract

House flies (*Musca domestica*) and several blood sucking Diptera are repelled by unsaturated cyclic esters, including certain substances which are without odor to man. Acetates of terpine alcohols are in every case superior to the corresponding alcohols.

In 1927, while employed on a Crop Protection Institute Fellowship supported by Stanco Incorporated, I undertook to develop an "odorless repellent," that is, to discover a substance which would repel insects, but whose odor would not be detectable by man. It was proposed to learn what kinds of chemicals would repel insects as a guide to selecting odorless substances for field testing.

In the early stages of this study I was fortunate in having access to a large mass of unpublished data accumulated by Mr. F. C. Nelson, formerly of this station and at present Biologist for Stanco Incorporated. Nelson's methods were such that the comparative efficiency of the substance tested was clearly shown. Having treated various parts of his body with the materials to be compared, he exposed himself to mosquitoes and compared the length of time each treatment remained effective.

Nelson tested a large number of essential oils, terpenes and esters. I was able to acquaint myself with the composition of many of them by consulting reference books on the subject. I then attempted to correlate the chemical nature of the repellents with their relative effectiveness as recorded by Nelson, and certain correlations were discovered. It was found that terpene alcohols as a class were superior to terpene hydrocarbons. Nelson had tested linalyl acetate and oil of lavender which contains linalool; geranyl acetate and the oils of rose geranium and citronella, both containing geraneol; terpinyl acetate and ter-

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pineol. In each instance the ester had proved superior to the corresponding alcohol. This suggested that repellent efficiency increases from hydrocarbon to alcohol to ester. Some of my work on repellents was arranged so that this hypothesis could be tested.

The materials studied were tested by comparing the relative length of time equal volumes on equal surfaces continued to repel flies. The surfaces used were filter papers wet with molasses and water. After treatment the papers were exposed at the college dairy and the behavior of the flies closely observed.

The reaction of the flies was very definite when they were numerous and hungry. At other times it was difficult to make comparisons because of the scarcity of flies or their indifference to the molasses. Observations were recorded in terms of the number of flies feeding on each paper after various time intervals. There were other indications which were significant to the observer but which are difficult to record. If flies fed on the molasses the filter paper became much whiter. A single fly feeding at the same spot for any length of time would often leave a small white area free from molasses as an indication of its visit. In the case of some materials, flies would, from time to time, "take a taste" and leave immediately. By taking such indications into consideration the observer was usually able to distinguish differences among the materials, provided a reasonable number of hungry flies were present. The differences were often much more marked than is indicated by the numerical data.

In the case of the poorer repellents, comparisons were most striking when pure materials were used. In testing the better repellents, dilution was desirable so that differences would become apparent more quickly.

A series of comparisons consisted of papers which were prepared and treated at the same time, in the same way and with the same volume of repellent liquid and which were exposed at the same time and place. Each such series will be tabulated separately. Within a series comparisons are shown between the materials tested. Materials which are not compared in one series may be compared in another, or their relative value may

TABLE I

COMPARATIVE REPELLENT EFFICIENCY OF CERTAIN MIXTURES, SHOWING NUMBER OF FLIES FEEDING WHEN OBSERVATIONS WERE TAKEN

Mixtures	P.M. 8/13		A.M. 8/14				P.M. 8/14				Order of efficiency
	4:30	5:00	9:00	10:00	11:00	12:00	1:00	1:30	2:00	2:30	
Containing menthol	0	0	1	0	1	2	2	1	5	6	5
Containing eugenol	0	0	0	1	0	1	0	3	3	2	4
Containing cedarwood	0	0	3	1	4	5	10	1	4	4	5
Check	1	1	0	0	1	2	4	7	5	9	
Containing sandalwood	0	0	0	0	0	0	0	5	1	3	2
Check	9	4	1	1	5	7	9	3	8	11	
Check	9	9	4	4	8	15	18	10	10	13	
Containing eugenol acetate	0	0	0	0	0	1	3	5	4	5	3
Containing pinene HCl	0	0	1	0	1	3	7	7	10	6	5
Containing menthyl acetate	0	0	0	0	0	1	2	1	–	2	3
Containing santalyl acetate	0	0	0	0	0	0	0	0	0	0	1
Check	13	9	2	0	4	5	4	4	4	4	

be inferred from their differences from another material with which both have been compared.

Series 1

August 13. 2.5 c.c. of liquid repellents or 2.5 gm. of solids were dissolved in 97.5 c.c. of kerosene-pyrethrum and the mixtures compared with each other, with Flit and with kerosene-pyrethrum. They were exposed at 4:30 P.M. on the 13th and examined at intervals until 2:30 P.M. on the 14th. The observations are given in table I.

The testing was resumed about the middle of September. At this season the flies did not react as strongly as in August. In order to bring out difference between different materials it was necessary in many cases to use the pure repellents without dilution.

In Series 2 undiluted materials were used. The observations follow in table II.

At 5:30 P. M. September 14th the behavior of the flies indicated that terpineol and cedarwood had lost all repellent properties.

At 11:00 A. M. September 15th santalol, santalyl acetate and terpinyl acetate still retained their repellent properties. Continued observations determined that the disc treated with santalyl acetate remained repellent the longest.

In Series 3 undiluted repellents were compared with ypre-thrum extracts. The observations follow in table III.

The figures do not show any difference between santalyl acetate and terpinyl acetate and do exhibit considerable differences among different trials of the same materials. This irregularity was due to the difficulty of covering the discs uniformly with the repellent. A definite end point would be reached when flies fed on all portions of the disc. This occurred with menthyl acetate at 5:30. It did not occur with terpinyl acetate, santalyl acetate or the kerosene pyrethrum combinations in three days. On the third day, however, a marked superiority of the santalyl acetate and the pyrethrum concentrate was apparent to the observer. The materials tested are, therefore, ranked as follows:

1. Pyrethrum concentrate: santalyl acetate.

TABLE II
COMPARISONS OF CERTAIN REPELLENTS

Repellent	P.M. 9/14		2:00	2:30	2:45	3:00	3:30	4:00	5:15	6:00	7:00	A.M. 9/15	Order of efficiency
	1:30	1:45										11:00	
Terpineol	0	0	1	1	1	5	2	1	1	2	1	4	5
Check	5	2	4	10+	3	4	5	9	7	9	8	2	
Cedarwood	2	0	0	4	0	3	2	6	6	1	3	3	6
Check	3	1	2	7	5	3	9	7	10+	5	5	4	
Santalyl acetate	0	0	0	0	0	0	0	0	0	0	0	0	1
Santalol	0	0	0	0	0	0	0	0	0	0	0	0	2
Check	0	3	8	12	5	8	7	9	8	10+	7	4	
Terpinyl acetate	0	1	0	0	0	0	1	0	0	0	0	0	3
Deodorized kerosene-pyrethrum	1	0	0	0	1	2	1	1	0	4	3	1	4

TABLE III

THE DISCS WERE EXPOSED AT NOON SEPTEMBER 15 AND OBSERVED AT INTERVALS UNTIL 5:15 P. M.

Repellents	1:30	1:45	2:00	2:30	2:45	3:00	3:30	4:00	5:15	Total Flies
Terpinyl acetate	0	0	0	0	1	0	1	0	0	2
" "	0	0	0	1	0	1	1	2	1	6
" "	0	1	0	2	6	1	3	2	1	16
Santalyl acetate	0	0	2	0	3	1	2	0	0	8
Check	0	0	3	10	7	10	5	10	4	49
Menthyl acetate	1	1	0	0	0	0	4	1	1	8
Santalyl acetate	1	0	0	0	0	0	1	1	1	4
Check	1	6	3	7	3	6	4	7	1	38
Deoderized kerosene	1	0	1	7	6	6	5	10	5	41
Check	2	1	3	4	3	6	4	4	10	37
Kerosene-pyrethrum con.	0	1	0	0	0	0	1	2	0	4
Deoderized kerosene and pyrethrum	0	1	1	1	0	0	0	2	2	7

2. Pyrethrum (dilute) in deodorized kerosene: terpinyl acetate.
3. Menthyl acetate.
4. Deodorized kerosene (worthless).

Series 4

This was a repetition of series 3 and led to the same conclusions. Pyrethrum concentrate and santalyl acetate were carefully compared. It was observed that the former remained partially repellent for the longer time; while the latter repelled *all* flies for the longer time.

In Series 5–10 essential oils of unknown or doubtful composition were compared with terpinyl acetate, santalyl acetate and santalol and none were found to equal them. Acetylization was found to increase the efficiency of oil of Java citronella and of oil of spruce.

The terpenes, their alcohols and acetates may now be compared by arranging them in the order of excellence found in the first three series of comparisons. The arrangement follows:

Series 1

(1) Santalyl acetate
(2) Santalol
(3) Eugenol acetate; Menthyl acetate
(4) Eugenol
(5) Pinene HCl; Oil cedarwood; Menthol

Series 2

(1) Santalyl acetate
(2) Santalol
(3) Terpinyl acetate
(4) Terpineol
(5) Oil cedarwood

Series 3

(1) Santalyl acetate
(2) Terpinyl acetate
(3) Menthyl acetate

Combining the three series the order of excellence of all the materials is about as follows:

	Order	*Chemical classification*
(1)	Santalyl acetate	ester, sesquiterpene
(2)	Santalol	alcohol, sesquiterpene
(3)	Terpinyl acetate	ester, terpene
(4)	Eugenol acetate	ester, phenol
	Menthyl acetate	ester, terpene, saturated
(5)	Eugenol	alcohol, phenol
	Terpineol	alcohol, terpene
(6)	Menthol	alcohol, terpene, saturated
	Pinene HCl	terpene, saturated
	Oil cedarwood	hydrocarbon, sesquiterpene

It will be seen that (1) all esters are better than the corresponding alcohols, (2) the saturated alcohol, menthol, is inferior to the unsaturated alcohols, (3) the hydrocarbon, oil of cedarwood is inferior to all alcohols except menthol, (4) the best material is a very slightly volatile unsaturated, cyclic ester.

Further, extensive field and laboratory experiments with cyclic esters brought out the superior repellent properties of the dialkyl phthalats (U. S. Patent #1,727,305) and of the pyrethrins to other substances. Both are odorless.

As a result of these findings the formula of a superior cattle spray was developed. This spray was placed upon the market by Stanco Incorporated under the name of "Molac."

NOTES ON CARABIDAE, INCLUDING A SYNOPSIS OF THE GENERA CYLINDROCHARIS, EUFERONIA, MELANIUS (OMASEUS) AND DYSIDIUS OF THE TRIBE PTEROSTICHINI

BY ALAN S. NICOLAY AND HARRY B. WEISS

Scaphinotus Dej.

S. snowi LeConte

Color uniformly violet; rather dull, not as shining as in *roeschkei* and *vandykei.* Thorax a little wider (5 mm.) than long (4 mm.); surface of disk uniformly coarsely punctured, rugous; side margins much thickened, smooth and rounded, not strongly reflexed as it is in all other species of this group; hind angles not produced, rounded at tip, sides of thorax broadly rounded, not at all sinuate at basal half, widest at the middle with one seta near margin; median line distinct; apex and base emarginate. Elytra oblong, slightly oval, about twice as long as wide; side margins faintly reflexed, a little more so towards humeri; very coarsely punctate; striae evident toward suture but indistinguishable on sides. Head black, long, narrow with a few scattered punctures along center arranged longitudinally. Mandibles piceous at tips with stiff coarse hairs on under side. Palpi black to dark, piceous on last joint. Beneath black, shining; coarsely and confluently punctured at sides, more finely and distinctly so on abdominal segments. Legs black. Hind trochanters short, rounded. Antennæ long and slender reaching to middle of body; first four joints black, smooth, remainder piceous and hairy. Length 15 mm. Width 6 mm.

The above description is drawn from a unique male taken in the White Mountains of Arizona at Diamond Creek, elevation 7,000 feet, by D. K. Duncan, June, 1926. This specimen is now in the Nicolay Collection. We are acquainted with only two other examples of this very rare and little known species. One female in the collection of the late Professor Snow, now installed in the museum collection of the University of Kansas, Lawrence, Kansas, and the single male type in the LeConte collection in the

Museum of Comparative Zoology at Cambridge, Mass. Both of these specimens came from Santa Fe Cañon, New Mexico (altitude 7,000 feet) and were taken by the Kansas University Scientific Expedition for 1880. The senior author has had the privilege of examining both. At the request of Mr. Charles Schaeffer, Mr. Benedict very kindly sent on the specimen in the collection of the museum of the University of Kansas for inspection. This female is larger, darker and with thorax slightly more reflexed and hind angles more acute than in the two males. Length $16\frac{1}{2}$ mm. The head of the snowi in the Nicolay collection is very sparingly punctured.

This species must inhabit high altitudes, all specimens coming from an elevation of 7,000 feet.

The measurements of the type in Cambridge are *length $13\frac{1}{2}$–14 mm.; *across thorax $4\frac{1}{2}$–5 mm.; *across elytra $6\frac{1}{8}$–$6\frac{1}{4}$ mm.

As there is some discrepancy between the type and the original description in the Transactions of the Kansas Academy of Science, 1881, we include this description: "*Cychrus* (*Scaphinotus*) *snowi,* LeConte Black, without purple tinge. Head impunctured. Prothorax densely punctured, about one third wider than long; sides thickened and reflexed, more widely towards the base which is strongly emarginate in an arc of a circle, tip also emarginate but less deeply, dorsal line well impressed, transverse impressions deep, basal impressions indistinct, lost in the concavity produced by the reflexed margin. Elytra suboval, not dilated behind, lateral margin strong, wider about the humeri which are rounded; striae 14 or 15, distinctly impressed, except the outer ones which are confused; punctures of the striae deep, distant a little more than their diameter. Flanks of prothorax not punctured; epipleurae, sides of meso- and metathorax and first ventral segments coarsely punctured. Length 9 mm.

"One male. The front tarsi have the joints 1–3 moderately dilated and spongy pubescent beneath over the whole surface as in *C. andrewsii.* This is a very singular species; the sides of the prothorax are thicker than in any other, and nearly as widely reflexed towards the base as in *C. elevatus,* though the hind

* Measurements from front of head to elytral apices. * Width taken at widest part.

angles are not prolonged nor is the humeral margin of the elytra as wide; the tarsi, as just stated are as in *C. andrewsii,* while the punctured prothorax distinguishes it at first sight from all the other species of the group.''

Since writing the above and as this paper goes to print several additional specimens have come to light. Nine are in the collection of the Academy of Natural Sciences of Philadelphia. These were all taken in Black Range, Sierra Co., New Mexico, by Dr. H. A. Pilsbry, while searching for snails. Also found at an elevation of about 8/9,000 feet.

Mr. Phillip Darlington of the Museum of Comparative Zoology at Cambridge writes, ''I have seen here two specimens of *Scaphinotus snowi* in addition to the type. These specimens are labelled respectively 55–7,000 feet, vicinity of Durango, La Plata County, Colorado, July 23–August 8, 1885, from the F. C. Bowditch Collection in the M. C. Z., and Blue Mountains, La Sal National Park, Monticello, Utah, July 20, 1933, W. S. Creighton, in the Darlington Collection.''

Maronetus Casey

M. schwarzi (Beut.)

Although there is no mention made of the type or its disposition in the original description, we have located it in the collection of Colonel Casey, now installed in the United States National Museum. There is no type in the American Museum of Natural History, New York. The single specimen bears a locality label ''Summit of Black Mts.'' After a careful examination we find that the punctures of the elytra are not confined to the basal half but continue toward the apex exactly as they do in the type material of *hubbardi* Schwarz, which is also in the National Museum. *Schwarzi* has the setigerous punctures the same as in *hubbardi* and is not more robust or broader than many specimens in the series of *hubbardi.* Therefore we have come to the conclusion that *schwarzi* is a synonym of *hubbardi.*

The senior author has collected *hubbardi* on the summit of Mt. Mitchell, N. C., and also on Mt. LeConte and near Mt. Guyot in Tennessee. It is found sifting leaves and moss and also on the underside of small sticks and under loose bark near the ground.

Some were taken in bottles filled with molasses mixed with a few drops of asafoetida.

M. imperfectus var. **tenuis** Casey

Described from a single specimen taken in the Black Mountains of North Carolina. Among the four examples in the Horn Collection in Philadelphia under the name *imperfectus* the one from Round Knob, N. C., is *tenuis,* the remainder are *imperfectus.*

M. imperfectus occurs in Pennsylvania (probably confined to the mountainous regions of the southwestern part of the state), Maryland and Virginia. The senior author took a nice series at Skyland, Page County, June 20, Virginia, sifting deep layers of leaves in one of the few ravines still preserved untimbered, in its natural state, with the consequent abundance of leaves, moisture and mold protected by the hemlocks which somehow escaped the axe. The specimen in the Horn Collection, marked type, is from Virginia.

Variety *tenuis* replaces the stem species in North Carolina. Like others of the genus Maronetus they are found in the mountains at elevations ranging from 3,000 feet up to the summit. It is doubtful if any species of this genus occur much below this elevation and certainly not farther down the mountains than 2,500 feet.

First three striae deep and heavily punctured, fourth conspicuous and punctured but not so decidedly, usually showing slight traces of fifth stria and a few punctures; thoracic margin somewhat reflexed laterally (Pa.; Md.; Va.;) .... *imperfectus.*

First two striae deep and heavily punctured, third faint, more abbreviated and not noticeably punctured; thoractic margin not reflexed (N. C.). var. *tenuis.*

Bembidion Latr.

B. vulsum Casey and *B. filicorne* Casey are synonyms of *B. planum* Hald. Casey did not consider that he had *planum* in his collection and described his specimens under the above two species. If he had possessed the series the author has there would undoubtedly have been more "new" names.

B. Champlaini Casey is a synonym of *B. fugax* LeConte.

Colonel Casey also did not recognize *fugax* as being in his collection.

B. albidipenne Casey and *B. petulans* Casey are the same as *B. caducum* Casey.

B. prociduum Casey and probably *B. simulator* Casey are the same as *B. imperitum* Casey.

B. habile Casey is *anguliferum* LeConte. *Anguliferum* is a very common boreal species extending from Nova Scotia and New England across the continent to British Columbia and south into California. In sphagnum bogs.

B. umbraticum Casey is apparently a rare and valid species lacking the carina of the hind thoracic angles.

Anillus Duval

A. fortis Horn

Holotype and topotype from Tennessee. Other specimens in Horn collection in the Academy of Natural Sciences, Philadelphia, from "Round Knob," N. C. The holotype and a single specimen taken by the senior author at Elkmont, Tenn., are apparently immature as they are much lighter in color. Casey's *carolinae* from the Black Mountains of North Carolina is identical with all the other specimens in Horn's series and consequently this name becomes a synonym. Mature specimens are of a chestnut brown color.

Pterostichini

Cylindrocharis Casey

Head large, tumid behind the eyes, which are not prominent. Body elongate and subcylindric, shining; elytra without dorsal punctures; elytra striae regular, rather deep. The mentum tooth broad with the apex deeply sinuate medially. Mandibles striate. Abdomen impressed at apex, in the male.

We recognize two species, which are superficially similar but structurally and geographically very different.

Key to Species

Hind trochanters acute at tip which is drawn out in a sharp pencil like point; thorax usually longer and larger than next species (N.C.–Ga.). *grandiceps.*

Hind trochanters rounded at tip which is short and blunt (N.E. U.S.–Ga.). *rostrata.*

C. grandiceps (Chaud.) (*rostrata*‡ Casey)

This is a somewhat larger species averaging 17–18 mm. in length and with a longer and wider thorax than *rostrata*. It can be readily separated from the next species by the characters given in the key and also the usually larger size although small specimens are met with, which are no larger than *rostrata*.

Grandiceps appears to be quite local in the south. The senior author has found it in elevations of about 2/3,000 feet at Elkmont and Mt. Leconte in Tennessee. Also reported from North Carolina and Georgia.

C. rostrata (Newn.) (*sulcatula* Casey, *piceata* Casey)

Rather common from Maine through North Carolina and Tennessee. Found in New England at low elevations but apparently in the mountains of the South it occurs at heights from about 3/6,000 feet. Replaces the more local and rarer *grandiceps* at these elevations. It is interesting to observe how the excellent character separating these two species (the hind trochanters as mentioned in the key) is verified by the habits of each, for while undoubtedly the two meet and overlap the other's range, all the specimens collected by the senior author in the North East and high elevations of the south were *rostrata*, while those specimens found only in the south and in the writers' experience at low elevations (2/3,000 feet) were *grandiceps*.

Rostrata averages smaller (about 13–14.7 mm.). The elytra striæ are somewhat more unevenly in this species and the intervals narrower and more convex. In both species the pronotum has a distinct carina near the margin posteriorly. Occasionally specimens are found where this carina is not quite so distinct and there is the more evident appearance of the striæ being punctate. This led Colonel Casey to erect two new species which we cannot recognize. Also Casey twisted the correct locations of the species with the resulting incorrect localities as given in the Leng list.

Both species may be found throughout the year except during winter and although local cannot be considered rare.

Casey's single type of *piceata* is merely a brownish immature specimen and the three specimens of *sulcatula* are typical *rostrata.* Casey did not even recognize *grandiceps* as being in his collection. Originally Colonel Casey considered that he had two examples of *piceata,* one from New York and one from Maine. Later he apparently regarded his Maine specimen as *sulcatula* and it is placed as such in his collection.

Euferonia Casey

Eyes present; mandibles without setigerous punctures. Basal three segments of the antennae glabrous. Anterior tarsi with dilated joints, regular in the male. Met-episterna notably short, never decidedly longer, and generally much shorter than wide. Dorsal punctures variable but usually two in number. Body elongata. Elytral striæ complete, deep; scutellar well developed. Thorax narrower at base than apex, coarsely margined at the sides. Angles of thorax usually obtuse, foveæ large, generally duplex. Abdomen not modified apically in the male. All our species are found in the East.

Key to Species

Basal impressions of thorax with a distinct tubercle; elytra sometimes with a distinct iridescent reflection ....(1).

Basal impressions without tubercle and never with an iridescent reflection ....(2).

(1) With distinct iridescent reflection. Length 17–18 mm. (S.C.). *iripennis* nov. sp.

Without iridescent reflection. Length 14–18 mm. Width 4.8–6.4 mm. *stygica.*

Smaller. Length 12–13 mm. Width 4–5 mm. (N.Eng. N.N.Y.). var. *vipada.*

(2) Basal impressions not linear ....(3).

Basal impressions of thorax linear and deep....*lachrymosa.*

(3) Hind angles of thorax carinate....(4).

Hind angles not carinate....(7).

(4) Form short, elytra distinctly rounded behind middle, narrowed towards base. Length 12.5–14 mm. Width 4.5–5.5 mm. ....(5).

Form much more elongate, subparallel. Length 14–18 mm. Width 4.8–6.5 mm. ....(6).

(5) Basal impressions rather rugosely punctured, interval much less so; tarsi and tibiæ piceous to dark reddish. (N.H.). *washingtonensis* nov. sp.

Basal impressions and interval not or much less distinctly punctured; tarsi and usually tibiæ more reddish. (Mts. of N.C.). var. *rufitarsis* nov. var.

(6) Head and thorax large, latter about 5 mm. in length and breadth. Length 15–18 mm. .... *coracina*.

Head and thorax not quite so large, latter about 4.5 mm. in length and breadth; thorax with foveæ narrower and deeper; form more narrow. Length 14–17 mm. (Mts. of Md., Ky., N.C., Tenn.). var. *roanica*.

Head and thorax still smaller, latter about 4 mm. in length and breadth; form shorter and proportionately broader, slightly more rounded. Length 14–15 mm. (Wisc., N.Eng., Pa.) .... var. *erebea*.

(7) Thorax long, distinctly and rather sharply narrowed behind. Length 16–20 mm. .... *relicta*.

Thorax more subparallel, not distinctly narrowed behind, smaller; a tubercle replaces the usual carina at hind angles. Length 14.5 mm. *flebilis*.

E. iripennis nov. sp.

Elongate-oval, rather robust. Black shining; elytra with iridescent reflection which is especially noticeable under artificial light. Thorax quadrate, narrowed behind, about as wide as long (5 mm.); surface smooth shining, side margins reflexed; basal impression with distinct flattened tubercle with a few distinct and scattered punctures on tubercle and basal impression; hind angles obtuse, carinate, with a single distinct seta; head smooth, large, with a distinct deep longitudinal sulcus on each side of middle commencing at the clypeal suture and extending as far back as the front of the eyes, which are conspicuous; clypeus with a seta on each side, front emarginate; labrum truncate, front with long, coarse brownish hairs; mandibles black conspicuous; antennæ and palpi piceous to dark brown, first three antennal joints smooth, remainder pubescent. Elytral striæ deep, finely punctured, more conspicuously so toward base and along scutellar striæ; intervals smooth, flat or nearly so; next to last stria with row of large conspicuous setæ; tips of elytra rounded. Femora black, tibiæ piceous, tarsi dark chestnut brown. Underside black. Metasternal and prosternal episternum, and first three ventral segments coarsely and distinctly punctured, prosternum and last three ventral segments not or very faintly punctured. Length 17–18 mm. Width 5.5–6 mm.

Described from a series of five males and three females all taken at Camden, South Carolina, June 23, by Mr. Phillip J. Darlington. Holotype ♂ and allotype ♀ in the collection of the Museum of Comparative Zoology, Cambridge, Mass. Two paratypes (♂ and ♀) in the Nicolay Collection. One paratype ♂ in the United States National Museum. Remaining paratypes in Darlington Collection.

This distinct species can be easily told from all others by the iridescent reflection of the elytra, more punctate elytral striæ and generally larger and more robust appearance. By daylight the iridescent reflection is hardly noticeable, giving way to a velvety black sheen. *Iripennis* will undoubtedly be found in other localities when the southern states are more carefully collected over.

E. stygica (Say) [*bisigillatus* (Harris) *rugicollis* (Hald.), *picipes* (Newn.) *quadrifera* Casey, *proba* Casey, *ingens* Casey, *umbonata* Casey, *subæqualis* Casey].

Elongate-oval, slightly less robust than preceding. Black shining. Thorax quadrate, somewhat narrowed behind; about as wide as long (4 mm.), surface smooth, shining, side margins reflexed; basal impression with distinct more or less flattened tubercle, tubercle with a few scattered punctures; hind angles obtuse, carinate, with a single distinct seta; carinæ average longer and more distinct than in *iripennis*. Head same as in *iripennis* but somewhat smaller. Elytral striæ deep, not punctured to very vaguely so towards base; intervals smooth, flat to slightly convex. Femora black, tibiæ piceous, tarsi dark chestnut brown. Underside black, punctured as in *iripennis*. Length 14–18 mm. Width 4.8–6.4 mm.

Very common. Found from Southern Canada (Ontario), down to and including North Carolina and Louisiana, westward to Iowa and Missouri. Taken all year round under logs and stones, many specimens being often met with under the same shelter. *Stygica*, according to the senior author's observations, prefers low ground and is disinclined to ascend even smaller mountains of 1,000 feet or more. Very abundant under almost every favorable hiding place along the Potomac River near Washington.

var. **vapida** (Casey).

Much smaller than *stygica*. More convex. Tubercle of basal impression high and distinct; carinæ of hind angles longer and more distinct than in most specimens of *stygica*. Elytral striæ very deep, not at all punctured.

Length 12–13 mm. Width 4–5 mm.

The single type specimen of this interesting and valid variety is deformed and in bad condition. It comes from the Adirondack Mts., New York. We have before us four specimens from Stowe, June 23–July 2 (Engelhardt), Vermont, and two specimens from New Hampshire, one from Claremont, May 2, also taken by Mr. George P. Engelhardt.

Vapida so far has been taken only in New England and northern New York, but later may be discovered in most of the more northern states and in southeastern Canada.

E. lachrymosa (Newn.).

Elongate-oval. Black dull, not shining. Thorax quadrate, rather sharply narrowed behind; a little wider (4.5 mm.) than long (4 mm.), surface smooth, shining, side margins reflexed; basal impression linear, deep, impunctate or with a few scattered punctures; hind angles obtuse, with a low flat and inconspicuous carina or not carinate at all; with a single distinct seta. Head smooth, averaging smaller than *stygica* with usual longitudinal sulcus on each side of middle; clypeus with a seta on each side, front emarginate; labrum truncate, front with long, coarse, brownish hairs. Elytral striæ very deep, not punctured; intervals convex and very minutely punctured. Femora black; tibiæ and tarsi usually black except last three tarsal joints but sometimes entirely a dark chestnut brown. Underside black. Metasternal and prosternal episternum, and first three ventral segments distinctly punctured, prosternum, middle of first three ventral segments and last three not or very finely punctured.

Length 13–15 mm. Width 4.5–6 mm.

Reported from Maine south through the mountains of North Carolina and Tennessee and westward to Cincinnati, Ohio (Dury). Very local but abundant where found. *Lachrymosa* seems to prefer the mountainous regions at elevations of from 2/4000 feet. The senior author has taken it plentifully in the Blue Ridge Mts. of Virginia, Smoky and Unaka Mts. of North Carolina and Tennessee. Apparently rarer in Maine and New England. During some twenty years of collecting along the Potomac River (Fairfax County, Va.) by the senior author one specimen was found (September). Undoubtedly this specimen was washed down from the mountains but it is also possible that *lachrymosa* is not quite so rare in this region. The impossibility of separating this species in the field from *stygica* which, because of the before-mentioned abundance, collectors soon tire of picking up may have a bearing on so few specimens being saved from accessible and often collected localities.

Lachrymosa is easily separated from all other species by characters mentioned in this description.

E. washingtonensis nov. sp.

Short, rather broadly oval to elongate-oval in certain male specimens. Black, shining. Thorax much wider towards apex than at base, rather sharply narrowed from just before the middle; about as wide as long to slightly wider (4–4 mm.) to (4.5–4 mm.); surface shining, smooth, except for the shallow, indistinct, transverse wavy lines found on almost all specimens of this genus and seen only when held obliquely to the light, side margins reflexed; basal impression coarsely, densely punctured and rugous, without tubercle; base of thorax rather sparsely punctured, much less so to not at all at center where occasionally there are short longitudinal sulca; hind angles obtuse, with the usual single seta, carinate, carinæ rather long and distinct turning in away from thoracic margins.

Head smooth, shining; rather large but slightly narrower than thorax; with the usual distinct, deep, longitudinal sulcus on each side of middle commencing at the clypeal suture and extending as far back as the front of the eyes which are conspicuous; clypeus with a seta on each side, front slightly emarginate; labrum truncate, front with long, coarse brownish hairs; mandibles black, conspicuous; palpi reddish brown; antennæ piceous to dark brown, first three joints smooth and somewhat darker, remainder pubescent. Elytral striæ deep, not punctured; intervals convex; next to last stria with row of large conspicuous setæ; tips of elytra rounded. Femora black, tibiæ and tarsi piceous to dark reddish brown. Underside black. Metasternal and prosternal episternum distinctly punctured, the latter usually much less so; first three ventral segments rather sparsely but distinctly punctured, last three not or extremely faintly so.

Length 12.5–14 mm. Width 4.5–5 mm.

Described from a series of three males and six females all from New Hampshire.

Holotype ♂ and allotype ♀ taken by the senior author on the slopes of Mt. Madison, July 15–20, and in the Nicolay Collection. Two paratypes ♀ one from Mt. Madison taken by the senior author and one from Mt. Washington, August, taken by P. J. Darlington, in the Nicolay Collection. Two paratypes (♂ and ♀) from Mt. Washington (Darlington) in the collection of the Museum of Comparative Zoology, Cambridge, Mass. One paratype ♀ from Mt. Washington (Darlington) in the United States National Museum. Remaining paratypes, one ♂ from Mt. Washington and one ♀ from Mt. Kinsman taken by and in the collection of Mr. Phillip J. Darlington.

This species has long been spotted by collectors, in the White Mountains of New Hampshire, as distinct. However in view of the existing doubt as to the true standing of the recently described species of Colonel Casey and the general confusion of names in the genus Euferonia, up to now *washingtonensis* was either lumped with *coracina* or a Casey species or set aside in a corner of the box without a label. Although so far met with only in New Hampshire especially in the Presidential Range, it will undoubtedly turn up elsewhere in New England and probably the Adirondack Mts. of New York.

Found at the base and sides of the mountains up to about 3,000 feet elevation it may be recorded as neither very common nor very rare. July through August.

var. **rufitarsis** nov. var.

Very similar to last. Slightly larger, more elongate and convex. Basal impressions of thorax and interval not or very faintly and sparsely punctured; averaging much less so than in *washingtonensis*. Tarsi lighter in color and more reddish; tibiæ darker but also less so than in *washingtonensis*.

Described from a pair kindly presented to me by Mr. Charles Schaeffer.

Holotype ♂ and allotype ♀ from Black Mountain, September 13, North Carolina and in the Nicolay Collection.

In view of the apparently very local and restricted area where *washingtonensis* is found we deemed it fitting to honor this southern mountain form with a varietal name even though some of the slight differences mentioned above may not prove entirely constant when additional material is collected.

E. coracina (Newn.) [*mœrens* (Newn.), *adjuncta* (Lec.), *venator* Casey, *lacustris* Casey].

Elongate-oval, somewhat narrower and averaging longer than *stygica* (the species with which it is most often confused). Black shining. Thorax quadrate, somewhat narrowed behind; about as wide as long (5 mm.), surface smooth, shining, side margins reflexed; basal impression broad, deep and rugosely punctured, without tubercle; hind angles obtuse, carinate, with a single distinct seta; carinæ rather variable ranging from a distinct convex ridge usually bent in away from thoracic margins and extending about a fifth of the length of the thorax to a rather short and less convex article often paralleling thoracic margin. Head smooth, larger than in *stygica;* eyes conspicuous. Elytral striæ very deep, not punctured; intervals smooth, rather convex (at least more so than in *stygica*). Femora black; tibiæ piceous; tarsi dark chestnue brown. Underside black. Metasternal and prosternal episternum and first three ventral segments coarsely and distinctly punctured, prosternum and last three ventral segments not or very faintly punctured.

Length 15–18 mm. Width 5–6.5 mm.

Hardly less common than *stygica* and next to it our most abundant and generally distributed species. More northern, however, in range and found more often in the hills and mountains while *stygica* seems to prefer the lowlands. Ranges throughout the eastern United States and Canada from Lake Superior and Newfoundland, July (Engelhardt), to the mountains of Virginia and westward to Indiana. The specimens from the Blue Ridge Mountains (Skyland, Va.) have the tendency to approach the next variety *roanica* but should be placed with *coracina* because of the distinctly wider and larger head and thorax. *Coracina* is abundant among the hills of northern New Jersey especially around Greenwood Lake. Found under stones and logs during the summer and early autumn months.

After examining the type and original description we are convinced that *adjuncta* LeConte and *coracina* are one and the same species. *Adjuncta* was described because "the carina of the thorax narrows the lateral margin posteriorly instead of being parallel with it as in *coracina;*" also the carina is "less elevated." As might be e xpected in large series these characters are variable and consequently cannot be retained.

var. **roanica** Casey (*strigosula* Casey).

Differs from *coracina* "in its much narrower form, narrower, deeper and more elongate thoracic foveæ and deeper subapical sinus of the elytra."

The thorax averages longer and less quadrate. Elytral striæ even deeper than *coracina* with intervals more convex. Eyes slightly smaller. Carinæ of thorax usually more distinct; longer, straighter and more convex.

Length 14–17 mm. Width 5–6 mm.

Casey's type is from Roan Mountain, North Carolina. The senior author has collected this geographical variety in the Unaka and Smoky Mountains (Elkmont, Mt. Leconte) of Tennessee during August and through early October. Common at elevations of 2,500 to 4,000 feet.

Despite Colonel Casey's assertion that *strigosula* "may be placed near *umbonata*" this cannot be. *Umbonata* has the distinct tubercle in the basal impression of the thorax which associates it immediately with *stygica* while *strigosula,* lacking it, falls in the *coracina* group. We regard it as a synonym of *roanica* and as extending this variety's range northward to Hagerstown, Maryland. We would also place specimens from Kentucky in the Horn Collection in Philadelphia under *roanica.* Material from Kentucky and Maryland would naturally be very close to and have characteristics of the true *coracina* taken in the Blue Ridge Mountains of Virginia and would not be as typically different as those from North Carolina and Tennessee which approach the next species *relicta* somewhat.

var. **erebea** (Casey) (*ludibunda* Casey).

Differs from *coracina* as follows, "much smaller, narrower form, more flattened upper surface, more broadly rounded thoracic angles and shorter, though strongly developed carina." *Erebea* is shorter, proportionately broader and generally a smaller beetle than either *coracina* or its other variety *roanica.*

Length 14–15 mm. Width 4.8–5.5 mm.

Described from Bayfield, Wisconsin (Wickham). This variety replaces *coracina* in some parts of New England. The senior author found it common at Greenville, Maine, during August. One specimen from Norfolk, Conn., May 5.

After examining Casey's type we can find no apparent differences between *ludibunda* and *erebea.* *Ludibunda* was described from Buena Vista Spring, Franklin Co., Pa.

Erebea might be confused more readily, by some, with *washingtonensis* rather than with its stem species *coracina.* It may be told at a glance from *washingtonensis* by the elytra not being distinctly rounded behind the middle and not so narrowed towards the base and also by its longer and more oblong form. It also apparently does not occur in the same localities as *washingtonensis.*

E. relicta (Newn.) [*protensa* (Lec.)].

Elongate; longer and narrower than either *stygica, lachrymosa* or *coracina.* Black, shining. Thorax longer and more distinctly narrowed behind than in any of the preceding species, surface smooth, shining, side margins reflexed; basal impression deeper and more of a channel than in *coracina,* rugosely punctured, without tubercle; hind angles obtuse, not carinate but with a small more or less distinct tubercle instead, on which there is a distinct seta. Head smooth, large; eyes conspicuous. Elytral striæ very deep, not punctured, intervals smooth, very convex. Femora black; tibiæ piceous. tarsi dark chestnut brown. Underside black; punctation as in *coracina.*

Length 16–20 mm. Width 5.5–6 mm.

Apparently a very local and rather uncommon species *relicta* is reported from Indiana as occurring beneath stones in deep ravines, May 25 through September 18 (Blatchley). Other localities are Lake Superior, New York, Canada, Pennsylvania, and North Carolina (Horn and Nicolay Collections), Black Mountains, N. C. (Schaeffer Collection).

The specimen marked *relicta* in Casey's collection from Louisiana is *stygica. Relicta* most closely resembles *coracina* variety *roanica* but can be easily separated by the absence of carinæ on the thorax and by its longer and more distinctly narrowed thorax behind and generally longer and more narrowed form.

E. flebilis (LeConte).

Somewhat resembles preceding but much smaller. Thorax more subparallel, not distinctly narrowed behind. Thorax with tubercle at hind angles as in *relicta.* The senior author examined the type some years ago and we are indebted to Mr. Phillip Darlington for obliging with the following note: "The type of *E. flebilis* measures 14.5 mm. from tip of head to apex of elytra. LeConte has a second specimen set beside the type but from a different source (it has a pink label, indicating Middle States). Both are placed at the end of LeConte's series of *coracina*."

Flebilis was described from a single specimen taken from Lake Superior and while it appears as an abundantly valid species, until more material is collected, it is hard to say whether or not the unique is after all only a "sport." Colonel Casey's *flebilis* is *coracina*.

***Melanius** Bon. (*Omaseus* Steph.)

Thoracic foveæ duplex. Head well developed with prominent eyes and slender palpi. Thorax more or less constricted at base, except in *luctuosus*. Each elytron with three dorsal punctures.

KEY TO SPECIES

Basal thoracic impressions coarsely, densely punctulate, space between usually punctulate, but punctures less dense; elytra not iridescent, striæ deep .... (1).
Basal thoracic impressions not or very sparsely punctured; elytra more or less iridescent, striæ fine .... *ebeninus*.
(1) Thorax moderately narrowed behind, angles small, rectangular, but slightly prominent .... (2).
Thorax sharply narrowed behind, cordate; angles rectangular and prominent .... *caudicalis*.
(2) Form slender, length 9–12 mm. .... *luctuosus*.
More slender and smaller 7–8 mm. .... var. *tenuis*.
Form much broader, slightly more convex; length 13–15 mm. .... *corvinus*.

M. ebeninus (Dej.) [*acutangulus* (Chd.)]

Elongate-oblong. Black shining with elytra more or less iridescent. Thorax widest at apex, sides rounded, sinuate near hind angles. Striæ of elytra finer and more shallow than in other species of the genus, very finely punctured; intervals flat. Length 14–16 mm.

* Replaces *Omaseus* of Leng list. The species of this genus with the exception of one introduced form *vulgaris* L. now established in Washington and Oregon (Hatch, Pan-Pacific Ent., Vol. IX, No. 3, 1933, pp. 117–121) are indigenous to Europe. According to Hatch, *Omaseus* may be told from *Melanius* by one or two setæ on either margin of the ventral surface of the last tarsal segment.

This is the rarest of the four species found around New York. It has been taken on Long Island by Mr. Engelhardt. There are a few scattered records from New York State which is probably its northern limit. We question the authenticity of some from the northern part of the State. Taken occasionally in New Jersey generally along the sea-coast and ranging southward to Florida and Texas. This species is placed in the subgenus Metamelanius Tschitsch by Csiki in "Coleopterorum Catalogus," Pars 112, p. 632, but we prefer to leave it in *Melanius*.

M. caudicalis (Say) [*nigrita* (Kby.), *agrestis* (Bland), *brevibasis* (Casey)]

Elongate, much more slender than the preceding species. Black, shining. Antennæ reddish brown, femora black, tibiæ and tarsi reddish to piceous. Thorax as given in key. Striæ of elytra moderately deep, finely punctured. Length 10–13 mm.

Fairly common on the New Jersey meadows at Arlington and also along the Potomac River in Virginia. Its range as shown in the Leng list is Oregon, Colorado, Lake Superior, Indiana and south to and including Maryland. Possibly the western records are incorrect and this species will be found to occur only in the east like all the other genera and species of *Pterostichini* treated in this paper. Found all year round under logs and stones.

M. luctuosus (Dej.) [*abjectus* (Lec.), *hamatus* (Harris), *confluens* (Casey), *testaceus* (Casey)]

Similar to *caudicalis* but smaller and more slender. Thorax as given in key; basal impressions usually but not always less coarsely and densely punctured than in *caudicalis,* space between smoother. Elytra slightly wider than thorax; striæ deep, finely punctured. Antennæ and legs as in *caudicalis.* Length 9–12 mm.

Very common wherever it occurs all year round. Especially abundant in the Arlington Meadows of New Jersey, along the Hudson River valley and throughout North Jersey. Ranges from Newfoundland and Nova Scotia south through Virginia and west to Indiana and Illinois.

Despite certain peculiarities of the thorax mentioned in the original description we feel that *O. testaceus* is only a brown and immature *luctuosus*.

var. **tenuis** (Casey)

Merely a small and narrower variety of the preceding species with consequently more parallel elytra. Length 7–8 mm.

Occurs with *luctuosus* but much less abundant. A very doubtful form and hardly worthy of a name. Incorrectly placed in the genus *Dysidius* along with *testaceus* Casey by Csiki in "Col. Catalogus," Pars 112, p. 638.

M. corvinus (Dej.) [*subpunctatus* (Harris), *tenebrosus* (Chd.), *aequalis* (Casey)]

Elongate, more robust and convex than previous species. Black shining. Antennæ and tarsi piceous to black. Sides of thorax rounded, hind angles only slightly prominent; basal impressions deep, sparsely and coarsely punctured. Elytral striæ deep, not noticeably punctured. Length 13–15 mm.

Not rare but by no means as common as *luctuosus*. Ranges from Lake Superior to Virginia and Georgia. Common along the Hudson River valley around New York and also in many localities around Washington, D. C. Found all year except during winter when the ground is frozen.

Dysidius Chd.

Thoracic foveæ single, linear; hind angles never carinate. Head moderate in size. Elytral striæ deep, not punctate; each elytron with three dorsal punctures.

Key to the Species

Color purplish; basal impressions not punctured .... *purpuratus*
Black; basal impressions punctured. Length 11–13.5 mm. .... *mutus*
Length 9.5–10 mm. .... var. *egens*

D. purpuratus Lec. (?*parallelus* Mots., *ohionis* Csiki, *trinarius* Casey)

Elongate, rather robust. Head and thorax black, shining. Elytra with distinct purplish tinge. Antennæ and tarsi piceous; femora somewhat purplish. Elytral striæ deep, not punctured; intervals convex. Length 12–14.5 mm.

Reported from middle Atlantic States from New York where it is very rare and can hardly be considered as indigenous (one specimen from Staten Island, caught by Mr. Charles Leng many years ago), through Virginia and westward to Illinois, Indiana, and Ohio. The senior author has taken many specimens of this fine species along the banks of the Potomac River in Fairfax County, Virginia. It is found under stones and logs in deep, dark woods where the ground is rich and damp. Entirely absent in most places but fairly common in others. September is the best month to find it.

Csiki, in "Col. Catalogus," Pars 112, p. 637, regards *Dysidius* as a subgenus of *Pterostichus.* This makes the name *purpuratus* preoccupied and he consequently calls his species *ohionis.* We feel that it is better to break up (when possible) such a large genus as *Pterostichus* and in considering *Dysidius* as valid the name *purpuratus* of course is retained.

D. mutus (Say) [*carbonarius* (Dej.), *morosus* (Dej.), *picicornis* (Kby.), *pulvinatus* Hausen, *stenops* Hausen]

Elongate, usually but not always more slender than *purpuratus;* subdepressed. Black, shining. Antennæ and legs piceous. Thorax smaller and less rounded than preceding species. Elytral striæ deep, faintly punctured, intervals subconvex.

One of the most common of our *Carabidæ.* Occurs throughout the northeastern part of the United States. Found all year round but most common in the spring and autumn.

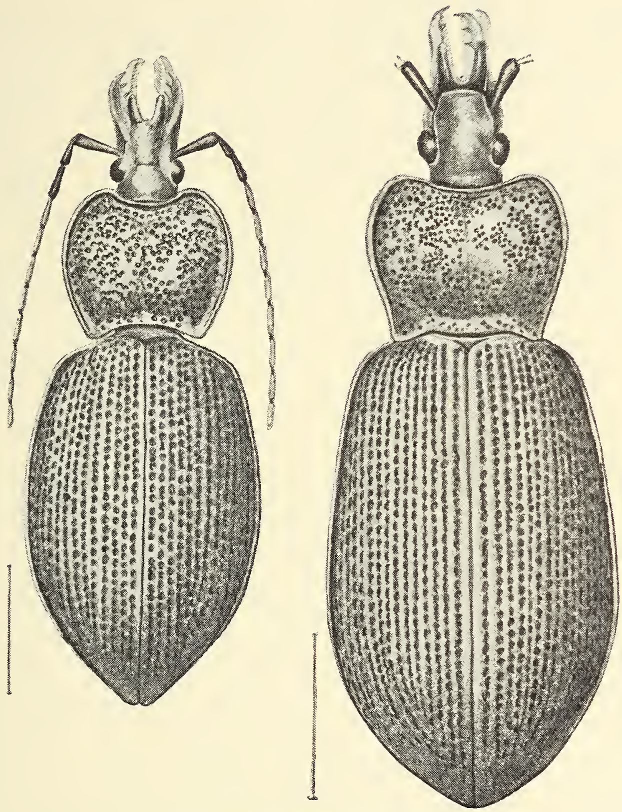
var. **egens** Casey.

An all around diminutive form of *mutus.* Occurs with it but much less abundant. Described from New Jersey. Specimens taken by the senior author at Hewitt and Arlington Meadows of the same state.

PLATE XIII

Scaphinotus snowi Lec.

Male drawn from specimen in collection of senior author. Female drawn from specimen in the collection of the Academy of Natural Sciences of Philadelphia. Male at left; female at right.



SCAPHINOTUS SNOWI

BOOK REVIEW

Bumblebees and Their Ways, by O. E. Plath. (The Macmillan Co., N. Y., 1934. $4.00.)

America has long needed a book on the interesting habits of our bumblebees to supplement Franklin's taxonomic monograph. Dr. Plath has now met that need in a very satisfactory manner, at least so far as Eastern United States is concerned. This book does for that region what Sladen's "The Humble Bee" did for the British Isles. It is interesting and informative reading for the general biologist and a good guide for those who may wish to extend such observations to other regions.

Incidentally, the present reviewer is delighted to see the name *Bombus* come back to our literature in place of *Bremus* and its terrible associates.

FRANK E. LUTZ

STUDIES IN AMERICAN SPIDERS, THE GENUS WUBANA

BY SHERMAN C. BISHOP AND C. R. CROSBY

WUBANA Chamberlin

Ent. Soc. Am. Ann. 12: 252. 1919.

Type, *Bolyphantes drassoides Emerton*

KEY TO SPECIES, MALES

Paracymbium armed on the side toward the cymbium with a large tooth. *drassoides* Em.

Paracymbium without this tooth.......... *pacifica* Banks.

Wubana drassoides Emerton

Bolyphantes drassoides Emerton, Conn. Acad. Sci. Trans. 6: 72, pl. 23, f. 5. 1882.

Nematogmus drassoides Banks, U. S. Nat. Mus. Bul. 72: 28. 1910.

Sphecozone drassoides Petrunkevitch, Cat. Am. Spid. p. 270. 1911.

Wubana drassoides Chamberlin, Ent. Soc. Am. Ann. 12: 252. 1919.

Wubana retrahens Chamberlin, same, p. 253, pl. 18, f. 10. 1919.

Male. Length, 2 mm. Cephalothorax orange yellow, very narrowly edged with gray, viewed from above rather broad, evenly rounded on the sides on the hinder half; on the front half the sides are nearly straight and converged, nearly straight across the front with the angles rounded. Cephalothorax viewed from the side steeply ascending in a straight line behind, then nearly level to the base of the horn which slants forward, blunt at tip and concave in front. Back of horn clothed with stiff hairs, curved forward and increasingly stouter towards the tip, the terminal one a very stout spine. Clypeus concave immediately below the eyes and then gently convex. Sternum broad, pale yellow, sometimes distinctly and narrowly margined with blackish. Endites pale yellow. Legs long and slender, pale yellow. Abdomen pale grayish with a medium stripe in front and three or four narrow cross bands on the hinder half, dark gray, spinnerets surrounded with dark gray except below. Sometimes the abdomen is all pale except for a light gray stripe in the middle in front and faint indications of the cross bars. In specimens from California the dark markings on the abdomen are much more distinct; in one from Berkeley the abdomen is almost entirely black. Venter with two grayish stripes, darker and broader in front.

Posterior eyes in a gently recurved line, the median separated by the diameter and from the lateral by the radius. Anterior eyes in a straight line, the median almost as large as the lateral, nearly equidistant, separated by less than the radius.

Femur of palpus nearly straight, patella short. Tibia with a deep, smoothly rounded excavation on the lateral side and produced into a long, broad, process that extends spirally along the side of the base of the cymbium. This process is narrower than in *pacifica*. The paracymbium is rather narrowly articulated to the cymbium; at the point of attachment the surface is elevated to form a small tooth; the anterior margin is sinuate and armed at the ventral angle with a stout curved tooth; posteriorly the paracymbium is produced into a long, slender process that extends almost to the base of the tibia; the posterior margin near the tip of the tibial process is also armed with a rather long, gently curved, black tooth. The long style-like embolus arises from a bulb-like base and loops proximally nearly to the base of the cymbium; it then turns distally and the tip lies near the apex of the bulb. Throughout more than half its length the embolus is protected by a membranous sheath.

Female. Length, 2.5 mm. Similar to the male, the head without the horn, armed with a median row of stiff hairs slanting forward. The dark markings on the abdomen distinct as in the more strongly marked eastern males.

Posterior eyes in a straight line, the median separated by a little less than the diameter and from the lateral by about the radius. Anterior eyes in a straight line, the median smaller than the lateral, separated by the diameter and a little nearer to the lateral.

Epigynum distinctly protuberant, the posterior margin evenly rounded, the middle lobe triangular and lying at the same level as the lateral lobes.

Type localities: Holotype ♂, Mt. Carmel, Hamden, Conn. Allotype ♀, Cabin John, Md.

District of Columbia: Washington, Nov. 1 ♂ (Fox); July 1, 1912. 1 ♂.

Maryland: Cabin John, Dec. 3, 1918, 1 ♀ (the allotype).

North Carolina: Minehole Gap, Oct. 17, 1923. 1 ♂; top of Blue Ridge, Towns and Rabun County Line, Oct. 18, 1926, 1 ♂.

California: Ingleside, San Francisco, Dec. 20, 1919, 1 ♂ (Dietrich); Berkeley, Jan., 1920, 1 ♂ (Dietrich), Dec., 1919, 1 ♂ (Dietrich).

Utah: Chalk Creek, 1917, 1 ♂ (Chamberlin); Filmore, 1 ♂ (type of *retrahens* Chamberlin).

Chamberlin also records this species from Utah: Uintah Mts., 7,500 ft.

The record of this species in Cornell Univ. Agr. Exp. Mem. 101: 1052. 1928, is an error. The specimen is *W. pacifica.*

The type of *W. retrahens* is a ♂ lacking one molt. The right palpus has been opened and the organ released. We compared it with specimens of *drassoides* and they seem to be identical. Chamberlin's figure of the palpus is drawn from the one unmolted. The black spine that seems to arise from the tibial process is the shorter tooth of the paracymbium.

Wubana pacifica Banks

Bolyphantes pacificus Banks, Am. Ent. Soc. Trans. 23: 69. 1896.
Nematogmus pacificus Banks. U. S. Nat. Mus. Bul. 72: 28. 1910.
Wubana pacifica Chamberlin. Ent. Soc. Am. Ann. 12: 252. 1919.

Male. Length 2.4 mm. Cephalothorax brownish with radiating lines, the head back to the cervical groove and the clypeus lighter; viewed from above evenly rounded on the sides, the eyes in profile, viewed from the side evenly rounded over the back to the base of the horn which is nearly vertical in front. The head is armed back of the eyes with a horn, triangular in outline when viewed from the side. On the back of the horn there is a double row of stiff hairs curved forward. On the type there was apparently a much stronger terminal spine similar to the one in *drassoides*, which had been broken off. Mr. Banks has an unpublished drawing of the type which shows this spine. A stiff hair above each anterior median eye, a pair on the clypeus just below the median eyes, one on each side between the posterior median and the lateral eyes, and one just above the posterior end of each posterior lateral eye. Posterior eyes in a gently recurved line, the median a little nearer to the lateral than to each other. Anterior eyes in a slightly procurved line, the lateral much larger than the median, the median a little nearer to each other than to the lateral. Sternum and endites yellowish, labium darker. Abdomen gray with a large pale spot near the tip. Venter gray with longitudinal sublateral light lines. Legs brownish yellow.

The palpus is similar to that of *drassoides*. The tibial process is broader. The most striking differences are to be seen in the structure of the paracymbium; the form of the tooth at the point of attachment is somewhat different, the posterior process is much broader and the black tooth between this process and the edge of the cymbium is lacking. The embolic division is almost the same as in *drassoides*.

Female. Length, 3 mm. Cephalothorax brownish yellow, viewed from the side the outline gradually rises to a point back of the eyes and then curves downward to the anterior median eyes. The clypeus is nearly vertical, slightly concave above and convex below. Posterior eyes in a straight line, nearly equidistant. Anterior eyes in a very slightly procurved line, the median smaller than the lateral and much nearer each other than to the lateral. Sternum and endites yellowish, labium darker. Legs and palpi brownish yellow.

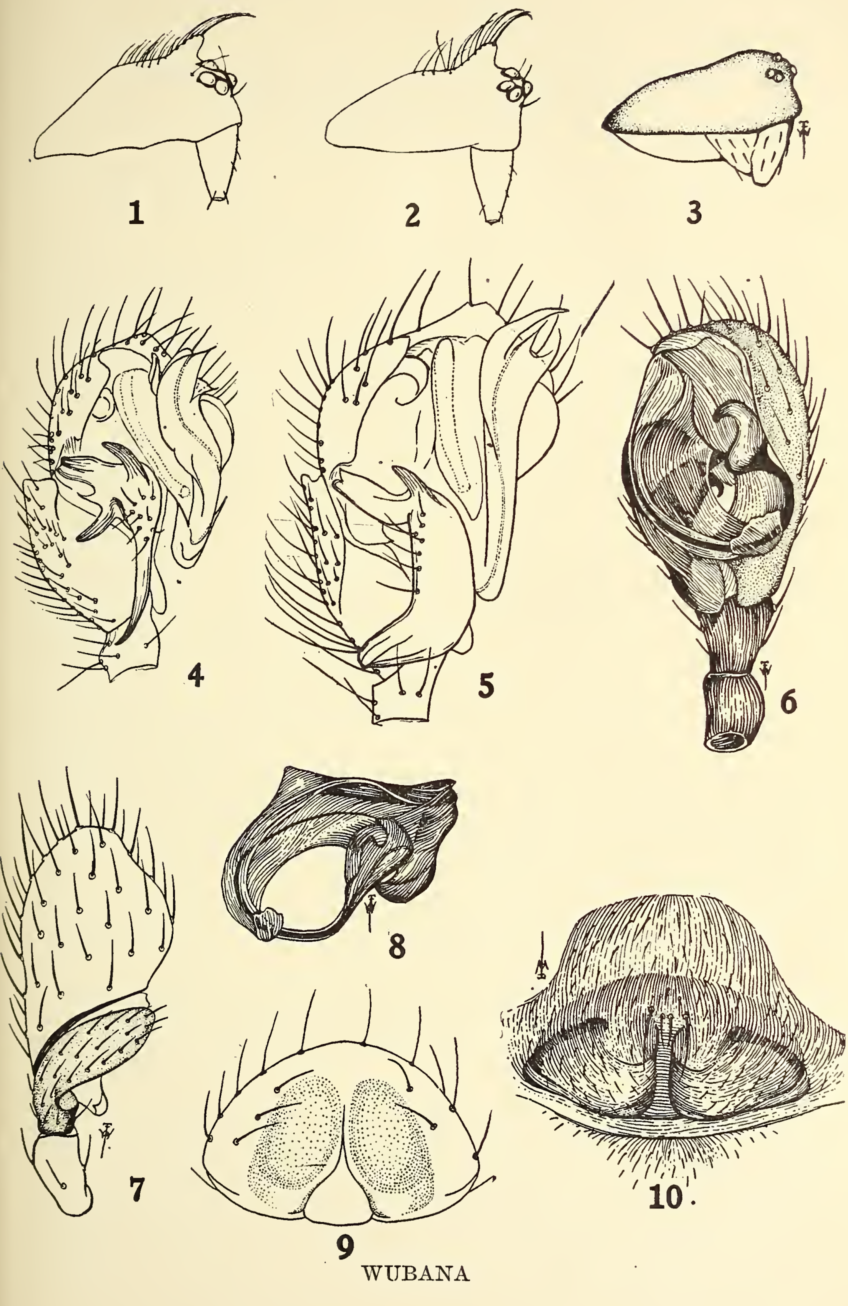
Abdomen high in front and somewhat pointed behind, gray above and below. A broad median stripe on the underside lighter, bounded on each side by a narrow longitudinal light line. Epigynum consists of two broad thickened lobes at the base of which there is another pair of thinner smaller lobes.

Type locality: Olympia, Wash.
Washington: Olympia, 1 ♂, 1 ♀, the types.
New York: Mt. Whiteface, Aug. 1916, 1 ♂.

PLATE XIV

1. Wubana drassoides ♂, cephalothorax from the side.
2. Wubana pacifica ♂, cephalothorax from the side.
3. Wubana pacifica ♀, cephalothorax from the side.
4. Wubana drassoides ♂, right palpus, lateral view.
5. Wubana pacifica ♂, right palpus, lateral view.
6. Wubana pacifica ♂, right palpus, ventral view.
7. Wubana pacifica ♂, right palpus, dorsal view.
8. Wubana drassoides ♂, embolic division of right palpus.
9. Wubana drassoides ♀, epigynum.
10. Wubana pacifica ♀, epigynum.

The preparation of the drawings by Helen M. Zorsch and Albert W. Force, was made possible by a grant from the Heckscher Research Foundation at Cornell University.



WUBANA

SOME NEW SPECIES OF CICADELLIDÆ (HOMOPTERA) FROM THE UNITED STATES

By Dwight M. DeLong and Ralph H. Davidson

Lævicephalus shoshone new species

In general appearance, resembling *striatus* but with distinct genital characters. Length 3.5 mm.

Vertex bluntly angled, wider between eyes than length at middle, pronotum more than twice as broad as long.

Color variable, pale green or yellowish without color markings, or with heavy infuscations on vertex, pronotum, and elytra.

Genitalia: Female last ventral segment with posterior margin roundedly produced, central half with a broad U-shaped notch extending more than two-thirds the distance to the base, usually with a small notch on either side.

Described from a series of thirteen female specimens collected from grasses in the Shoshone Basin in southern Idaho during June, July and August, 1930. Female holotype and female paratypes in author's collection.

Euscelis maculipenis new species

In form closely resembling *E. deceptus* but with distinct color pattern. Length 5–5.5 mm.

Vertex bluntly produced, one-third wider on middle than next the eyes. Elytra rather long and flaring.

Color: Vertex with a row of four spots just above margin and a transverse spot on either side, sometimes divided, extending from eye above ocellus almost to middle of vertex, black. Pronotum marked with black spots and transverse striæ. Elytra marked with small dark brown spots especially paralleling or between veins, more intensified in some specimens. Apices of elytra infuscated.

Genitalia: Female last ventral segment broadly excavated from the rather prominent lateral angles to a median broad, slightly produced tooth which is black margined. Male valve bluntly triangular, plates rather long, bluntly rounded.

Described from a series of twenty-eight male and female specimens collected at Moscow, Idaho, during July and August, 1930 and 1931, by Mr. Paul Rice, at trap lights. Holotype male and allotype female and male and female paratypes in author's collection.

Amphipyga nigrofascia new species

A small species with definite black markings on pronotum, scutellum, base of elytra and abdomen. Length male 2.7 mm.

Vertex rather sharply angled, a little wider between eyes than length at middle. Pronotum about four times as wide as long. Elytra short, exposing more than half the abdomen.

Color: Pale yellow, ocelli black. Pronotum, scutellum, and basal inner portions of elytra black. This covers a portion of the claval area. Basal half of abdomen and dorsal portion of last ventral segment black. The posterior portion of the basal half is exposed beyond the ends of the brachypterous elytra.

Genitalia: Male valve produced, triangular, almost twice as wide as long. Plates exceeding valve about one-half its length, sloping on outer margins to blunt apices. Pygofers conspicuously produced beyond plates.

Described from two male specimens collected by the senior author in a low swampy meadow at Lodi, California, August 8, 1930, near the Sacramento River.

This species can be distinguished by its small size and conspicuous color markings.

Thamnotettix chrysothamnus new species

General form of *T. atridorsum* but smaller and with distinct color markings. Length 4.5–5. mm.

Vertex bluntly angled, slightly more than one-third wider between eyes than length at middle. Pronotum almost twice as wide as long.

Color: Elytra straw yellow marked with brown. Vertex, pronotum and scutellum yellowish unmarked. Markings of elytra varying in intensity and size of pattern. In pale specimens the inner half of the clavus, a stripe extending along the claval vein and a rather broad stripe paralleling the clavus but separated from it by a narrow yellow band, dark brown. In well marked specimens the elytra are brown except for the posterior half of clavus a spot on the disc and a narrow margin along the clavus, yellow.

Genitalia: Female last ventral segment with lateral margins roundedly produced to posterior margin which is shallowly excavated on median third with sunken portion broadly embrowned. Male valve broad, triangular, plates not quite as long as combined basal width gradually sloping to bluntly pointed, appressed apices.

Described from a series of twenty-four male and female specimens collected at Minidoka, Idaho, from *Chrysothamnus* sp. in the southern Idaho desert. This species is distinct and is apparently restricted to a certain species or type of *Chrysothamnus*. Holotype male and allotype female, and male and female paratypes in senior author's collection.

Chlorotettix acus new species

A small slender species with vertex well produced and angled. Length 5–5.2 mm.

Vertex one-third wider between eyes than length at middle, pronotum one-third longer than vertex. Elytra rather long, compressed apically.

Color pale green tinged with yellow without definite markings. Eyes black.

Genitalia: Female last ventral segment rather long, lateral angles prominent, posterior margin broadly angularly notched from lateral angles. Male valve scarcely produced, almost transverse, plates rather long and narrow, as long as combined basal width. Œdagus extending considerably beyond plates, apical structures pointed and divergent.

Described from one female and two male specimens collected near Fort Hanchuca during June, 1919. Male holotype, female allotype and male paratype in collection of senior author.

Cicadula clavata new species

Resembling *variata* in form but with distinct color markings. Length 4 mm.

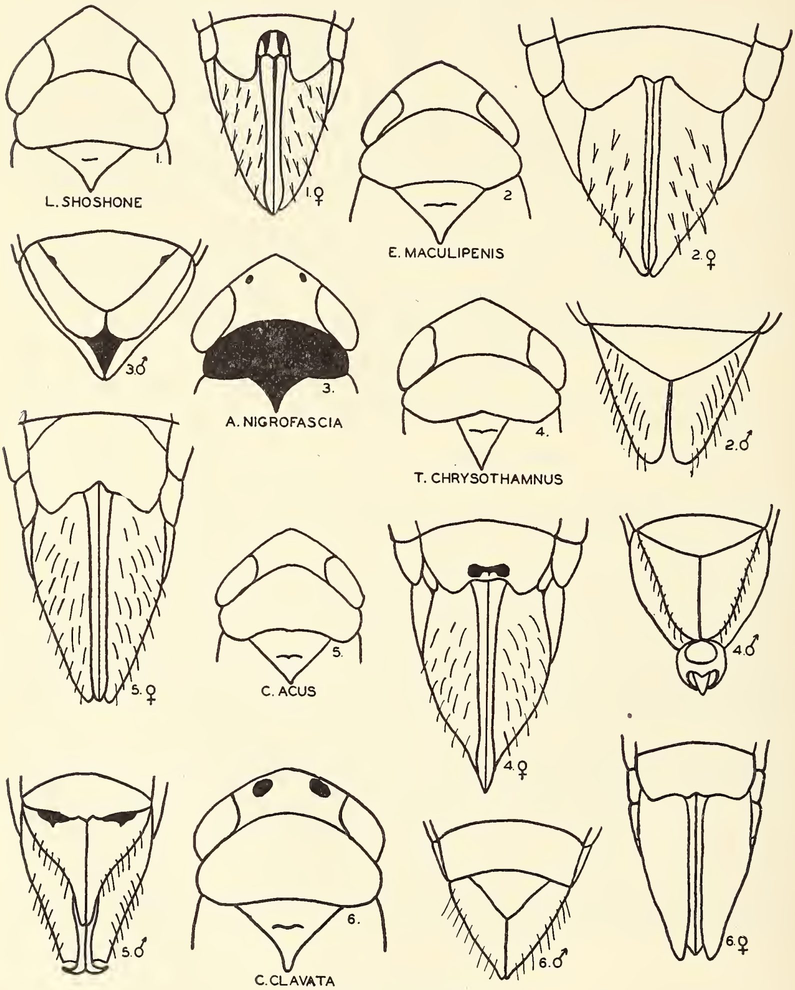
Vertex bluntly produced, twice as wide as long, pronotum almost twice as long as vertex.

Color: Golden yellow, vertex with a pair of large round, black spots just above margin. Pronotum unmarked. Scutellum with an impressed dark transverse line across middle. Elytra with clavus dark brown, apical third, frequently extending anterior to apex of clavus, dark smoky to brown. Face yellow, antennal sockets black or dark brown.

Genitalia: Female last ventral segment with posterior margin roundedly produced, almost truncate. Male valve strongly produced and rounded, plates triangular, produced into elongated, upturned apices.

Described from two male and two female specimens collected at Fairlawn, N. J., in July, 1915, by Mr. E. L. Dickerson. Male holotype, female allotype and male and female paratypes in author's collection.

It is quite possible that this is an European species but we have been unable to identify it.



CICADELLIDÆ

TWO NEW DASYPOGONINE ROBBER FLIES FROM THE SOUTHWEST (ASILIDAE: DIPTERA)

BY S. W. BROMLEY

An examination of material sent to me by Mr. J. W. Monk, of Donna, Texas, and Mr. A. E. Pritchard, of Stillwater, Oklahoma, revealed two undescribed species, one each of the genera *Ospriocerus* and *Ceraturgopsis.* Both genera belong to the subfamily *Dasypogoninae.* The types are in the author's collection.

Ospriocerus monki new species

Total length, 16–21 mm. Body, legs, and wings black, but differs from *minos* Osten Sacken in having the hairs and bristles of coxæ, mystax, beard, and occiput, and the supra-alar bristles white. The head and thorax are also more or less white pruinose, and abdominal segments 2–5 have a white pruinose spot on the posterior lateral margins. In *minos,* the hairs and bristles are all black and there are no pruinose spots on the abdomen.

MALE. Head black: face, vertex and occiput sordid white pruinose and pollinose. Mystax, beard, palpal hairs, occipital hairs, white. Hairs of vertex and antennæ, black. Thorax, black. Pleura with white pollinose areas; pronotum and scutellum, humeri, sides and posterior portion of mesonotum, white pollinose. Two very faint longitudinal whitish pollinose stripes on disc of mesonotum. Mesonotum with fine black hairs anteriorly and black bristles posteriorly. Supra-alar and scutellar bristles, hairs of pleura and bristles and hairs of pronotum white. Wings fumose. Legs black with black hairs and bristles; pulvilli pale brown. Abdomen cylindrical, black with fine scattered black hairs; some of the longer hairs on the sides of the first two segments, white. Segments 2–5 with a small white lateral spot on posterior angles. Genitalia black with black hairs.

HOLOTYPE, male, Donna, Texas, August 21, 1933. PARATOPOTYPE, male, July 28, 1933. PARATYPE, one male, no date. All collected by J. W. Monk. This brings the number of asilid species known from Texas to 166.

Ceraturgopsis oklahomensis new species

Total length, 13–15 mm. A small, robust, pilose, black, bee-like species, abdomen banded with white, smaller than *cornutus* (Wiedemann). The light pollinose areas are white, not golden as in *cornutus,* the wings nearly hyaline, not dark yellowish-brown, the legs black or brownish, not light reddish, the thorax and head more pilose, and the mesonotum without the golden and black pattern on the disc, characteristic of *cornutus.*

MALE. Head black, sordid white pilose. Thorax black, pilose, the hairs and bristles sordid white. Disc of mesonotum with short pale brown hairs. Pleura with white pruinose spots. Borders of mesonotum and scutellum white pollinose. Scutellum with white bristles and hairs. Legs black; the four anterior tibiæ and tarsi brownish; hairs and bristles sordid whitish or pale brown. Wings hyaline, veins pale brownish. Abdomen black, segments 2–5 with posterior margins broadly white, giving the abdomen a banded appearance.

FEMALE. Similar; abdominal segments 1–5 with posterior margins white. In the allotopotype, the femora are reddish-brown, in the paratype, the femora are black.

HOLOTYPE, male, Caddo County, Oklahoma, April 16, 1933 (R. Dahms). ALLOTOPOTYPE, female, same data. PARATYPE, female, Norman, Oklahoma, April 9, 1932 (R. D. Bird).

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF DECEMBER 6, 1932

A regular meeting of the Society was held on December 6, 1932, in the American Museum of Natural History; Vice-president Bell in the chair, with twenty-five members and thirteen visitors present.

The Program Committee announced that, at the next meeting, Dr. Melander would speak on ''Insect Embryology'' and that Dr. Leonard would speak on ''Recent Entomological Developments in Porto Rico.''

Dr. Ruckes delivered the second part of his paper on ''The Mouth Parts of Insects.'' The following abstract of his paper, delivered at the meetings on Nov. 15 and Dec. 6, was furnished by Dr. Ruckes.

Abstract of Dr. Herbert Ruckes' Paper

MOUTH PARTS OF INSECTS, PART I

Developmental Aspects. The principal workers on this subject have been: Cholodkovsky; Kowalevsky; Nusbaum; Grabe; Tischmiroff; Carriere; Heymons; Wiesmann; Patten; Wheeler.

The general accepted plan is, that insects are constructed in 18 segments; the head constitutes not less than six. These are known respectively as the cephalic segments, consisting of three metameres; the mandibular; the first maxillary; and the second maxillary. The identification and designation of the various mouth parts is obscured by the fact that in almost all instances, extensive coalescence of the above-mentioned six segments takes place.

The finer analysis of the segmentation of the head is based upon the arrangement of the appendages and the finer structure of the brain. Under the latter heading we can recognize:

(1) The proto-cerebrum, which locates the pro-stomial region and the pre-antennal segment.
(2) The duto-cerebrum, which limits the pre-antennal segment, and
(3) The trito-cerebrum, which locates the mandibular segment.

Heymons recognized the following; an unsegmented preoral region and six postoral segments: (1) the pre-antennal segment; (2) the antennal segment (the first antennæ of crustacea); (3) the post-antennal part (the second antennæ of crustacea); (4) the mandibular segment; (5) the first maxillary segment; and (6) the second maxillary segment.

In homologizing the mouth parts of insects with other arthropods, we can recognize:

(a) the labium, equivalent to the pro-stomium
(b) pre-antennal segment, equivalent to the eyestalks of crustacea
(c) antennæ, equivalent to the first antennae, or antennules of crustacea
(d) the post-antennal segment (almost invariably absent, or at the most vestigial), equivalent to the second antennæ of crustacea
(e) the mandibular segment, equivalent to the mandibules of crustacea
(f) the maxillary segment, equivalent to the first maxillæ
(g) the labium, equivalent to the second maxillæ

The fundamental plan of the insect mouth parts was explained, and its various parts homologized with the corresponding parts of the crustacean mouth parts.

Abstract of Dr. Herbert Ruckes' Paper

MOUTH PARTS OF INSECTS, PART II

Evolutionary Trends in the Mouth Parts: The orthopteroid type is considered primitive and generalized; a relatively broad labrum, chewing type of mandibles, maxillæ with a full complement of parts and five jointed palps and a labium of full development and three jointed palps.

Tendencies of the Labrum: This as well as other parts illustrates the principles of evolution by either addition (aggrandizement) or reduction. The labrum is proportionately bigger in larval lepidoptera and larval and adult odonata. The labrum is reduced in the adult lepidoptera, neuroptera and hymenoptera. In the diptera it is changed considerably in shape, being usually much elongated and stylet-like.

Tendencies of the Mandibles: They become greatly enlarged in certain species of coleoptera, in the Formicidæ, Odonata, termites and larval neuroptera (Myrmelionidæ). They show marked reduction in the adult lepidoptera, trichoptera, and ephemeridæ. They become extremely elongated in the hemiptera and diptera.

Tendencies in the Maxillæ: These show relatively little enlargement in any orders of insects, for the most part the evolution is one of reduction or of change in shape. Reduced maxillæ are found in the trichoptera and ephemeridæ and become greatly elongated in the diptera, lepidoptera and hemiptera.

Tendencies in the Labium: This organ shows least modification of any of the mouth parts. It reaches its greatest degree of modification in the diptera and hemiptera where it is much elongated and forms a casing for the other stylet-like mouth parts or forms the sucking and lapping apparatus in the diptera.

On the whole, the mouth parts of insects are plastic enough to evolve into forms that best meet the food-getting requirements of the species. The orthopteroid plan is best suited as a foundation from which the various lines of evolution might take place. Mouth parts of various orders of insects might be homologized if time permitted.

Dr. E. P. Felt gave a historical account of "The Development of Insect Control on Shade Trees" from the time of Harris, when whale oil solution and tar bands were used, and when it was recommended that corn be spread around under trees to attract swine which would destroy caterpillars by trampling upon them and eating them. Present control methods are largely the result of the campaign waged since 1890 against the Gypsy Moth. He emphasized the great value of the discovery of arsenate of lead as an effective agent of control, obviating leaf injury. He described in some detail the scouting method used to uncover new infestations, including the means by which the operations of the various agents were checked up. He said that eventually the use of traps might prove to be a more economical method of locating new infestations and that dusting from *aeroplanes* would no doubt be used more and more for control purposes. The outbreak at Pittston, Penna., of a Gypsy Moth infestation during the season of 1932 was mentioned as a serious threat of a further spread of this insect.

Commerce has introduced some fifty or more species of insects which attack shade trees besides our own native pests. Some fifteen foreign insect parasites have been successfully established in this country in the Gypsy Moth campaign. Large areas of a single species of trees are especially subject to insect attack, but vigorous and healthy trees resist such attacks quite successfully.

Illustrating the present attention paid to the problem of the care of shade trees, Dr. Felt mentioned that Connecticut in 1932 had 164 Tree Wardens and Rhode Island 37, and that there are 136 Shade Tree Commissions in the State of New Jersey, and in various states several commercial organizations are engaged in this work.

Dr. C. T. Brues, of Cambridge, said that he was especially glad to attend a meeting of the New York Society as the first meeting of any entomological society he ever attended was of this same society.

JOHN D. SHERMAN, JR.,
Secretary Pro-tempore

MEETING OF DECEMBER 20, 1932

A regular meeting of the Society was held on December 20, 1932, at the American Museum of Natural History at 8:15 P.M.; Vice-president Bell was in the chair, with twenty-four members and twenty-three visitors present.

The Program Committee announced that the Annual Meeting of the Society would be held on January 3rd, 1933.

The following resignations were accepted, with regrets, on the part of the Society: Christian E. Nielson, and W. R. Walton, of Washington, D. C.

Mr. Davis spoke briefly on the death of Dr. W. J. Holland, who was a beloved member of the Society, a great executive, and who had helped many little societies by means of the Carnegie Fund. It was the unanimous wish of the members present that the Secretary write a note of sympathy to Mrs. Holland expressing the regret of the Society in the passing of one of their members.

The Nominating Committee, consisting of Messrs. Horsfall, Safro, and Sherman, was asked to report at the next meeting of the Society.

It was announced that in the future a period not to exceed fifteen minutes, under Miscellaneous Business, would be a part of the program in order to give members an opportunity of exhibiting specimens, etc.

Dr. Melander gave the third paper in the series on the Biology of Insects. Speaking on ''Insect Embryology,'' he illustrated his remarks with lantern slides showing the mysterious phenomenon of the unfolding embryo.

Dr. Leonard then gave an interesting review of the ''Entomological Developments in Porto Rico.'' He spoke first of the Fourth International Congress of Sugar Cane Technologists, which was held in Porto Rico in 1932 and attended by forty-five foreign delegates, the largest group of entomologists ever in Porto Rico. Dr. Pemberton, of Honolulu, was the Chairman. The Proceedings of the whole Congress are to be published in a few months. One of the most interesting papers presented was that on the giant toad, *Bufa marinus,* which is bred very easily, found as high as 6,000 feet above the sea, and whose food consists largely (55%) of insects injurious to agriculture. These toads have been transported successfully from the United States to Honolulu, packed in moistened sawdust, forty toads in a box. They have arrived at their destination, hungry and shrunken, but otherwise none the worse for their three weeks' trip. In Honolulu, they were used to protect the sugar-cane and also ornamentals.

Dr. Leonard said that the cottony cushion scale, the insect that nearly ruined the citrus in California in the seventies, was discovered in Porto Rico for the first time in April, 1932. Through the rapid cooperation of the Florida State Plant Board, Australian lady beetles were received in Porto Rico a week after the infestation of the scale was discovered. By July, the two original infestations and others had been greatly reduced. Later on in the summer, a hurricane finished the job by destroying much of the citrus of Porto Rico. Dr. Leonard concluded his remarks by showing a slide of a group of some of the entomologists present at the Congress of Sugar Cane Technologists.

Dr. Reginald Painter, of the Kansas State College of Agriculture and Applied Science in Manhattan, said he was very happy to attend a meeting of the Society on his trip through the east, where he was studying Bombyliidæ types in the various museums. His particular field is the study of the resistance of plants to insect attack. He extended a cordial invitation to the members of the Society to visit the Kansas Entomological Society, which publishes the only entomological journal between the Atlantic coast and the Pacific coast.

Dr. Paul E. Hering, of Cornell University, expressed his pleasure in being present at a meeting of the Society.

ELIZABETH SHERMAN, *Secretary*

MEETING OF JANUARY 3, 1933

The annual meeting of the Society was held on January 3, 1933, in the American Museum of Natural History; Vice-president Ernest L. Bell in the chair, with twenty members and twenty visitors present.

The Nominating Committee read its report. It was moved and seconded that the Secretary cast a ballot electing the officers and committees nominated in this report, as follows:

President: Ernest L. Bell
Vice-president: A. L. Melander
Secretary: Miss Elizabeth Sherman
Treasurer: G. C. Hall

Executive Committee: Henry Bird
Wm. T. Davis
F. E. Lutz
Herbert Ruckes
H. F. Schwartz

Publication Committee:	H. B. Weiss
	C. W. Leng
	John D. Sherman, Jr.
	C. E. Olsen
Auditing Committee:	E. T. Huntington
	H. F. Schwartz
	E. R. P. Janvrin
Curator:	A. J. Mutchler
Librarian:	F. E. Watson

The following committees were appointed:

Field Committee:	Herman Moennich
Program Committee:	C. H. Curran
	H. B. Weiss
	J. L. Horsfall

The resignations of Dr. O. A. Johannsen and Mrs. Alan S. Nicolay from the Society were accepted with regrets.

The Librarian submitted his report on accessions to the Library of the Society. It was placed on file.

Dr. Ruckes spoke of the meloid beetle, *Cystodemus wislizeni,* which is found in the dry areas of New Mexico with a physiological adaptation for the heat and dryness of the climate. The elytra are folded in a tent over the body to give ventilation.

The following were proposed for membership in the Society: Mr. Clayton M. Cook, 23 West 70th Street, New York City; James M. Leonard, 15 Minetta Street, New York City.

Dr. Roland F. Hussey then presented the paper of the evening, ''Collecting Insects in Paraguay,'' which was an interesting account of his travels and collecting experiences in this country.

The party, consisting of Dr. and Mrs. Hussey and Dr. Donald Wees, left New York early in September, 1931, with the intention of doing zoological reconnaissance work in the Chaco, in a region lying on the Paraguayan-Argentine boundary about 200 km. west of the Paraguay River. The particular objective of the party was the Estero de Patiño, a great swamp about 70 km. in length, which interrupts the course of the River Pilcomayo.

On arriving in Buenos Aires, Dr. Hussey was advised strongly against attempting to work in that part of the Chaco, as it had been made a military zone and was within the scene of action in the hostilities between Paraguay and Bolivia. When the party reached Asuncion in mid-October, the flooded conditions of the Chaco, and the threats of still higher water, when the rainy season arrived, precluded the possibility of working in the Pilcomayo district, and accordingly the program was changed and work was undertaken in the east central part of Paraguay.

The first field work was done in Colonia Independencia, a homestead colony located about 30 km. northeast of Villarrica, and it was here that Dr. Hussey found conditions for entomological work the best that he encountered in Paraguay. The seasonal distribution of insects is very strongly marked, and at this time (October 25 to November 15) the spring was not so far advanced as to reduce the number of forms very materially. This was a district characterized by broad flat *campos*, surrounded by gently rolling land which was unusually heavily forested; and it was upon the higher ground that the homesteads were cut out of the forest and planted with a variety of crops and subtropical fruits. Dr. Hussey commented on the fact that apparently there were very few insect pests affecting these crops, the notable exceptions being the ever present Attine ants and the abundant *Dysdercus ruficollis*, which in some places is a serious cotton pest. The native food plant of the latter is *Sida rhombifolia*, an abundant and wide-spread weed which, like the cotton plant, is of the family Malvaceae.

From Colonia Independencia, the party moved north-east, stopping for a few days at Colonia Troche, to a large ranch located about ten miles from the village of Caaguazu. This lies east of the watershed and the drainage is to the Paraná: the district is one of green rolling plains and large areas of heavy forest, always on the higher ground. On the plains there are scattered trees of a dwarf palm, *Cocos yatai*, and less frequent low trees of a Euphorbiaceous species, *Sapium haematospermum*. The latter is the food plant of a remarkable Scutellerid bug, *Pachycoris torridus* which, like its Central American and Antillean Congeners, furnishes the only example of maternal solicitude displayed by any American Heteroptera, in which the female stands over the egg mass until the young emerge, and sometimes even until after their first moult. This plant also has a certain species of Coreid identified with it, whose dark brown eggs are inserted singly into the tissues of the seed covering.

Conditions for entomological work in this region proved most disappointing. The preceding winter had been cold, with several snow falls; the spring had been cold and wet; and from the time of the party's arrival the weather turned dry and hot. Thunder showers passed almost daily, at a considerable distance, but seemed to avoid the particular region where Dr. Hussey was working. The plains yielded few insects other than orthoptera, ants, termites, and predatory diptera and hymenoptera. Lumbering operations in this vicinity had been discontinued because of the depression, and there was no opportunity to collect any tree-top forms. Collecting at light was very poor, and formed a striking contrast with conditions as described for other years. Certain Leguminosæ, notably Acacias and Mimosas, yielded a fair variety of insects, but the plant which seemed to have the greatest variety of insects was the "Caa-ô-beti" (*Solanum verbascifolium*), a small slender tree which Dr. Hussey described as ecologically equivalent in the Paraguayan flora to the sumac in ours. The insect fauna of this plant is most varied, but the various individual plants rarely show any considerable number of different species. Thus one may have a number of large Meloid beetles, another may yield a dozen of the large *Edessa rufomarginata,* a third may have specimens of the curious Pentatomid *Dryptocephala punctata* half hidden under its closely appressed leaves.

Dr. Hussey also spoke of meeting several entomologists in the course of his travels, notably Dr. Carlos Bruch, now living in retirement near Buenos Aires after many years of service in the La Plata Museum; Messrs. Adolfo and Alberta Breyer, possessors of noteworthy collections of Argentine Coleoptera and Lepidoptera, and leaders in the Argentine Entomological Society; Mr. Heywood, curator of the Breyer collections and collector extraordinary of Argentine insects; Mr. Pedro Jorgensen, of Villarrica, Paraguay, and several others. He also commented on the insect collections in the museums in Buenos Aires and La Plata, referring particularly to the La Plata collection, which contains the specimens studied by Carlos Berg, pioneer in the Hemipterology of Argentina.

Dr. Lutz said that, whereas Dozier had observed female fulgorids showing maternal solicitude in hovering aaround the eggs which they had deposited, he wondered if this were not a case of the mother bug being too lazy to move on after depositing her eggs.

ELIZABETH SHERMAN, *Secretary*

MEETING OF JANUARY 17, 1933

A regular meeting of the New York Entomological Society was held on January 17 in the American Museum of Natural History; President Ernest L. Bell in the chair, with twenty-two members and nineteen visitors present.

The annual report of the treasurer was received and ordered placed on file. Mr. Bell stated that he had examined the treasurer's report and found it to be correct.

Mr. Clayton M. Cook and Mr. James M. Leonard, proposed for membership at the previous meeting, were duly elected members of the Society.

Mr. F. L. Fillion, a charter member, was made a life member of the Society, and the Secretary was directed to notify him of this fact.

A motion proposed by the executive committee with regard to members whose dues are in arrears was carried and the treasurer was directed to notify such members accordingly.

Dr. Lutz exhibited wings of butterflies shown between two sheets of lantern slide glass, bound by strips of bristol board impregnated with celluloid and acetone, making the specimens mould-proof and pest-proof—the name label being similarly treated and thus made permanent. He had devised this method for preparing an identification collection needed at Barro Colorado Island, but said he would like very much to have other suggestions, mentioning as one objection that the preparation of each mount of this kind took him about two hours.

Dr. Lutz then delivered the paper of the evening by Mr. Richard Burlingame and himself on ''Ultraviolet Lepidoptera,'' indicating that these insects are not seen by one another as human beings see them. Charts of the various octaves of sound, heat, and light waves were shown, together with several cases of Lepidoptera, and also black and white photographs taken with a G 586 filter of the ultraviolet colors and patterns of these insects. Various experiments made and cited showed all insects sensitive to ultraviolet with reactions indicating that they could *see* it. Dr. Lutz mentioned Lubbock's experiments with ants, in 1879, showing them to be blind to red, or color-blind to colors as we know them, and cited the more recent experiments of various German students showing insects to be attracted by ultraviolet, whether food was offered or not.

Dr. Lutz afterwards spoke on "Diurnal Rhythm of Orthopteran Activity" exhibiting the apparatus used in his experiments, together with various charts of the activity of these insects both under normal conditions, and also when constant darkness, or constant light was imposed. Even under abnormal conditions the insects after a while adapted their activity to a diurnal rhythm, showing maximum activity at regular intervals. Similar experiments by German students with the honey-bee, were mentioned by Dr. Lutz.

This paper was discussed by Dr. Ruckes who called attention to Hingston's book "Instinct and Intelligence" illustrating the inflexibility of instinct.

Mr. Sanders was interested in the economic possibilities in the use of ultraviolet lamps as traps, but their cost of maintenance was considered to be prohibitive, and their use as likely to destroy not only injurious insects, but useful ones as well.

JOHN D. SHERMAN, JR., *Secretary—Pro tem.*

MEETING OF FBRUARY 7, 1933

A regular meeting of the Society was held on February 7, 1933, in the American Museum of Natural History; President Ernest L. Bell in the chair with twenty-two members and twenty-three visitors present.

It was duly moved and seconded that the by-laws be suspended and the first meeting in March be held on the second Tuesday instead of on the first Tuesday of the month. This change will enable Dr. C. T. Brues to address the Society on "Our Changing Insect Population."

Mr. Harry Stiner of The National Biscuit Company, 85 Ninth Avenue, New York City, was proposed for membership in the Society.

The resignation of Mr. George B. Wilmott, 155 Prospect Avenue, Staten Island, New York, was accepted with regret.

A communication from the Entomological Society of London was read inviting the New York Entomological Society to take part in the celebration of the first hundred years of the existence of the London society to be held on the 3rd and 4th of May, 1933.

On motion, the secretary was instructed to send greetings to the Entomological Society of London and an appreciation of the honour in being invited to attend the celebration of its centenary, and stating that in the event any members do attend these meetings in May they will be duly appointed as delegates for the occasion.

Mr. Wurster exhibited a specimen of *Telea polyphemous* (Cramer), described in the Bulletin of the Brooklyn Entomological Society, Vol. XXV, No. 5, pp. 273–275, as a new aberration, differing from the normal in having a large portion of the ground color of all the wings, above and below, black or blackish. He proposed the name *Telea polyphemous ab. fumosus* n. ab. for this melanic form.

Dr. James P. Chapin gave the address of the evening, ''Insects as a Diversion in the Congo,'' illustrated by lantern slides. Dr. Chapin modestly gave Herbert Lang the credit for the great number of insects that were collected on their expedition to the Belgian Congo, 1909–1915. He, also, mentioned their good fortune in having the backing of Dr. Schouteden of Tervueren, Belgium, and also their indebtedness to Dr. J. Bequaert whom they met late in their expedition, but who rendered them invaluable entomological service as an authority on the zoology of the Congo. Among the many interesting facts and experiences that Dr. Chapin related were the activities of the driver ants, *Dorylus* (*Anomma*) *nigricans* Illiger, which are a hundred and one per cent courageous, travel in columns, and swarm over everything; the Love Birds and the African doormouse which live in the holes made by the small woodpeckers in termite nests; the termite ''pagodas'' and larger mounds, in which there are chambers of fungous gardens (the termites feed on the fungus buds); the edibility of termites, which have a nutty taste, even though they may be a little gritty because of the mandibles; the larvæ of a bot-fly which is found in tunnels on the elephant's foot—under a pressure of one ton to each foot; and the grey cloud of geometrid moths which was seen in the Alpine zone of the Ruwenzori Mountain. The white cattle herons which walk with sheep in the morning ''as if they had a real fondness for their society,'' the wagtails which prey on butterflies (they shake off the wings then swallow the body), and the European white stork, which has a great fondness for grasshoppers were some of the bird-entomologists described by Dr. Chapin. Besides his many fine slides, Dr. Chapin showed many specimens and exhibits pertaining to his travels in the Belgian Congo.

Mr. Davis exhibited some exceptional and butterfly-like Cicadas.

ELIZABETH SHERMAN, *Secretary.*

MEETING OF FEBRUARY 21, 1933

A regular meeting of the Society was held on February 21, 1933, in the American Museum of Natural History; President Ernest L. Bell was in the chair, with twenty-two members and twenty-six visitors present.

On motion, it was voted that the secretary cast a ballot electing Mr. Harry Stiner a member of the Society.

Dr. Herbert Ruckes delivered a most interesting and edifying talk on ''The Biology of South-Western Insects,'' illustrating his remarks with slides, some colored, and with motion pictures. An abstract of his talk appears, as follows:

New Mexico is approximately 400 miles long by 380 miles wide, equal in area to about New England, New York, Pennsylvania, and New Jersey. Northerly, it lies next to Colorado; southerly, it abuts on the northern limit of Mexico. Within these boundaries lie five of the six life zones of the Southwest. Three rivers pass vertically through the state. Near the eastern border lies the Pecos. Through the central part extends the Rio Grande. On the western border extends the Gila. Extending from south to north along the valleys of these rivers, we find the zone called the Lower Sonoran. Directly northwards of the Lower Sonoran is a very expansive, arid desert region known as the Upper Sonoran. Together these two life zones form at least 2/3 of the area of the state. Following these in turn are the Transitional Zone, then the Canadian, the Hudsonian, and in two or three instances, we have evidences of the Alpine.

The Lower Sonoran Zone extends in altitude from about 2500′ to 3500′ elevation, or, from the international border to the town of Hot Springs. The Upper Sonoran Zone, starting about the 3500′ elevation extends approximately to 7000′, or, from the town of Hot Springs to the city of Santa Fe. The Transitional Zone the extends from 7000′ to about 8500′; the Canadian from 8500′ to 9500′; the Hudsonian Zone from 9500′ to about 12,000′. Where the mountain peaks rise higher than 12,000′, in two or three localities, evidences of Alpine life are visible.

The mountain system of the state belongs to the lower foothills of the Rockies, and is a continuation of the mountainous area of northern Mexico.

The rainfall of the state as a whole, based on the observations of the last 50 years, is about 10 inches per annum. In certain areas of the Upper Sonoran Zone, the rainfall is less than three inches per annum; while in the higher mountain ranges, it may reach as much as 24 or 25 inches. Obviously, these control the type of vegetation and animal life in these different parts of the state.

The fauna and flora of the Lower Sonoran and Upper Sonoran regions are similar to those of the lowlands and highlands of northern Mexico. The dominant plants of the region, cactus and mesquite and greasewood, are in each instance, either succulent or leafless and spiny. Insects are relatively few in numbers in these areas due to the lack of moisture. The Upper Sonoran Zone, in addition, has an abundance of piñon pine and juniper, with bees the most abundant type of insects visiting the small abortive flowers that occur on these deserts. The richest vegetation and insect life are found in the cooler and wetter mountain regions. No less than 3000 species of plants have been collected from the mountain ranges. Most of these are similar to the plants of Colorado, Utah, and Wyoming.

Wherever waterways occur, and these are few and far between, insect life rises to its height. The poorest represented orders of insects are the mayflies, dragonflies, and other deeply aquatic forms. Butterflies and moths are particularly abundant in the Canadian Zone; while beetles extend well down into the Upper Sonoran region.

Extensive collecting was carried on during the trip, which covered 13,000 miles of road within the state.

Dr. William S. Creighton then spoke on "Collecting Insects in the Southwest." Using colored slides, he described his travels through the spectacular scenery of Colorado and Utah, the fantastic formations of Bryce Canyon National Park, the many insects that were crowded into the flat sections at the bottom of the canyon of Zion National Park, the big trees of Sequoia National Park, and the immense scope of the valley of the Yosemite. In Arizona, the Wachucha Mountains offer great entomological possibilities, as does the Kaibab region on the rim of the Grand Canyon and the Grand Canyon itself. Dr. Creighton expressed the hope that his remarks and pictures would arouse interest among entomologists to do more extensive collecting in this, the Southwest, region of the United States.

ELIZABETH SHERMAN, *Secretary.*

MEETING OF MARCH 14, 1933

A regular meeting of the Society, postponed from March 7, was held at the American Museum of Natural History on March 14, 1933; with President Ernest L. Bell in the chair and eighteen members and twenty-six visitors present.

Mr. F. E. Church of 655 Park Avenue, New York City, and Mr. Frank A. Soraci, 314 Verona Avenue, Newark, New Jersey, were proposed for membership in the Society.

The resignation of Philip Dowell was accepted with regret.

A letter from Miss Lillian Leale stated that her father, Dr. Chas. A. Leale, a member of the Society died in June, 1932. The secretary was directed to send a letter of condolence to Miss Leale.

On motion of Mr. C. H. Curran the secretary *pro tem* was directed to convey to Miss Elizabeth Sherman, the secretary, the best wishes of the Society and hopes for her complete recovery and renewed attendance at the meetings at an early date.

Dr. A. L. Melander delivered a paper on ''Some Fossil Insects'' with several lantern slides showing various specimens, mostly from Mazon Creek, Illinois, contained in the collection of the University of Chicago, and also hypothetical and synthetic restorations of fossil insects by Handlirsch and others. Charts showing the Handlirsch scheme of the ancestry and classification of insects were distributed to those present. Dr. Melander stated that the earliest animals lived in water and mud, and that their first successors were amphibious or shore forms. The first terrestial arthropods were trilobites and scorpions (modified trilobites), arachnids and millipeds. The first spiders had segmented abdomens. The earliest insects appeared in the Carboniferous Age constituting an Order no longer existent, named Palaeodictyoptera. These Insects had the legs bent forward and the hind wings were identical with the fore wings: lobes at the side of the body were commonly present. In the Palaeozoic era various distinct Orders of Insects appeared. Protorthoptera, Protoblattoide—the very abundant prototypes of our present cockroaches, Protodonata—the prehistoric dragonflies, some very large with a wingspread of 20″, Protoephemerodea—ancient mayflies with enormous hind wings, Protocoleoptera with distinct venation of the elytra, etc. The closest analogy to existing insects is found in the Protoblattoidea. Dr. Melander does not believe the wingless specimens of the Devonian Age to be insects: some have considered them as fossil Thysanura.

Dr. C. T. Brues then spoke on ''Our Changing Insect Population,'' illustrating his remarks with slides, charts and motion pictures. While admitting the present very great importance of the insects, he thinks that this is perhaps only a passing phenomenon. Insects found imbedded in the resin of turpentine trees in pine forests of Florida suggested to him a comparison of such forms with those of the fauna of the Eocene Age found imbedded in the amber deposits of N. W. Europe in the region of the Baltic Sea. Amber is fossilized resin, very much hardened, and the insects found in it are the best representatives of fossil insects which exist. These fossil insects of the Eocene Age, 60,000,000 years or so ago, found in the amber deposits of N. W. Europe find their nearest living relatives in the present Nearctic Fauna. Ulmer working on the caddis flies of the amber was able to figure out what the terrain of these ancient forests was probably like, and his verdict suggested a close resemblance to the present hilly forests of New England, and acting on these ideas, Dr. and Mrs. Brues, from early May to late September, 1930, made a census of the insects taken in tanglefoot fly-paper around their home at Petersham, Mass., at an altitude of 800–1100 feet where the ecological conditions coincide with Ulmer's hypothetical Eocene amber terrain. The bands of tanglefoot were placed on three trunks at various heights in the Petersham forests. Tanglefoot takes the place of amber admirably trapping the insects just as resin did in the Eocene Age. The specimens caught were readily released upon immersing the tanglefoot in 95% alcohol. Over 21,000 insects were trapped, with a great preponderance of Diptera. Comparing these insects with a large number of amber insects it was noted that Parasitic Hymenoptera of the amber fauna were more diversified than in the Petersham collection, and Ichneumonidae and Platygastridae are relatively far more abundant at the present time, while the Braconidae and Scelionidae are much less abundant than in the Eocene era. Ants show a great decrease now, but it is possible that a similar tanglefoot census made in Australia would not confirm this decrease. In the Coleoptera, 62 families are represented in the amber collections, only 39 in the tanglefoot; diversification occurred much earlier in geological periods, among the Coleoptera than in other orders. The Diptera have shown a great increase in numbers and in diversity since the amber days, and especially in the family Phoridæ the great diversity shows that these insects are in an active state of evolution. 6,040 of the tanglefoot collection were Phoridae, far exceeding all other groups of insects: 3,070 were Dolichopodidae.

Dr. Brues suggested that as the primitive forms, especially in the Parasitic Hymenoptera, were more diversified, and as the more specialized types have increased, perhaps insects are no longer increasing in importance, and that a crisis of Insect Dominance may not really impend.

At the conclusion of Dr. Brues remarks a motion-picture reel was run showing the method of making the tanglefoot census at Petersham.

Mr. Curran stated that the Baltic amber flies were mostly Dolichopodidae, some of the species being still in existence in Europe: many of the amber specimens are better preserved than the pinned or slide specimens of present collectors.

JOHN D. SHERMAN, JR., *Secretary—Pro tem.*

MEETING OF MARCH 21, 1933

A regular meeting of the New York Entomological Society was held at the American Museum of Natural History Tuesday evening, March 21, 1933, with President Ernest L. Bell in the chair and fifteen members and fourteen visitors present.

Mr. F. E. Church and Mr. Frank A. Soraci were elected members of the Society.

Mr. H. C. Hallock spoke on ''Methods of Studying Asiatic Beetles in New York,'' his remarks referring almost exclusively to the Oriental beetle, *Anomala orientalis,* not very injurious, except as a grub when it causes great injury to lawns and strawberry beds, and especially to the Asiatic Garden Beetle, *Autoserica castanea.* These species were first found in the United States in 1920 and 1921. Several slides were exhibited showing the insects, various types of injury to roots, leaves, blossoms and sod, caused by the beetles, as well as traps and breeding cages and charts. The Asiatic garden beetle does by far the greatest injury, feeding extensively in the adult stage on a great variety of ornamental plants. At Westbury and Jericho, L. I., this species is strongly attracted to electric lights on warm nights: on one occasion 21,000 specimens have been taken in a single trap on one night. On cold nights the beetles feed near the ground and do not fly to lights. Bred in cages at a temperature of 81°–82° Fahr., the beetle has a life cycle of some 80–90 days. In the cages many of the larvae are killed by mites.

Mr. Hallock's paper and various methods of control were discussed by Mr. Sanders, Mr. Horsfall and Mr. Curran; and President Bell expressed particular resentment over the destruction of his chrysanthemums at Flushing, by the beetle.

JOHN D. SHERMAN, JR., *Secretary—Pro tem.*

MEETING OF APRIL 4, 1933

A regular meeting of the New York Entomological Society was held at the American Museum of National History Tuesday evening, April 4, 1933, with President Ernest L. Bell in the chair and nineteen members and seven visitors present.

Mr. Curran exhibited Dr. Howard's new book, ''Fighting the Insects: the Story of an Entomologist,'' calling attention to its many fascinating features and characterizing it as the Life History of an entomologist, who has always been a person of dominant charm, told it converstional style with a veritable treasure trove of interesting anecdotes.

Dr. A. L. Melander then spoke on ''Life Zones in Washington State,'' mentioning the various factors of temperature, climate, soil, altitude, rainfall, amount of sunshine which are taken into consideration in determining what biologists call a Life Zone, a term including both animal life and plant life. Mention was made of the especially intensive study of these zones in North America, beginning with Merriam. The various regions of the state of Washington were described and illustrated by numerous fine photographs and lantern slides representing both scenery and plants and insects. The lofty mountains of the Western Coast, permanently snow-capped and reaching an altitude of 14,400 feet, offer a great contrast to the Eastern United States, and their Alpine Gardens are very different from those of Mt. Washington, N. H., where the flowers are all white instead of brilliantly colored as in the West. The heavy forests and enormous annual rainfall of 12 feet in the Olympic Peninsula, and the lack of deciduous trees were commented upon, and the fine collecting in the Puget Sound region. Dr. Melander described the method by which certain large, very active syrphid flies frequenting squaw grass were taken; two persons each armed with a net operating at different blossoms far apart: eventually one person or the other might secure the fly sought for. Rubbing liver over trees to keep off Chrysobothris beetles was useful but the coyotes damaged the trees in eating off the liver applications. Earwigs overrun the Western Pacific Coast: they came from Holland with shipments of bulbs some 20 years ago and are now more ubiquitous by far than cockroaches here, swarming in automobiles and everywhere. Many and expensive attempts have been made to control them, but all have been in vain. The Coulee cricket was described and well illustrated as a very spectacular insect. Periodically there are great outbreaks of this wingless locustid, as huge armies migrate slowly but persistently from the sage brush areas, into the agricultural regions. There was a great outbreak in 1917, when 50 miles of fencing and ditching, subsidized by the nation and state when wheat was worth something, were constructed to save the wheat districts.

Mr. Engelhardt expressed his especial interest in the arid region of the state, which he hopes to visit this summer in quest if Sesiidae and their life histories. Dr. Melander apologetically confessed his personal appraisal of Lepidoptera as too messy to interest him.

JOHN D. SHERMAN, JR., *Secretary—Pro tem.*

MEETING OF APRIL 18, 1933

A regular meeting of the New York Entomological Society was held at the American Museum of Natural History Tuesday evening, April 18th, 1933, with President Ernest L. Bell in the chair and twenty-three members and thirty-one visitors present.

Dr. F. E. Lutz spoke on his recent experiments with bees, during a stay of about four weeks in Panama, to determine whether these bees could distinguish ultraviolet. He gave a summary of various experiments along this line during the last ten or eleven years conducted by Dr. Richtmeyer and himself in Colorado, by Dr. von Frisch in Munich, and others, including his own recent work as presented at Atlantic City in 1932. The bees tested in Panama were stingless honey-bees of the family Meliponidae, genus Trigona, a group of social bees common in the tropics and in Panama. Cards with various patterns of Chinese white, which did not reflect ultraviolet color, and velvet white, which did reflect it, were used. The bees would not come to any sweetened baits, as did the domestic honey bees to Dr. von Frisch's baits, but a colony of the bees fortunately happened to be established in the wall at one side of the laboratory building and the decoy cards were placed in the vicinity of the entrance to this nest, in various positions. The tests were made in good sunlight and despite all temptations, the bees by a great preponderance of evidence showed their ability to distinguish white reflecting ultraviolet from white which did not reflect this color. Dr. Lutz while in Panama experimented also with ants but postponed his remarks on these insects until a later date. The full results of Dr. Lutz's investigations will be published by the American Museum of Natural History.

Dr. H. W. Stunkard of New York University then spoke on "Protozoa that Live in Insects" mentioning the various groups of protozoa and commenting on the literature and work of various students. He recommended especially Wenyon's "Protozoology" in two volumes and "Problems and Methods of Research in Protozoology" by Hegner and Adams. He stated that the study of Protozoology thus far has been practically limited to those aspects which affect man. The protozoa were originally free living organisms which at first became associated with other organisms and then developed their parasitic habits. All kinds of animals are parasitized by them but insects were evidently the primary hosts and through custom and adaptation are very little troubled by them. When organisms become parasitic, they become very prolific and various methods of reproduction occur. When the protozoa are transferred to a new host, especially if it is not related to the former host, they become very virulent and various diseases result.

Particular comment was made on recent studies of the protozoa of termites by Cleveland and Kirby and Kofoid. One hundred and ten species of flagellate protozoa parasitic on termites have been found: if these parasites are removed the termites die. Protozoa are also very common parasites of cockroaches, water striders, and insect larvae.

Dr. Stunkard's paper was discussed by Dr. Lutz who characterized termites as specialized social cockroaches, by Dr. Ruckes who mentioned that no protozoan parasites had so far been found in wood boring Coleoptera, by Mr. Curran, and others.

JOHN D. SHERMAN, JR., *Secretary—Pro tem.*

MEETING OF MAY 2, 1933

A regular meeting of the New York Entomological Society was held on May 2, 1933, in the American Museum of Natural History with President Ernest L. Bell in the chair and seventeen members and fifteen visitors present.

Mr. Curran introduced Mrs. Shore to the Society as the daughter of the late Dr. S. W. Williston. Twenty-five years ago, Dr. Williston published the third edition of his "Manual of Diptera." Today Mr. Curran is working on a revision of this Bible of Dipterologists. Wishing to obtain the original drawings and cuts of the Manual, Mr. Curran appealed to Mrs. Williston and Mrs. Shore who have been very generous in allowing him to use those drawings and cuts which they found in their possession. Mr. Curran then gave a short history of Dr. Williston saying that he was originally interested in Coleoptera in Colorado, then became interested in Diptera while he was studying Paleontology. Mr. Curran then spoke very highly of Dr. Williston's work in Dipterology and gave tribute to him for his excellent though brief work in this field of Entomology.

Dr. Lutz then stated that the Exotic Diptera of Dr. Williston's collection are in the American Museum of Natural History. Dr. Lutz said that he, too, had been an ardent admirer of Dr. Williston ever since his acquaintance and association with him at the University of Chicago.

Dr. C. C. Hamilton of the New Jersey Agricultural Experiment Station delivered his paper on "Some Problems in the Control of Insects infesting Ornamental Plants." Because of the commercial importance of greenhouses, the greenhouse plants have received the most study and experimentation. The conditions and methods of control for outside flowering plants are entirely different from those found in the greenhouse. Likewise the insects infesting nursery plants and again those infesting shrubs and shade trees present entirely different problems. It has been found that those insects which have a limited number of host plants are difficult to work with. Also, most home owners lack the proper equipment to cope with insect infestation. Dr. Hamilton has been working on the control of Gladiolus thrips for the past year. These thrips appeared suddenly and have spread very rapidly. In speaking of the chemicals which had been used for control of the various thrip infestations, Dr. Hamilton stated that bichloride of mercury is most satisfactory when used as a dip and introduced into the spot where insect is feeding; Pyrethrum is not so satisfactory because it leaves no residue; hot water and nicotine or Pyrethrum dust are successful when handled carefully by an expert; Napthaline is also excellent when used in a closed container. For the control of thrips in the field, rotenone dusts which remain repellent for a period of a week have been found to be the most satisfactory. At present, the New Jersey Agricultural Experiment Station is trying to determine on a pine oil mixture which has a sufficient resinous base to retain nicotine resinate over a short period of time for the control of boring insects such as the Shot Hole Bark Borer type in dogwood and pin oak.

Dr. Horsfall, in answer to a question of Dr. Hamilton then spoke on the control of the European pine shoot moth. By spraying into the wind with a nicotine and penetrol spray after the moths had emerged June 1 to June 15, it was possible to reduce the infestation from clouds of the insects before the first spray to very rare occurrences after the third spray.

In answer to a question by Dr. Felt, Dr. Hamilton stated that a rotenone spray is effective as a stomach poison for one week.

Dr. Felt spoke on the literature on shade trees and ornamental plant infestations by Gregory and Davis and by Andrew Wilson saying that a great many problems still remained to be solved in this field of ornamental plant infestation. It is necessary to make spray tolerance tests not only for the special host plant in question but also for those plants that may be found in the vicinity of this host plant.

ELIZABETH SHERMAN, *Secretary.*

MEETING OF MAY 16, 1933

A regular meeting of the Society was held on May 16, 1933, at 8:15 o'clock in the American Museum of Natural History, with President Ernest L. Bell in the chair and sixteen members and nineteen visitors present.

Dr. E. D. Wilson of 72 Pine Brook Drive, Larchmont, New York, was proposed for membership in the Society. The by-laws were suspended and Dr. Wilson was elected.

Dr. George E. Sanders read a paper on the "Abundance and Distribution of Termites in the New York Region." An abstract follows:

THE ABUNDANCE AND DISTRIBUTION OF TERMITES IN THE NEW YORK REGION

BY GEORGE E. SANDERS

The termite in the district about New York City and North has only recently become a serious pest. This year we hear of probably three times more houses infested by them than last year. Last year about three times more than the previous year. As I understand it damage up to two or three years ago was rare. Termites were here previously but not a common nuisance, and I find from records that termites were doing some damage in Massachusetts in 1870. Strangely enough the old records mostly cite them as greenhouse pests damaging geraniums and similar plants. They are recorded as doing damage in Manchester, New Hampshire, in 1903. Possibly the termite is a native insect in this territory. However, damage from them in appreciable amounts is very recent. Why they are doing so much more damage now than previously is not clear. It may be that the past few seasons have been particularly moderate, but we have had periods of warm seasons before. It has been suggested that heated houses is the cause, but we have had heated houses for a long time and, more than that, the most severe outbreak of all, in this vicinity is in poles, out of doors.

I remember some twenty-five years ago I was working on June beetles and white grubs in Illinois. In fourteen years collecting only two adult June beetles had been taken on corn. Tens of thousands of specimens had been taken from various trees and classified. Common among them was *Lachnosterna gibbosa,* found as an adult feeding mostly on willow. One day we got a call that a field of corn then about ten inches high was being devoured by some unknown insect. I visited the field and found nothing on the plants, the leaves badly eaten and plenty of *Lachnosterna gibbosa* in the ground. John J. Davis and I arranged to visit the field that night. If I remember rightly that visit showed two to three *Lachnosterna gibbosa* to each hill, feeding freely on the corn leaves, the first and only record of an adult June beetle eating corn or any other grass plant. That particular field was almost destroyed by that freak strain of *Lachnosterna gibbosa* that had adapted itself to it. It may be that some freak strain of termites similar to that freak strain of Lachnosterna is the cause of this outbreak.

It may be that unusual transportation facilities are the cause of the termite now doing so much more damage. Colonies transported from one locality to another and perhaps distantly strains of the species crossing and resulting in a strain more vigorous than either of the parent strains. The reason for the unusual outbreak, which promises to last a number of years if not permanently, is all guess work. The fact remains that we have termites more active and doing more damage than ever before in this area.

The only termite recorded from this locality is *Reticulitermes flavipes* Kollar. It seems now so wide spread and to have adapted itself to so many different conditions that I look for it to become a more and more serious pest as times goes on, until possibly some of the natural enemies adapt themselves more to it.

We know of severe outbreaks at the present time in every section about New York City. A row of houses in Westchester County, a Courthouse. Several dwellings in Northern New Jersey. A theatre near 42nd and Broadway. A building in downtown New York, several houses in Brooklyn and Queens. On the east end of Long Island we found them very numerous; every dead piece of wood over an area of four square miles seemed infested. The ground seemed almost alive with them.

In some cases serious damage has already resulted, requiring the replacement of timber. In one case the house was built on a concrete wall seven feet high and the nests were under the cellar floor. The tunnels were built up the entire height of the wall and the sills and joists damaged badly. The owner said the tunnels had been brushed down from time to time, but that the termites would rebuild them in about two weeks.

A ship was recently in port, the topwork of which was badly infested by a dry wood termite. I do not know the species. Without doubt the dry wood termite has been repeatedly introduced here on ships. We have no record of dry wood termites having established themselves in this area. However, from descriptions of two outbreaks I have reason to suspect that some species of dry wood termite is present here. One case is described as a house on a poured concrete foundation. Some of the timbers are eaten to tinder. No trace of any tunnels. Another case; serious damage to the woodwork around a third story window. No evidence of termite injury lower down in the building. I am inclined to suspect dry wood termites in both cases. Undoubtedly they have been introduced here many times as the evidence from the ship indicates yet they are not recorded so far as I know north of Norfolk, Va. We hope in a short time to determine whether the two outbreaks that we suspect are dry wood termites or not.

Until we are sure that the dry wood and moist wood termites are not established in this area it might be wise to treat ships, known to be infested by either of the two forms, entering these ports. We know that some of them in the west extend as far north as Montana, and some of the species, not now here, could easily become established here.

We know that *Reticulitermes flavipes* Kollar extends as far north as the border of Maine and has been found doing damage at Albany, N. Y., and Manchester N. H. The most northerly serious outbreak that I have come in contact with is in Wellesley, Mass., where one of the College buildings is seriously damaged.

So far as natural enemies are concerned we have found no fungous diseases attacking them. We have found two species of ants attacking them and apparently cleaning out the colonies. We have found *Cremastogaster lineolata* cleaning up termite colonies and then proceeding to continue the damage to the wood in which the termites were living. We have also found a yellow ant, that I used to know, cleaning up a termite colony. This ant I am quite sure will not attack the wood.

As I said before, why the termite has not damaged property here before, or why it is becoming epidemic now, is not at all clear. I am sure that we could get records of upwards of 100 outbreaks in and around New York at the present moment that are under treatment of one sort or another. Naturally that is only a fraction of the colonies that are damaging buildings. In most cases the owners do not recognize them. They are just flying ants. The termite situation here looks like a repetition of what has just occurred in California. Termites had been recorded from California for years but the first real damage occurred in 1926 when the Public Library in Pasadena was attacked. Now the damage is state-wide and is costing California property owners hundreds of thousands annually. The construction of new buildings there has been changed and buildings made termite proof when erected. Without doubt builders in this locality will have to follow suit and erect termite proof buildings.

It may interest you to know that the damage to wooden buildings by termites in termite areas is estimated at one percent per year. The annual damage to farm buildings in the South is estimated at $29,000,000 per year.

A recent federal publication estimates the cost of treating and termite proofing an infested dwelling house at from $500.00 to $2,000.00, whereas the cost of making the same building termite proof when erected would only amount to an additional cost of from $50.00 to $100.00.

In some countries notably in Hawaii, a man whose property is made or built termite proof can get larger loans on his property or his loans at a lower rate of interest than the man whose property is subject to termite attack. This angle of the termite problem has not yet been considered in this area by our banks and money loaning institutions.

Last year Mr. Durling and I estimated that by 1934 termites would begin to be a real problem in and about New York. They seem more serious now than we expected them to be by 1934. They are present in every section in and around the City and every building with wooden construction within at least seven feet of the ground is susceptible to attack. Their damage has already been severe enough in many buildings to necessitate the replacement of timbers. So far no buildings have collapsed from termite injury about New York, as they did in California before owners became acquainted with the termite and learned to apply control measures before the damage was beyond repair.

In California termite control operators are all controlled as are tree surgeons, commercial sprayers, etc., by the state through the County Agricultural Commissioner. So much fake work was being done by incompetent operators in the early stages of the Californian outbreak that this system of regulation became necessary in order to protect the public.

Control: Real control, of course, means buildings made termite proof when erected, either the timbers treated or the basement walls arranged so that termites cannot pass to the wooden superstructure above. Sometimes a sheet of metal is used as a barrier. Recently the Pyrex glass people produced a glass brick intended for use on the top of the wall and below the sill. The idea being that the termite would not build a tunnel over the light transmitting glass. The perfect termite remedy is yet to be discovered. It may be a poisonous material volatile at 150 F or thereabouts. It may be a poison in solution and more penetrating than anything we have yet seen. It may be something harmless to man and toxic to protozoa which will kill only the protozoa in the intestines of the termite, and then, of course, starve the termite to death, in the midst of plenty of food and with its stomach full. This of course sounds fantastic but is possible and even probable.

At the present time the operator must look the outbreak over, (each outbreak is different from the next) and select from the list of chemicals the poison or poisons that can best be used in that particular location with regard to the cinstruction of the building, the comfort of the inhabitants safety of nearby trees or shrubs, the location of the colony, etc. Then the operator chooses from Paris Green, Cyanide, Petroleum, paradichlorbenzene, orthodichlorbenzene, arsenite of soda, white arsenic, soda ash, copper sulphate, beta naphthol, kerosene, crank case oil, gasoline, rotenone, sodium fluoride, sodium silicofluoride, zinc chloride, zinc arsenite, sodium arsenate, creosote, borax, magnesium fluosilicate, copper fluosilicate, benzol, carbon tetrachloride oil emulsions, chlorinated naphthalene, carbolic acid, cresylic acid, mercuric chloride, sodium dinitrophenilate, coal tar, wood tar, carbon bisulphide, etc., etc., the chemicals he thinks best adapted for that particular piece of work. All of the chemicals mentioned and many more have been and are now in successful use in one place or another in termite control work, the operators adapting them to conditions and equipment.

Every termite outbreak is a separate and distinct problem and no two of them are alike, so it is impossible to lay out any system of treating, without first examining the particular outbreak to be treated.

A symposium on termites followed this very interesting paper. Dr. Lutz, Dr. Bromley, Mr. Curran, Dr. Horsfall, Mr. Davis, and others took part in this discussion. The Society was honored by the presence of the Reverend

Doctor Assmuth, from Fordham University, an authority on termites both here and abroad, whose remarks, both scientific and humorous, added a great deal to the interest of this meeting. The possibility that termites have become more noticeable in the past few years as a result of the layman becoming termite-conscious was discussed. It was felt, however, that the general movement of the termites from the tropics to northern climates was due to the fact that the heating of buildings has become so universal thus giving the insects a constant, warm temperature to live and work in. The sudden appearance of termite damage may be due and in most cases is due to several if not many years of infestation. Mr. R. M. Church, Vice-President of the American Wood Preserving Association, spoke of the necessity for making a fence against the termite and in this connection he suggested the use of metal shields to preserve wood in contact with the soil. Treating wood with creasote under pressure is found to be successful in this climate but in the tropics, the heat and torrential rains render even this treatment ineffectual. The Redwood of California is the only wood which has been found to be immune from termite attack. Extensive experiments with various woods are being conducted at Barro Colorado in the Canal Zone.

Mr. Curran spoke of the death of Norman Criddle, for many years an entomologist for the Canadian Government. Mr. Criddle was well known for his manufacture of a poison bait, known as the Criddle Mixture, for the extermination of grasshoppers in Manitoba. Mr. Curran expressed his deep regret at the loss of so fine an entomologist and one who was his personal friend.

ELIZABETH SHERMAN, *Secretary.*

FIVE NEW GENERA OF NEW ZEALAND AND MALAYAN OESTROIDEA

BY CHARLES H. T. TOWNSEND

In Mr. Malloch's Calyptr. Dipt. N. Z. VII and Dipt. Calyptr. Fed. Malay St. III, there are described five forms which are entitled to separate generic recognition, which is accorded in each case below.

Homohexamera gen. nov.

Genotype, *Protohystricia huttoni* Mh.–N. Z.

Belongs in Macromyini and differs from Hexamera BB. (syn. Photohystricia Mh.) by the long and slender proboscis, the haustellum being about as long as head height; and the atrophied palpi, which are reduced to tubercles. The remigium is posteriorly ciliate above, as in Hexamera.

Mallochomacquartia gen. nov.

Genotype, *Macquartia vexata* Hutt.–N. Z.

Belongs in Macquartiini and differs from Macquartia RD. by two ST, MM pair on first segment in both sexes, cheeks about as wide as eye length, FRS stopping at base of antennae, a low facial carina distinctly present, wider male and narrower female vertex, first antennal joint erect and moderately elongate, and cubitulus V-like.

Named in honor of Mr. Malloch, who has made known a very large number of interesting muscoid and œstroid forms.

Austromacquartia gen. nov.

Genotype, *Macquartia claripennis* Mh.–N. Z.

Belongs in Macquartiini and differs from Macquartia RD. by clypeus moderately well sunk, other head characters as in Mallochomacquartia except facial carina practically obsolete and parafacialia more narrowed below, MM on first segment in female, abdomen of female broadly ovate, female front tarsi not widened, and 5R petiolate with its stalk in the arcuate line of M1.

Uschizactia gen. nov.

Genotype, *Actia uniseta* Mh.–Malay Pen.

Belongs in Actiini and differs from Actia RD. by R5 bristled halfway, R1 with a bristle near middle, last section of C1 over three fourths length of preceding section, no MD on any segments, cheeks scarcely one fifth eye length, third antennal joint of male thickly pubescent and cleft to base, the front ramus nearly equalling the hind one.

Setasiphona gen. nov.

Genotype, *Actia siphonosoma* Mh.–Malay Pen.

Belongs in Siphonini and differs from Siphona Meig., by R1 bristled on terminal third, R5 bristled beyond R6, MSS not developed, labella shorter than haustellum, male vertex scarcely one third head width and second aristal joint scarcely twice as long as thick.

The
New York Entomological Society

Organized June 29, 1892—Incorporated June 7, 1893

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Columbus Avenue.

Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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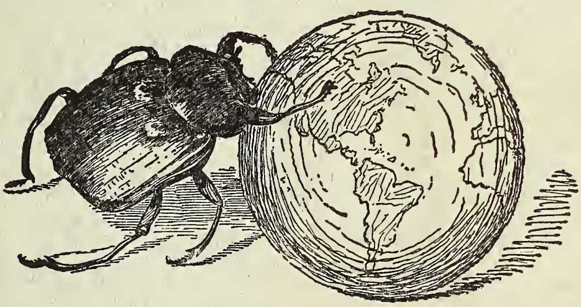

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Publication Committee

Harry B. Weiss Charles W. Leng J. D. Sherman, Jr.
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JOURNAL

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Vol. XLII September, 1934 No. 3

SOME INSECTS COLLECTED IN MEXICO, MOSTLY IN ASSOCIATION WITH MAN AND ANIMALS OR ANIMAL PRODUCTS

By Raiford A. Roberts

Assistant Entomologist, Division of Insects Affecting Man and Animals, Bureau of Entomology

During April, 1931, the author travelled by automobile from the Mexican plateau *via* Victoria to the Gulf of Mexico. Observations and collections were made of insects which affect man and animals. At San Luis Potosi and Victoria flies were trapped in cone traps baited with meat. Here and at Tampico pint Mason jars, each containing a 4-ounce piece of meat on 2 inches of sand, were exposed and from them meat-breeding flies and their associated insects were reared.

San Luis Potosi, S. L. P., stands 6,290 feet above the sea-level on the great plateau of Mexico. Although south of the Tropic of Cancer, at latitude 22° and longitude 100°, the climate, because of the altitude, is cool and temperate. Low, rough, and jagged hills dot a table-land thinly covered with cactus and sparse vegetation. The annual rainfall is low, but sufficient humidity occurs to permit the breeding of many insects, including myriads of flies and their predators and numerous parasites of man and animals. A mountain chain, the Sierra Madre Oriental, forms the eastern margin of the plateau. Passing through this range, about 150 miles northeast of San Luis Potosi, one abruptly descends from the mountains to a coastal plain. Here, at 1,473 feet, is Ciudad Victoria, surrounded by orange and avocado orchards, henequen plantations, and cattle ranches. The climate is warm and the rainfall high. Numerous rivers are fed from the mountains, and the trees and underbrush which line their banks abound with animal life. Particularly abundant are birds and insects. To the southeast 125 miles lies Tampico where the Panuco River empties into the Gulf of Mexico. Tampico, although built at sea-level and in a humid climate, is a healthy and modern city, but in the surrounding lowlands there is opportunity for collection of many kinds of ticks, gnats, flies, and other insects which affect man.

The author wishes to express his appreciation to the Mexican Federal and State authorities who aided him in this work. He is also indebted to Ronald C. Mundell, of the Australian Prickly Pear Overseas Investigation Staff, in whose company the trip was made.

Species of Insects Collected

Insects in the list below were collected by the author except in a few instances where species of particular interest were furnished by R. C. Mundell. Specimens were determined by the following specialists: Mallophaga, H. S. Peters; Dermaptera, A. N. Caudell; Coleoptera, E. A. Chapin, H. S. Barber; Diptera, J. M. Aldrich, David G. Hall; Hymenoptera, C. F. Muesebeck; and Siphonaptera and Ixodidæ, F. C. Bishopp.

List of Insects Collected

(All dates are 1931 unless otherwise noted)

MALLOPHAGA

MENOPODINÆ

Menopon gallinæ L. Victoria: Apr. 23, on heads of chickens.

HEMIPTERA

CIMICIDÆ

Cimex lectularius L. Linares, Nuevo Leon: Apr. 25, feeding on man.

DERMAPTERA

FORFICULIDÆ

Doru lineare Esch. Victoria: Apr. 23, associated with blowfly larvæ in meat bait.

COLEOPTERA

STAPHYLINIDÆ

Aleochara sp. Victoria: Apr. 23, feeding on blowfly larvæ in meat bait.

Belonuchus formosus Grav. Victoria: Apr. 23, feeding on blowfly larvæ in meat bait.

Creophilus villosus Grav. San Luis Potosi: Aug. 2, 1930, collected by Mundell.

HISTERIDÆ

Saprinus æneicollis Mars. Victoria: May 9, feeding on blowfly larvæ in meat bait.

Saprinus lugens Er. San Luis Potosi: July 21, 1930, collected by Mundell.

Saprinus sp. Victoria: May 9, feeding on blowfly larvæ in meat bait.

DERMESTIDÆ

Dermestes caninus Germ. San Luis Potosi: Aug. 1, 1930, collected by Mundell.

Dermestes vulpinus Fab. San Luis Potosi: Aug. 1, 1930, collected by Mundell. Victoria: Apr. 23, on old beef.

SCARABAEIDÆ

Canthon chevrolati Har. Tampico: Apr. 18, in cow dung.

Canthon sp. Victoria: Apr. 14, in cow dung.

Chœridium sp. Victoria: Apr. 14, in cow dung.

Onthophagus sp. Victoria: Apr. 14, in cow dung. Tampico: Apr. 18, in cow dung.

Aphodius sallei Har. Victoria: Apr. 14, in cow dung.

DIPTERA

TABANIDÆ

Lepidoselaga lepidota Wied. Tampico: Apr. 19, numerous on edge of swamp half mile from gulf.

PHORIDÆ

Megaselia iroquoiana Mall. Victoria: May 2, bred from hog liver.

LONCHÆIDÆ

Lonchæa sp. San Luis Potosi: Apr. 9, trapped over rabbit meat.

ORTALIDÆ

Chrysomyza demandata Fab. San Luis Potosi: Apr. 9, trapped over rabbit meat.

CHLOROPIDÆ

Hippelates dorsalis Loew. Tampico: Apr. 17, single specimen collected about eyes.

Hippelates nobilis Loew. Tampico: Apr. 15, abundant in thick underbrush, very annoying about face and eyes.

Hippelates nudifrons Mall. Tampico: Apr. 17, abundant in underbrush on hillside.

Hippelates pallipes Loew. Tampico: Apr. 15, abundant in dense underbrush; Apr. 17, very annoying in underbrush on hillside. Victoria: Apr. 14, abundant under small trees at noon hour, continually getting into eyes, 16 specimens collected over potted beef; Apr. 24, abundant on banks of Corona River, 17 specimens collected, some filled with blood.

Hippelates plebejus Loew. Tampico: Apr. 15, in thick underbrush; Apr. 17, abundant and very annoying.

Neohippelates pilosis Hall. Tampico: Apr. 17, three specimens collected near edge of Panuco River, a continual annoyance on hands and face.

Oscinella sp. Victoria: May 23, bred from hog liver.

ANTHOMYIIDÆ

Phaonia texensis Mall. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Ophyra ænescens Wied. San Luis Potosi: Apr. 9, trapped over rabbit meat. Tampico: Apr. 17, on carcass of calf. Victoria: Apr. 25, trapped over beef liver.

Fannia canicularis L. San Luis Potosi: Apr. 9, trapped over rabbit meat; Apr. 14, frequenting dwellings and latrines.

Fannia pusio Wied. Tampico: May 7, bred from beef. Victoria: May 7, bred from hog liver.

Fannia vittata Mall. Victoria: Apr. 24, on human excrement.

Fannia sp. San Luis Potosi: Apr. 9, trapped over rabbit meat. Victoria: Apr. 25, trapped over beef liver.

Limnophora debilis Will. Victoria: Apr. 24, on human excrement.

Limnophora narona Wlk. Tampico: Apr. 19, abundant in marsh, resting on weeds growing from mud and slime.

Limnophora sp. Tampico: Apr. 19, on horse manure.

Anthomyia pluvialis L. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Hylemyia sp. San Luis Potosi: Apr. 9, trapped over rabbit meat.

CALLIPHORIDÆ

Calliphora latifrons Hough. San Luis Potosi: Apr. 23, bred from beef liver.

Calliphora sp. San Luis Potosi: Apr. 9, trapped over rabbit meat; this was the most abundant fly trapped at San Luis Potosi.

Lucilia australis Towns. Tampico: Apr. 17, on carcass of calf; May 9, bred from beef. Victoria: single specimen on human excrement; Apr. 25, large numbers trapped over beef liver; May 7, 58 per cent of flies bred from hog liver at Victoria were of this species.

Lucilia sericata Meig. San Luis Potosi: Apr. 9, trapped over rabbit meat; Apr. 23, bred from beef liver. Victoria: Apr. 25, trapped over beef liver.

Lucilia unicolor Towns. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Phormia regina Meig. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Cochliomyia macellaria Fab. San Luis Potosi: Apr. 29, trapped over rabbit meat. Tampico: Apr. 28, collected over fresh beef and on carcasses, the most abundant blowfly at Tampico. Victoria: Apr. 25, 29 per cent of the flies trapped over beef liver were of this species, the commonest blowfly at Victoria.

SARCOPHAGIDÆ

Sarcophagula occidua Fab. Tampico: Apr. 19, on fresh horse manure. Victoria: Apr. 24, on human excrement; Apr. 25, trapped over beef liver.

Sarcophaga affcta Wlp. Tampico: Apr. 17, on carcass of calf.

Sarcophaga ampulla Ald. Victoria: Apr. 24, on human excrement.

Sarcophaga cessator Ald. San Luis Potosi: Apr. 9, trapped over rabbit meat; May 1, bred from beef liver, the most abundant Sarcophaga at San Luis Potosi.

Sarcophaga chrysostoma Wied. Tampico: Apr. 28, collected over fresh beef; May 12, bred from beef, the commonest Sarcophaga at Tampico.

Sarcophaga effreneta Wlk. (*adamsii* Hall). Tampico: Apr. 15, on fresh cow dung. Victoria: Apr. 24, on human excrement.

Sarcophaga errabunda Wlp. (*rheinhardii* Hall). Victoria: Apr. 24, on human excrement. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga kellyi Ald. San Luis Potosi: Apr. 9, trapped over rabbit meat. Victoria: Apr. 25, trapped over beef liver.

Sarcophaga l'herminieri R.D. (*pallinervis* Thom., *communis* Park.). San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga misera var. *sarracenioides* Ald. San Luis Potosi: Apr. 28, bred from beef liver.

Sarcophaga ochripyga Wlp. Tampico: Apr. 17, on carcass of calf.

Sarcophaga omani Hall. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga pedunculata Hall. Victoria: May 15, bred from hog liver.

Sarcophaga pexata Wlp. Tampico: May 14, bred from beef. According to Aldrich (*1*), this species was previously known only from two specimens in the British Museum.

Sarcophaga planifrons Ald. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga plinthopyga Wied. San Luis Potosi: Apr. 9, trapped over rabbit meat; May 1, bred from beef liver. Victoria: Apr. 25, trapped over beef liver, the most frequently trapped Sarcophaga at Victoria.

Sarcophaga rapax Wlk. San Luis Potosi: Apr. 9, trapped over rabbit meat. Victoria: Apr. 24, on human excrement; Apr. 25, trapped over beef liver; May 2, bred from hog liver.

Sarcophaga stimulans Wlk. (*quadrisetosa* Cop.). Tampico: Apr. 19, on fresh horse manure. Victoria: Apr. 25, trapped over beef liver.

Sarcophaga sueta Wlp. (*ochracea* Ald.). San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga (*Oxysarcodexia* group). Tampico: Apr. 17, on carcass of calf; Apr. 19, on fresh horse manure.

Sarcophaga sulcata Ald. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga trivialis Wlp. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Sarcophaga volucris Wlp. Victoria: Apr. 14, bred from hog liver. According to Aldrich (*1*), this species was known previously only from the type specimen in the British Museum.

MUSCIDÆ

Musca domestica L. San Luis Potosi: Apr. 9, 27 per cent of the flies trapped over rabbit meat were of this species, common in dwellings. Tampico: Apr. 16, abundant in dwellings. Victoria: Apr. 25, trapped over beef liver.

Cryptolucilia cæsarion Meig. Victoria: Apr. 14, larvæ found in cow dung; Apr. 24, adults numerous on fresh cow dung on banks of Corona River.

Graphomyia maculata Scop. Tampico: Apr. 17, on carcass of calf.

Muscina stabulans Fall. San Luis Potosi: Apr. 9, trapped over rabbit meat.

Synthesiomyia nudiseta VdW. Tampico: Apr. 28, collected over fresh beef; May 11, 75 per cent of flies bred from beef exposed at Tampico were of this species. Victoria: Apr. 25, trapped over beef liver; May 9, bred from hog liver.

Cyrtoneurina rescita Wlk. Tampico: Apr. 15, on cow dung; Apr. 19, on horse manure.

HYMENOPTERA

BRACONIDÆ

Aphæreta muscæ Ashm. Victoria: Apr. 24, collected from human excrement infested with Sarcophaga and other fly larvæ.

CYNIPIDÆ

Aspicera sp. San Luis Potosi: June 21, 1930, reared from blowfly larvæ by Mundell.

CHALCIDIDÆ

Brachymeria fonscolombei Dufour. Tampico: Apr. 21, collected on beef containing blowfly larvæ; May 22–28, bred from blowfly larvæ.

SIPHONAPTERA

PULICIDÆ

Pulex irritans L. San Luis Potosi: Apr. 9, abundant in dwellings on beds and floors, feeding on man. Victoria: Apr. 23, feeding on dog.

Ctenocephalus felis Bouche. San Luis Potosi: Apr. 9, feeding on man. Victoria: Apr. 23, feeding on dog.

OTHER ARTHROPODA

IXODIDÆ

Rhipicephalus sanguineus Latr. Victoria: Apr. 23, feeding on dog.

Amblyomma cajennense Fab. Villa Juarez, Tamps.: Apr. 14, on man. Tampico: Apr. 17, on man; Apr. 18, specimens removed from horse, chickens and dog. The abundance of this tick in the area surrounding Tampico and in northern Vera Cruz during April deserves particular notice. All stages were present. They readily attacked man and as many as a hundred could be removed from the author's body at the end of a day. The ticks were found attached to the heads of chickens and were common on horses. They were abundant on dogs, and one small puppy was seen with over 200 attached ticks. It was stated that the ticks were removed from the dog every third day, but it was immediately reinfested. In many places hundreds of ticks were

TABLE 1

FLIES TRAPPED IN SMALL SCREEN WIRE FLY TRAP BAITED WITH JACK RABBIT (3 POUNDS). APRIL 6 TO 9, 1931, SAN LUIS POTOSI, S. L. P., MEXICO

Species	Number	Per cent of total
Musca domestica L.	303	27.27
Calliphora sp.	213	19.17
Lucilia sericata Meig.	186	16.74
Fannia sp.	129	11.61
Phormia regina Meig.	73	6.57
Fannia canicularis L.	72	6.48
Sarcophaga cessator Ald.	28	2.52
Hylemyia sp.	15	1.35
Muscina stabulans Fall.	14	1.26
Lonchœa sp.	13	1.17
Cochliomyia macellaria Fab.	8	0.72
Lucilia unicolor Towns.	6	0.54
Phaonia texensis Mall.	5	0.45
Sarcophaga sueta Wlp.	4	0.36
Sarcophaga plinthopyga Wied.	4	0.36
Sarcophaga planifrons Ald.	3	0.28
Anthomyia pluvialis L.	3	0.27
Chrysomyza demandata Fab.	2	0.18
Sarcophaga errabunda Wlp.	2	0.18
Sarcophaga l'herminieri R. D.	2	0.18
Sarcophaga omani Hall	2	0.18
Sarcophaga trivialis Wlp.	2	0.18
Sarcophaga kellyi Ald.	1	0.09
Sarcophaga sulcata Ald.	1	0.09
Sarcophaga rapax Wlk.	1	0.09
Ophyra œnescens Wied.	1	0.09
Unrecognizable	18	1.62
Total	1,111	100.00

found swarming on the ground. Schwarz and Bishopp, according to Hooker (*2*), in 1909 found much the same condition to exist at Tampico. They commented on the intense itching and annoyance of the bites, but stated that none of the bites became infected. The author encountered no cases of infection, but found the bites very painful. The point of attachment of the tick was usually surrounded by a swollen, inflamed area which persisted from two to three days.

Dermacentor parumapertus marginatus Banks. San Luis Potosi, Apr. 8, abundant on jack rabbits; in one instance about 40 ticks were secured from six rabbits.

FLIES TRAPPED OVER MEAT BAITS

Tables 1 and 2 give the species of flies trapped at San Luis Potosi and Victoria, together with their relative abundance as shown by the numbers of specimens of each species trapped.

TABLE 2

FLIES TRAPPED IN SMALL SCREEN WIRE FLY TRAP BAITED WITH BEEF LIVER (2 POUNDS). APRIL 22 TO 25, 1931, VICTORIA, TAMPS., MEXICO

Species	Number	Per cent of total
Cochliomyia macellaria Fab.	59	29.07
Lucilia australis Towns.	52	25.62
Musca domestica L.	34	16.75
Lucilia sericata Meig.	22	10.84
Ophyra æenescens Wied.	9	4.43
Synthesiomyia nudiseta VdW.	9	4.43
Sarcophaga plinthopyga Wied.	6	2.96
Fannia sp.	4	1.97
Sarcophaga sp. (females)	3	1.48
Sarcophaga stimulans Wlk.	1	0.49
Sarcophaga kellyi Ald.	1	0.49
Sarcophaga rapax Wlk.	1	0.49
Sarcophagula occidua Fab.	1	0.49
Unrecognizable	1	0.49
Total	203	100.00

FLIES REARED FROM JAR EXPOSURES

The method of determining the status of the insects breeding in meat consisted of the exposure of 4-ounce meat baits in pint Mason jars. The jars contained 2 inches of sand on which the meat was placed and in which the dipterous larvae pupated.

During exposure the jars were capped with lids of 4-mesh hardware cloth, a size that allowed the entry of flies and other insects

TABLE 3

BLOWFLIES REARED FROM 10 STATUS JARS, EACH CONTAINING 4 OUNCES OF BEEF LIVER, EXPOSED APRIL 5 AND BROUGHT IN APRIL 9, 1931. SAN LUIS POTOSI, S. L. P., MEXICO

Species	Number of days between exposure of meat and emergence of fly		Number of flies	Per cent of total
	Range	Average		
Lucilia sericata	18–32	21	1,273	44.59
Calliphora latifrons	16–26	21	1,079	37.79
Sarcophaga plinthopyga	23–32	27	338	11.83
Sarcophaga cessator	19–40	24	145	5.08
Sarcophaga misera sarracenoides	23	23	20	0.70
Total			2,855	100.00

TABLE 4

BLOWFLIES REARED FROM 10 STATUS JARS, EACH CONTAINING 4 OUNCES OF HOG LIVER, EXPOSED APRIL 13 AND BROUGHT IN APRIL 23, 1931. VICTORIA, TAMPS., MEXICO

Species	Number of days between exposure of meat and emergence of fly		Number of flies	Per cent of total
	Range	Average		
Lucilia australis	19–42	27	791	58.33
Synthesiomyia nudiseta	24–31	28	228	16.81
Sarcophaga pedunculata	21–42	35	108	7.97
Sarcophaga rapax	19–30	23	70	5.16
Oscinella sp.	40–42	41	63	4.65
Sarcophaga volucris	26–42	31	57	4.20
Megaselia iroquoiana	19	19	28	2.07
Fannia pusio	24	24	11	0.81
Total			1,356	100.00

but prevented molestation by birds and small animals. Ten jars were exposed at both San Luis Potosi and Victoria. The jars were placed in a variety of positions, some upon the ground and others in trees. At Tampico only five jars were exposed. Upon conclusion of the exposure period the predatory beetles were removed and counted and lids of 60-mesh brass strainer cloth were placed on the jars. During the emergence period of the flies, daily records were made of the number of each species that emerged.

Tables 3, 4, and 5 give a record of the flies reared from the exposed meat baits.

TABLE 5

BLOWFLIES REARED FROM FIVE STATUS JARS, EACH CONTAINING 4 OUNCES OF BEEF, EXPOSED APRIL 17 AND BROUGHT IN APRIL 21, 1931. TAMPICO, TAMPS., MEXICO

Species	Number of days between exposure of meat and emergence of fly		Number of flies	Per cent of total
	Range	Average		
Synthesiomyia nudiseta	22–32	23	661	74.44
Sarcophaga chrysostoma	24–33	26	161	18.13
Fannia pusio	20–22	21	37	4.17
Lucilia australis	20–33	24	17	1.91
Sarcophaga pexata	27–33	28	12	1.35
Total			888	100.00

DIPTERA COLLECTED FROM ANIMAL EXCREMENT

In addition to *Musca domestica* L. and *Fannia canicularis* L., which were commonly found frequenting latrines, the following species were collected from excrement. The number of specimens collected is given in parenthesis after the specific name.

On Human Excrement:

Victoria, Apr. 24: *Fannia vittata* Mall. (1), *Limnophora debilis* Will. (3), *Lucilia australis* Towns. (1), *Sarcophagula occidua* Fab. (4), *Sarcophaga effreneta* Wlk. (10), *Sarcophaga* *ampulla* Ald. (1), *Sarcophaga rapax* Wlk. (2), *Sarcophaga errabunda* Wlp. (2).

On Horse Manure:

Tampico, Apr. 19: *Limnophora* sp. (1), *Sarcophaga occidua* Feb. (3), *Sarcophaga stimulans* Wlk. (4), *Sarcophaga* (*Oxysarcodexia* group) (8), *Cyrtoneurina rescita* Wlk. (2).

On Cow Dung:

Victoria, Apr. 24: *Cryptolucilia cæsarion* Meig. (2).

Tampico, Apr. 15: *Sarcophaga effreneta* Wlk. (4), *Cyrtoneurina rescita* Wlk. (1).

Discussion of Species of Flies and Their Parasites

The house fly, *M. domestica,* which was abundant in all localities, was taken in greatest numbers at San Luis Potosi, where it represented 27 per cent of the trap catch. In addition, the lesser house fly, *F. canicularis,* was common there. These flies are of particular interest to public health because of their prevalence, their breeding habits, and their relation to diseases transmittable to man.

At San Luis Potosi, the blowflies trapped and bred from meat were the species common in cool weather. This was evidenced by the abundance of Calliphora and the presence of *L. unicolor* and *P. regina.* Of the flies bred from meat, 44.59 per cent were *L. sericata* and 37.79 per cent *C. latifrons.* Species of these genera were also highest in the percentage list of blowflies trapped.

At Victoria and Tampico summer species were predominant. *Cochliomyia macellaria* was the most abundant fly, and *L. australis* was common, 58.33 per cent of the flies bred from meat at Victoria being of this species. *Phormia regina, L. unicolor* and Calliphora were not present. *Synthesiomyia nudiseta* at Tampico represented 74.44 per cent of the flies bred from meat. Thus it is clearly shown that in descending from the mountains the cool-weather species were replaced by summer species.

The various species of Lucilia and *P. regina* are responsible for wool-worm attacks on sheep and often are implicated in cases of myiasis. The Sarcophaga are of interest because of their diversity of species, their presence in many screw-worm wounds, and the frequency with which they are found around dwellings.

Sufficient data are not at hand to warrant a broad statement as to the effect of parasites and predators on blowflies in Mexico. *Brachymeria fonscolombei* is a larval parasite bred most frequently from Sarcophaga, but it also readily parasitizes Phormia and Synthesiomyia and, to a less extent, Lucilia. Adults of *B. fonscolombei* were found at Tampico and specimens of the second generation were obtained from larvæ reared in 4-ounce meat baits. As this species is common in the United States from Brownsville, Tex., to California, to might be expected to be found at corresponding points on the Mexican side of the border. It no doubt extends down the eastern coast, but there is no information as to its activity on the plateau or on the western coast. *Aspicera* sp. has been bred frequently from blowfly larvæ at San Luis Potosi. It is known to parasitize *C. macellaria,* Lucilia, and Sarcophaga. It, too, is quite generally distributed, and probably may be found in any portion of Mexico. *Aphæreta muscæ,* a pupal parasite, is commonly bred from dipterous pupæ in both manure and carrion.

LITERATURE CITED

(1) Aldrich, J. M.
1930. Notes on the Types of American Two-Winged Flies of the Genus Sarcophaga and a Few Related Forms Described by the Early Authors. No. 2855. Proceedings of the U. S. Nat'l Museum, Vol. 78, Art. 12, pp. 1–39, 3 pls.

(2) Hooker, W. A., Bishopp, F. C., and Wood, H. P.
1912. The Life History and Bionomics of Some North American Ticks. U. S. Dept. Agr., Bur. Ent. Bull. 106, pp. 1–239, 17 figs., 15 pls.

SOME EFFECTS OF REFRIGERATION ON THE BIOLOGY OF TRICHOGRAMMA IN ARTIFICIAL BREEDING

JOHN C. SCHREAD AND PHILIP GARMAN

It has been observed by various workers that Trichogramma in grain moth eggs cannot be held successfully in ordinary refrigeration for any great length of time. In order to clear up some of the reasons why this cannot be done, the following experiments were carried on. The host used was the grain moth *Sitotroga cerealella* and all material was kept in electric refrigerators. As might be expected with any host, the mortality on prolonged exposure to cold is considerable, but from a practical production standpoint, the actual length of survival is not so important as the percentage surviving and the behavior of the survivors upon emergence. In grain moth eggs, for example, less than 10 per cent of the parasites will survive at 40° F. for more than two months. It is possible, however, to hold eggs with parasites longer at higher temperatures, but the mortality is considerable even at higher temperatures. Attempts to hold them in larval, prepupal, and adult stages at 40° were made, but results were not encouraging.

In the course of these experiments more than 450,000 parasitized grain moth eggs and about 200,000 adult individuals of Trichogramma were examined.

EFFECTS OF REFRIGERATION AT 37° F.

Tables 1, 2

With two days' pre-refrigeration development and eight days' refrigeration the mortality was 12 per cent for the yellow species, *pretiosa*,[1] and 45 per cent for the dark species, *minutum*.[1] Three days' pre-refrigeration resulted in 34 per cent mortality for *pretiosa* and 32 per cent for *minutum*. Four

[1] These names are used throughout for the dark and yellow or light species.

days' pre-refrigeration development and eight days' refrigeration gave 22 per cent mortality for *pretiosa* and 34 per cent for *minutum.* The greatest mortality, 90 per cent for a period of 40 days, took place in the species *minutum* with a pre-refrigeration development of three days. For an equal length of time and with five days' pre-refrigeration development, there was an 84 per cent mortality in the yellow species. The least mortality at the termination of a 40-day refrigeration period was 50 per cent for the dark species (*minutum*) with four days' pre-refrigeration development. Over the same period and having the same number of days of pre-refrigeration development, the mortality of the yellow species (*pretiosa*) was 77 per cent.

EFFECTS OF REFRIGERATION AT 44° AND 46° F.

Tables 3 and 4

After one week of refrigeration at 44° F., the mortality was four per cent when the parasite had been allowed four days of pre-refrigeration development. This is considered to be a normal emergence, for under ordinary conditions without refrigeration, not more than 96 to 98 per cent of parasitized eggs will hatch. At the end of 40 days of refrigeration the mortality was less than 66 per cent and in 60 days all of the parasites were dead.

EFFECTS OF REFRIGERATION AT 47° F.

Tables 5, 6

There is little comparison between the refrigeration results obtained for the dark and yellow species at this temperature. The yellow species survives longer than the dark species and there is less mortality for equal periods of refrigeration. For three days' pre-refrigeration development, 97 per cent of *pretiosa* emerged after one week of refrigeration, as compared with 92 per cent for the dark species. However, at the end of 40 days' refrigeration only 10 per cent of *minutum* emerged, while 48 per cent of the *pretiosa* came through. Four days' of pre-refrigeration development and one week refrigeration resulted in 96 per cent emergence for the yellow and 76 per cent for *minutum.* From the same lot, in 40 days about 50 per cent of the *pretiosa* emerged and only 21 per cent of the dark species. The mortality was proportionately the same for the two species when comparing the results of two days' pre-refrigeration development with three and four days' pre-refrigeration development.

EFFECTS OF REFRIGERATION AT 49° F.

Table 7

The results at this temperature were more encouraging than at any of the others for exposures of less than one month. After one month, the emergence was 85 per cent for four days of pre-refrigeration development, 86 per cent for three days, and 73 per cent for two days. For one week of refrigeration (in the sequence given above) the percentages of emergence were 92, 91 and 94 per cent.

In grain moth eggs, Trichogramma are capable of withstanding low temperatures for long or short periods, depending on the stage of development at the time of refrigeration. There seems to be a considerable difference between the yellow and dark species in their ability to survive low refrigeration temperatures (Table 8). Of the two, *pretiosa* will survive longer than *minutum* at any single temperature, except 37° F., with a pre-refrigeration development of four days. Here, for a period of two weeks, there was less mortality of *pretiosa* at 37° F. than the dark species, but after that the mortality of *pretiosa* was more rapid at 37° than *minutum*. Furthermore, a comparison of the extreme and mean refrigeration temperatures for *minutum* indicates that it would be more profitable to hold the species for a period of more than two weeks at 37° F. than at 47°, providing four days' pre-refrigeration development has been allowed. During the first two weeks of refrigeration, regardless of pre-refrigeration development, there is less mortality at 47° F. than at 37° F. After two weeks, for two, three and four days' pre-refrigeration development, the mortality increases rapidly at 47° (Table 6). At 37° F. the mortality is slower and more uniform for two and four days' pre-refrigeration development. The rapidity of mortality at 37° F. for three days' pre-refrigeration development is more comparable to the results at 47° F. than either the two or four days' pre-refrigeration developments.

Sex Ratio

Inspection of Tables 1 to 6 will show that low temperatures frequently produce a change in sex ratio. This is probably accompanied by a weakening of individuals (also evident in wing deformation) which results in a further change in the following generation. At higher temperatures this is not so apparent, though some lots kept at 44° and 46° F. showed tendencies in this direction. There was no apparent action upon the individuals of 47° and 49° F. Peterson[2] states that no such effect of temperature can be observed when the parasites are reared in bagworm eggs, but it is abundantly evident that some alteration takes place in the grain moth egg which profoundly affects the vitality and reproductive powers of the individual.

Comparative Results of the Refrigeration of Trichogramma in Grain Moth and Fruit Moth Eggs

In comparing the emergence records of Trichogramma from Oriental fruit moth eggs, it will be seen that the maximum survival of the yellow species was not so high at 45° F. as it was for the dark species. At the end of four weeks 75 per cent of the dark species emerged, while less than 65 per cent of the yellow species survived. After four additional weeks in the refrigerator, or eight weeks from the beginning of refrigeration, 13 per cent of the dark species (*minutum*) emerged and 7 per cent of the yellow species. Furthermore, 5 per cent of *minutum* were still alive at the termination of a 12-week period of refrigeration, while all of *pretiosa* were dead. A one degree rise in temperature from that of 37° F. made some difference in the emergence of the yellow species from fruit moth eggs. However, this may be in part accounted for in the slight difference in humidity at which the two lots of material were refrigerated. The relative humidity for the 37° F. material was 55 per cent and for the 38° F. material 60 per cent. The percentage of mortality at the end of three weeks at 37° F. was 55 per cent, and at 38° F. slightly less than 37 per cent. The mortality in five weeks at 37° F. remained the same, 55 per cent, while there was a decrease at 38° F. to 45 per cent mortality. For the first four weeks the

[2] Peterson, A., *Jr. Econ. Entomology*, 24: 1070–1074. 1931.

mortality of *pretiosa* was less at 45° F. than at either 37° or 38° F. However, during the fifth week the mortality at 45° F. dropped below that at 38° F. Although the minimum percentage of mortality was less at 45° F. than at either 37° or 38° F., there is a more abrupt death rate over the entire period of refrigeration at the higher than at either of the lower temperatures. Trichogramma refrigerated in grain moth eggs at 45° to 46° F. were less susceptible to the low temperatures than when subjected to the same temperatures in fruit moth eggs. On the other hand, the maximum mortality in grain moth eggs for a period of five weeks at 37° F. was greater than in fruit moth eggs at the same temperature for an equal length of time.

Although *pretiosa* does better in grain moth than in fruit moth eggs at 45° to 46° F. (Table 9), it can be seen by examination of Table 11 that the results are apparently reversed when the dark species is refrigerated at 45° to 47° F. in the eggs of grain and fruit moths. In this case the minimum mortality in grain moth eggs was 65 per cent, and in fruit moth eggs 25 per cent, at the end of four weeks' refrigeration, although the two are not strictly comparable because of differences of humidity. The maximum mortality in 12 weeks in fruit moth eggs was 95 per cent, while in grain moth eggs it was 98 per cent in nine weeks. Humidity, although important, apparently was not a limiting factor so far as these results are concerned.

WING DEFORMITY IN TRICHOGRAMMA

The dark and the light species of Trichogramma are subject to varying degrees of wing deformity, both before and during periods of hibernation. This condition is at a minimum when the species are reared continuously under laboratory conditions. However, although the ratio of increase is variable during the numerous periods of hibernation investigated for both species, the percentage of increase in wing deformity is continual throughout the range of hibernation investigated for each strain of the two species of Trichogramma under discussion. Table 12.

As a rule there is but one adult Trichogramma per grain moth egg when handled under conditions suitable for mass production in the laboratory. Nevertheless, there are sometimes two individuals per egg (but to our knowledge never any more than two) when the grain moths from which the eggs for Trichogramma investigations were obtained were reared in wheat. The wing deformity of only those individuals that have developed and emerged from monoparasitized eggs will be considered in detail at this time. It may be mentioned here that, although Trichogramma will oviposit a number of times in a grain moth egg, there is apparently only enough room and available food for the complete development of two individuals. When the number of parasites an egg contains far surpasses its capacity for supplying food, all the progeny as well as the host perish prematurely. The condition of superparasitism is more prevalent in the dark (*minutum*) than in *pretiosa;* due to the fact that there are a greater number of females to each male in the dark than in the yellow species and likewise because the dark species is more prolific. Superparasitism may be accentuated by providing a great number of parasites with a small number of host eggs. Likewise, it may be reduced to a minimum by reversing the order of the above procedure. Trichogramma are apparently unable to detect existing parasitism in host eggs, or if they do detect it they disregard it. Observations have been made on females ovipositing in previously parasitized eggs in which the parasite developing from the initial oviposition has reached the pupal stage.

It may be seen by the accompanying table (12) that for the first two weeks of hibernation the percentage of deformity is higher in *minutum* than in the light species. However, after that time there is no significant difference between the percentages of wing deformity of the two species. There are varying degrees of deformity for equal periods of hibernation between the several strains of the same species and between the various strains of the two species. Notwithstanding these facts, the average of the total number of observations, including all the strains of the *pretiosa,* shows approximately 25 per cent less wing deformity than does that of *minutum.*

As the wing deformitly of individuals from duoparasitized eggs is at a minimum, a differentiation has been made in the table between the percentage of wing deformity in the total number of adults from the monoparasitized and duoparasitized eggs, and in the adults from the monoparasitized eggs only. The dark species is of strikingly higher percentage in this respect than is the light species. The wing deformity of the males in both species is greatly in excess of that of the females; only twice in 56 investigations did the percentage of wing deformity in the females exceed that of the male; once in the dark (*minutum*) and once in the light species (*pretiosa*). Although there are fewer males for every female in the dark species than in the light, the percentage of deformity runs higher in the males of the former species than in that of the latter. Furthermore, the percentage of wing deformity is higher among the females of *minutum* than among the females of *pretiosa*.

CONCLUSIONS

(1) Trichograma species reared in grain moth eggs are affected by refrigeration in the following ways. (a) At temperatures below 47° F. mortality is gradual and increases with the length of exposure. There is some survival with refrigeration extended to 72 days, but the percentage is so small that it is worthless for production purposes. (b) The sex ratio is upset when temperatures below 47° F. are employed, the change being more evident in the generation following than in the generation emerging from refrigerated eggs. (c) Wing deformity is directly proportional to length of refrigeration and indicates a general weakening of the individuals.

(2) There are some differences in the ability of the two species considered to survive exposure to cold.

(3) Results of a comparison of refrigeration of the parasite in Oriental fruit moth and grain moth eggs indicate (a) that mortality in general is greater with short exposures in fruit moth eggs than in grain moth eggs. (b) At 37° F. mortality of *pretiosa* is less in Oriental fruit moth eggs after 30 days than in grain moth eggs. (c) There is some indication that mortality is lower with *pretiosa*, the yellow species native to Connecticut, than with *minutum*, both in grain moth and fruit moth eggs. (d) The survival in grain moth eggs for *pretiosa* is greater than fruit moth eggs at the same temperature, but less in grain moth eggs for *minutum;* the latter results, however, are not strictly comparable because of differences of humidity.

TABLE 1

TRICHOGRAMMA REFRIGERATED AT 37° F.; HUMIDITY, 60 PER CENT
Dark Species (Louisiana Strain)

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio	
				Males	females
	2 days' pre-refrigeration development				
8	$7\frac{1}{3}$ days	55	84	1	: 5.2
16	$7\frac{1}{3}$ "	50	83	1	: 4.8
25	$7\frac{1}{8}$ "	50	72	1	: 2.5
39	$7\frac{1}{2}$ "	20	50	1	: 1.0
	3 days' pre-refrigeration development				
8	$7\frac{1}{3}$ days	69	75	1	: 3.0
18	$7\frac{1}{3}$ "	57	75	1	: 3.0
24	$7\frac{1}{2}$ "	26	72	1	: 2.5
38	$7\frac{1}{2}$ "	10	35	1	: 1.0
	4 days' pre-refrigeration development				
9	$7\frac{1}{3}$ days	66	80	1	: 4.0
18	$7\frac{1}{3}$ "	53	80	1	: 4.0
28	$7\frac{1}{2}$ "	50	75	1	: 3.0
37	$7\frac{1}{3}$ "	50	50	1	: 1.0

TABLE 2

TRICHOGRAMMA REFRIGERATED AT 37° F.; HUMIDITY, 60 PER CENT
Yellow Species (Conn. Strain)

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio Males : females
	2 days' pre-refrigeration development			
8	$6\frac{3}{4}$ days	88	62	1 : 1.6
1 card 16	$6\frac{2}{3}$ "	82	57	1 : 1.3
26	$6\frac{2}{3}$ "	60	50	1 : 1.0
40	$6\frac{2}{3}$ "	30	50	1 : 1.0
	3 days' pre-refrigeration development			
8	$6\frac{3}{4}$ days	66	63	1 : 1.7
1 card 19	$6\frac{2}{3}$ "	64	62	1 : 1.6
25	$6\frac{5}{6}$ "	40	50	1 : 1.0
39	$6\frac{2}{3}$ "	21	35	1 : 1.0
	4 days' pre-refrigeration development			
8	$6\frac{3}{4}$ days	78	62	1 : 1.6
1 card 18	$6\frac{3}{4}$ "	66	55	1 : 1.2
26	$6\frac{2}{3}$ "	35	55	1 : 1.2
38	$6\frac{2}{3}$ "	23	50	1 : 1.0
	5 days' pre-refrigeration development			
9	$6\frac{2}{3}$ days	67	64	1 : 1.7
1 card 18	$6\frac{2}{3}$ "	40	63	1 : 1.7
26	$6\frac{3}{4}$ "	26	57	1 : 1.3
37	$6\frac{3}{4}$ "	16	50	1 : 1.0

TABLE 3

TRICHOGRAMMA REFRIGERATED AT 44° F.; HUMIDITY, 85 PER CENT

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio Males : females
		Pretiosa, Yellow Species (Conn. Stock)		
7	$6\frac{2}{3}$ days	98	73	1 : 2.7
14	$6\frac{1}{2}$ "	77	76	1 : 3.1
21	$6\frac{1}{2}$ "	68	79	1 : 3.7
28	$6\frac{2}{3}$ "	55	78	1 : 3.3
38	$6\frac{5}{6}$ "	37	50	1 : 3.7
45	$6\frac{2}{3}$ "	9	0	1 : 3.7
54		1		1 : 1
60		0		0 : 0
		Pretiosa, Yellow Species (Mass. Strain)		
7	$6\frac{2}{3}$ days	96	65	1 : 1.7
17	$6\frac{3}{4}$ "	73	58	1 : 1.3
24	$6\frac{5}{6}$ "	73	62	1 : 1.6
32	$6\frac{5}{6}$ "	60	61	1 : 1.7
38	$6\frac{2}{3}$ "	30	63	1 : 1.7
45		27	64	1 : 1.7
49		23	64	1 : 1.6
		Pretiosa, Yellow Species (Ohio Strain)		
7	$6\frac{2}{3}$ days	96	66	1 : 1.9
16	$6\frac{2}{3}$ "	78	63	1 : 1.7
23	$6\frac{6}{8}$ "	75	60	1 : 1.5
32	$6\frac{5}{12}$ "	55	62	1 : 1.6
38	$6\frac{7}{12}$ "	35	59	1 : 1.5
45	$6\frac{2}{3}$ "	20	63	1 : 1.7
49	$6\frac{5}{6}$ "	19	63	1 : 1.7

TABLE 3 (*Continued*)

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio	
				Males	females
		Pretiosa, Yellow Species (West Texas)			
7	$7\frac{1}{6}$ days	90	56	1	: 1.2
16	$7\frac{1}{4}$ "	67	63	1	: 1.7
23	$7\frac{1}{2}$ "	54	63	1	: 1.7
32	$7\frac{1}{6}$ "	25	75	1	: 3
38	$7\frac{2}{3}$ "	13	68	1	: 2.1
45		6	80	1	: 4
49		5	78	1	: 3.5
		Minutum, Dark Species (Georgia Strain)			
7	$7\frac{1}{3}$ days	75	83	1	: 4.8
14	$7\frac{1}{3}$ "	73	83	1	: 4.8
21	$7\frac{1}{2}$ "	55	79	1	: 3.7
28	$7\frac{1}{6}$ "	55	85	1	: 5.6
34	$7\frac{5}{6}$ "	54	80	1	: 4.0
41		24	70	1	: 2.3
45		22	66	1	: 1.9
		Minutum, Dark Species (Louisiana Strain)			
7	$7\frac{1}{3}$ days	70	80	1	: 4
15	$7\frac{1}{3}$ "	70	82	1	: 4.5
23	$7\frac{1}{4}$ "	68	83	1	: 4.8
30	$7\frac{1}{8}$ "	58	80	1	: 4.0
37	$7\frac{1}{8}$ "	28	83	1	: 4.8
43	$7\frac{5}{6}$ "	22	84	1	: 4.8
50		16	90	1	: 9.0*

Note:—Temperature and humidity of parasite incubator – 80° F. and 75 per cent R. H.

* The sudden increase in sex ratio is due to the fact that there are few individuals to work with.

Pre-refrigeration development, 4 days.

TABLE 4

TRICHOGRAMMA REFRIGERATED AT 46° F.; HUMIDITY, 85 PER CENT

Pretiosa, Yellow Species

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio	
				Males	females
	2 days' pre-refrigeration development				
8	$6\frac{3}{4}$ days	96	63	1 :	1.7
15	$6\frac{2}{3}$ "	92	63	1 :	1.7
22	$6\frac{5}{6}$ "	92	63	1 :	1.7
30	$6\frac{7}{12}$ "	65	69	1 :	2.2
36	$6\frac{3}{4}$ "	33	69	1 :	2.2
44	$6\frac{5}{6}$ "	39	54	1 :	1.1
69	$6\frac{1}{2}$ "	0	0	0 :	0
	3 days' pre-refrigeration development				
7	$6\frac{2}{3}$ days	97	70	1 :	2.3
14	$6\frac{3}{4}$ "	93	76	1 :	3.1
21	$6\frac{5}{6}$ "	85	75	1 :	3
28	$6\frac{2}{3}$ "	60	78	1 :	3.5
35	$6\frac{3}{4}$ "	50	73	1 :	2.7
43	$6\frac{1}{4}$ "	58	75	1 :	3
71	$6\frac{1}{2}$ "	2	100	0 :	1
90		0	0	0 :	0
	4 days' pre-refrigeration development				
7	$6\frac{3}{4}$ days	96	71	1 :	2.3
14	$6\frac{1}{12}$ "	92	63	1 :	1.7
23	$6\frac{1}{4}$ "	90	72	1 :	2.3
31	$6\frac{1}{12}$ "	90	75	1 :	3
37	$6\frac{3}{4}$ "	86	75	1 :	3
45	$6\frac{2}{3}$ "	84	81	1 :	4.2
70	$6\frac{3}{4}$ "	1	0	0 :	0
89		0	0	0 :	0

TABLE 5

TRICHOGRAMMA REFRIGERATED AT 47° F.; HUMIDITY, 85–90 PER CENT

Minutum, Dark Species (Louisiana Strain)

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio	
				Males	females
2 days' pre-refrigeration development					
8	$7\frac{1}{12}$ days	85	80	1	: 4
16	$7\frac{1}{2}$ "	76	80	1	: 4
25	7 "	50	82	1	: 4.5
39	$6\frac{3}{4}$ "	22	80	1	: 4
3 days' pre-refrigeration development					
8	$7\frac{1}{6}$ days	92	86	1	: 6.1
18	$7\frac{1}{6}$ "	74	84	1	: 5.2
24	$7\frac{1}{12}$ "	40	82	1	: 4.5
38	7 "	10	82	1	: 4.5
4 days' pre-refrigeration development					
9	$6\frac{5}{6}$ days	76	83	1	: 4.8
18	$6\frac{2}{3}$ "	71	84	1	: 5.2
28	$6\frac{7}{8}$ "	35	83	1	: 4.8
37	$6\frac{1}{2}$ "	21	83	1	: 4.8

TABLE 6

TRICHOGRAMMA REFRIGERATED AT 47° F.; HUMIDITY, 85–90 PER CENT

Pretiosa, Yellow Species (Conn. Strain)

Number days retained in refrigerator	Minimum length of life cycle	Per cent egg hatch after refrigeration	Per cent females	Sex ratio	
				Males	females
	2 days' pre-refrigeration development				
8	$6\frac{1}{2}$ days	98	70	1	: 2.3
16	6 "	90	67	1	: 2.0
26	$5\frac{3}{4}$ "	70	70	1	: 2.3
40	$5\frac{1}{6}$ "	50	70	1	: 2.3
63	—	13			
	3 days' pre-refrigeration development				
8	$6\frac{2}{3}$ days	97	65	1	: 1.8
16	$6\frac{1}{12}$ "	84	70	1	: 2.3
25	6 "	70	70	1	: 2.3
39	$5\frac{3}{4}$ "	48	67	1	: 2.0
62					
	4 days' pre-refrigeration development				
8	$6\frac{2}{3}$ days	96	63	1	: 1.7
18	$6\frac{1}{2}$ "	74	70	1	: 2.3
26	$6\frac{1}{3}$ "	70	67	1	: 2.0
38	6 "	50	63	1	: 1.7
61					
	$4\frac{5}{6}$ days' pre-refrigeration development				
9	$6\frac{7}{8}$ days	89	64	1	: 1.7
17	$6\frac{2}{3}$ "	82	64	1	: 1.7
28	$6\frac{1}{2}$ "	68	65	1	: 1.8
39	6 "	35	65	1	: 1.8
62		2			

TABLE 7

TRICHOGRAMMA REFRIGERATED AT 49° F.; HUMIDITY, 85 PER CENT
Pretiosa, Yellow Species

Number days retained in refrigerator	Minimum length of life cycle at 80° F. minus development in refrigeration at 49°	Per cent egg hatch after refrigeration	Per cent females	Sex ratio Males : females
	2 days' pre-refrigeration development			
7	$6\frac{3}{4}$ days	94	58	1 : 1.4
14	5 "	90	59	1 : 1.4
21	$2\frac{6}{8}$ "	80	57	1 : 1.3
29	$2\frac{1}{2}$ "	73	51	1 : 1.0
	3 days' pre-refrigeration development			
7	7 days	91	64	1 : 1.7
14	$5\frac{3}{4}$ "	90	65	1 : 1.8
21	$4\frac{1}{2}$ "	90	64	1 : 1.7
28	3 "	86	57	1 : 1.3
	4 days' pre-refrigeration development			
8	7 days	92	50	1 : 1.0
15	$6\frac{2}{3}$ "	92	23	1 : 2.5
22	$4\frac{2}{3}$ "	88	45	1 : 1.2
29	$3\frac{2}{3}$ "	85	43	1 : 1.3

Note:—2 days' pre-refrigeration development—parasites emerged in refrigeration in 30 days.
3 days' pre-refrigeration development—parasites emerged in refrigeration in $33\frac{1}{4}$ days.
4 days' pre-refrigeration development—parasites emerged in refrigeration in 35 days.
2 days' pre-refrigeration development—parasites are in the larval stage.
3 days' pre-refrigeration development—parasites are in the early prepupal stage.
4 days' pre-refrigeration development—parasites are in the late prepupal stage.
5 days' pre-refrigeration development—parasites are in the pupal stage.

TABLE 8

EMERGENCE OF TRICHOGRAMMA FROM ANGOUMOIS GRAIN MOTH EGGS (*Sitotroga cerealella* OLIVER) RERIGERATED AT DIFFERENT TEMPERATURES

49° F. Pre-refrigeration development in days						46° F. Pre-refrigeration development in days						44° F. Pre-refrigeration development in days						37° F. Pre-refrigeration development in days							
2		3		4		2		3		4		2		3		4		2		3		4		5	
*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**	*	**
Pretiosa, Yellow Species																									
7	94	7	91	8	92	8	96	7	97	7	96					7	96	8	88	8	66	8	78	9	67
14	90	14	90	15	92	15	92	14	93	14	92					16	78	16	82	19	61	18	66	18	40
21	80	21	90	22	99	22	92	21	85	23	90					23	75	26	60	25	40	26	35	26	26
29	73	28	86	29	85	30	65	28	60	31	90					32	55	40	30	39	21	38	23	37	16
						36	33	35	50	37	86					38	35					55	12		
						44	30	43	48	45	84					45	20					64	5		
						69	0	71	2	70	1					49	19					72			
								90	0	89	0					60	0								

Minutum, Dark Species

47° F.						37° F.					
*	**	*	**	*	**	*	**	*	**	*	**
8	85	8	92	9	76	8	55	8	69	9	66
16	76	18	74	18	71	16	50	18	57	18	53
25	50	24	40	28	35	25	50	24	26	28	50
39	22	38	10	37	21	39	20	38	10	37	50

Note:—* Number days of refrigeration. ** Percentage of emergence.
Refrigeration humidity 70–90 per cent.
Pre-refrigeration and post-refrigeration development of Trichogramma at 80° F. and 75 per cent. R. H.

TABLE 9

COMPARISON OF THE MORTALITY OF THE YELLOW SPECIES (*Pretiosa*) AFTER FIVE WEEKS' REFRIGERATION IN GRAIN MOTH AND ORIENTAL FRUIT MOTH EGGS

Host eggs	Temperature	Per cent mortality	Temperature	Per cent mortality
Grain moth	45°–46° F.	14	37° F.	77
Fruit moth	45°–46° F.	54	37° F.	57

TABLE 10

MORTALITY OF TRICHOGRAMMA FROM FRUIT MOTH EGGS REFRIGERATED AT 45° F. AND 60 PER CENT RELATIVE HUMIDITY AND SEX RATIO OF ADULT PARASITES EMERGING THEREFROM

Number days refrigeration	Per cent emergence	Per cent females emerging	Sex ratio	
			Males	Females
		Pretiosa, Yellow Species		
8	78	63	1	1.7
18	78	60	1	1.5
26	65	58	1	1.3
32	50	60	1	1.5
48	11	58	1	1.3
58	7	50	1	1.0
		Minutum, Dark Species		
29	75	77	1	3.3
42	23	80	1	4.0
58	13	82	1	4.5
82	5	80	1	4.0
		Refrigerated at 37° F. and 55 per cent relative humidity *Pretiosa, Yellow Species*		
12	54	58	1	1.3
22	45	60	1	1.5
30	45	71	1	2.4
33	45	60	1	1.5
		Refrigerated at 38° F. and 60 per cent relative humidity *Pretiosa, Yellow Species*		
6	70	50	1	1
19	63	50	1	1
25	59	50	1	1
35	55	50	1	1

TABLE 11

COMPARISON OF YELLOW AND DARK TRICHOGRAMMA REFRIGERATED IN GRAIN MOTH AND ORIENTAL FRUIT MOTH EGGS

Grain moth eggs			Fruit moth eggs		
Number days refrigerated	Humidity	Per cent emergence	Number days refrigerated	Humidity	Per cent emergence
Pretiosa, Yellow Species, 45°–46° F.					
1– 7	90%	95	1– 8	60%	78
7–14	"	92	8–18	"	78
14–23	"	90	18–26	"	65
23–31	"	90	26–32	"	50
31–45	"	84	32–48	"	11
Minutum, Dark Species, 45°–47° F.					
1–28	90%	35	1–29	60%	75
28–37	"	21	29–42	"	23
37–60	"	2	42–58	"	13
60	"		58–82	"	5
Pretiosa, Yellow Species, 37° F.					
1– 8	60%	78	1–12	55%	54
8–18	"	66	12–22	"	45
18–26	"	35	22–30	"	45
26–38	"	23	30–33	"	45

TABLE 12

WING DEFORMITY IN TRICHOGRAMMA

HIBERNATION TEMPERATURE 38°–46° F.

HUMIDITY 60–85 PER CENT

Pretiosa, Yellow Species

Period of hibernation, days	Average of the total per cent adults with deformed wings	Corrected per cent of adults with deformed wings	Per cent males with deformed wings	Per cent females with deformed wings	Period of prehibernation development at 80° F.
		Connecticut stock			
0	6.9	4.7	4.5	3.8	0.0
5	11.0	7.0	9.0	6.0	5.0
10	7.4		9.0	7.4	5.0
16	18.0	17.0	11.0	17.0	5.0
28	25.0		42.0	23.0	5.0
		Massachusetts stock			
0	3.1		4.2	1.9	0.0
7	5.0		10.0	3.0	4.0
17	18.7	18.0	18.0	9.0	4.0
23	25.0		32.0	13.0	4.0
30	50.0		66.0	33.0	4.0
40	86.0		87.0	76.0	4.0
		Ohio stock			
0	2.5	1.3	2.2	0.3	0.0
7	10.0		8.0	3.0	4.0
15	16.0	8.1	25.0	20.0	4.5
23	34.0		41.0	26.0	4.5
30	29.0		66.0	22.0	4.0
45	86.0		91.0	64.0	4.5
99	93.0		100.0	85.0	4.5
		West Texas stock			
0	7.2	0.9	7.0	0.5	0.0
10	5.6	3.8	9.9	3.8	4.0
20	15.0	7.0	20.0	7.0	4.0
34	26.0		50.0	9.0	4.0
41	50.0		81.0	45.0	4.0
57	67.0		90.0	62.0	4.0
71	55.0		98.0	55.0	4.0
92	100.0		100.0		4.0

TABLE 12 (*continued*)
Minutum, Dark species

Period of hiber-nation, days	Average of the total per cent adults with deformed wings	Corrected per cent of adults with deformed wings	Per cent males with deformed wings	Per cent females with deformed wings	Period of prehiber-nation de-velopment at 80° F.
		Georgia stock			
0	11.3	5.8	25.2	3.9	0.0
12	16.6		21.1	9.0	4.0
18	38.0		43.0	33.0	4.0
25	53.0	52.5	50.0	34.0	4.0
36	64.0	63.0	87.0	50.0	4.0
100	83.0		100.0	83.0	4.5
		Louisiana stock			
0	16.0	7.7	24.0	7.2	0.0
6	17.0	9.0	24.0	2.0	4.0
10	25.0	18.0	44.0	18.0	4.0
15	37.0		48.0	28.0	4.0
20	54.0	50.0	66.0	51.0	4.0
41	50.0		74.0	50.0	4.0
61	68.0		10.00	63.0	4.0
75	50.0		10.00	50.0	4.0
		Arizona stock			
0	44.0	7.5	16.0	6.1	0.0
10	5.6	3.8	25.0	4.0	4.0
15	16.0		25.0	8.3	4.0
40	20.7		32.0	11.0	4.0
56	25.0		50.0	16.0	4.0
70	50.0		50.0	50.0	4.0
		Canada stock			
0	17.0	7.1	30.0	5.0	0.0
10	20.0	16.0	37.0	9.0	4.0
15	29.0	34.0	91.0	15.0	4.0
20	40.0	37.0	50.0	23.0	4.0
41	35.0		50.0	36.0	4.0
57	50.0		50.0	40.0	4.0
73	83.0		63.0	83.0	4.0
87	100.0		100.0	100.0	4.0

NOTES ON SOME WESTERN ERYTHRONEURA WITH DESCRIPTION OF THREE NEW SPECIES (HOMOPTERA: CICADELLIDÆ)*

BY R. H. BEAMER

Erythroneura inornata McAtee

Erythroneura inornata McAtee, W. L., Proc. Biol. Soc. Wash., Dec. 29, 1929, p. 133.

This species was named from a single male specimen taken at Ward, Colorado, by Doctor E. D. Ball. I collected thirty-one females and twenty-nine males August 8, 1933, about two miles northeast of Flagstaff, Arizona, on a low growing Coenothus sp. A comparison of these specimens with the type and an examination of the male internal genitalia proves them to be this species. A female from this lot is here chosen as the allotype.

Genitalia: Pygofer with two processes or hooks; smaller one on side with heavy base and slender sharp shaft; apical one long, with quite slender curving shaft directed toward other process. Style with small foot typical of western species, practically no heel and single point on toe. Oedagus large in lateral view, flat, quite broad, with swollen place on ventral side of base of shaft; short, sharp, retrorse, spine either side about middle and median ventral spine half way from these to tip and shaft ending in a dorsally bent spine slightly shorter than ventral.

Holotype in collection of Doctor E. D. Ball. Allotype in Snow Entomological Collection, Lawrence, Kansas.

Erythroneura aprica McAtee

Erythroneura aprica McAtee, W. L., Proc. Biol. Soc. Washington, Dec. 29, 1924, p. 132.

McAtee described this species from one female specimen taken in the Santa Rita Mts., Arizona. In 1932 I collected ten males and four females in the same locality which on comparison with

* Contribution from Department of Entomology, University of Kansas, Lawrence, Kansas.

the type proves to be this species. The following is a description of a male which is here designated as the allotype: general ground color semi-hyaline to yellowish white with orange to red markings. Vertex with apical round black spot, basal, rectangular orange spot next each eye mesally separated by narrow yellowish white band. Pronotum orange except basal band and three semi-circular spots on anterior margin, and sometimes a narrow median longitudinal band yellowish white. Scutellum with basal angles and spot near apex orange, extreme tip black. Clavi with basal anchor shaped orange spot and another elongated fumose spot tinged with orange midway between that and tip. Coria with costal margin orange to lemon yellow, including costal plaque; large rectangular orange spot bordering claval suture near its middle, hollowed out opposite dark area of clavus and brighter colored near apex of clavus. Tegmina more or less fumose on apical third. Venter stramineous.

Genitalia: Style with small foot, almost no heel and single curved point. Pygofer with but one rather heavy almost straight process. Oedagus large; shaft in lateral view very broad, slightly curved dorsally, tip rounded; ventral side with two processes, smaller one near middle, just before opening of duct, U-shaped; larger one leaves base at right angles then turns parallel to ventral margin of shaft for about its length, then ends in a sharp half U-shaped bend toward shaft.

This species is closely related to *Erythroneura milleri* Beamer but may be separated from it by the black spot on apex of vertex and black tip of scutellum. All the specimens were taken on oak.

Erythroneura ritana new species

Slightly resembling *Erythroneura aprica* McA. in orange markings but does not have the black spot on apex nor black tip of scutellum.

Color: General ground color semi-hyaline to yellowish white. Vertex with basal band connecting eyes and projecting slightly foreward on mesal line, orange. Pronotum with disc orange, lobe on either side and smaller anterior mesal one yellowish white. Scutellum with basal angles and tip orange or yellow. Clavi orange except small rectangular spot near tip of scutellum and another oval or rectangular one near tip. Coria with costa yellow, orange spot near tip of clavus and apices more or less yellowish fumose. Dorsum of abdomen dark. Venter stramineous, tip of ovipositor black.

Genitalia: Pygofer with two hooks, one marginal, other apical; marginal hook heavy, almost straight, half as long as pygofer; apical hook, smaller, about as wide as lateral, straight. Style with typical western foot; heel small, angular; toe short with single point. Oedagus large, shaft heavy, slightly curved dorsally, widest in lateral view, outer fourth narrows on ventral side to rather small tip; pair of ventral processes arise at base of shaft, extending slightly more than half its length and almost parallel to it.

Holotype male and allotype female Santa Rita Mts., Arizona, July 17, 1932, R. H. Beamer. Numerous paratypes both sexes same data.

This species was swept from blue oak. Types in Snow Collection, Lawrence, Kansas.

Erythroneura huachucana new species

Resembling *Erythroneura quadricornis* Beamer but larger, usually with more red coloring and with but two processes on pygofer.

General ground color semi-hyaline to yellowish white, more or less fumose throughout. Vertex with pair of velvety black round spots surrounded by yellowish white bands, remainder dusky. Spots separated by slightly more than their own width. Pronotum mottled with fumose, an inverted W mark darker. Scutellum with black oval spot in each basal angle surrounded by lighter area, remainder dusky. Tegmina fumose throughout with semblance of pair of oblique red strips bordering claval suture. Venter yellowish white with clypeus, mesosternum and some of abdominal segments black. Dorsum of abdomen black.

Genitalia: Style simple; heel small; toe ending in simple point. Pygofer with two hooks or processes and one seta; basal process short, parallel with margin of pygofer; apical one very long sickle shaped curving around apex of pygofer. Oedagus large, almost straight, shaft slightly narrower in middle, with 2 pairs of lateral proces, basal pair three fourths as long as shaft, parallel with it; apical pair retrorse, joining shaft at 45 degree angle, about as long as shaft is wide, straight.

Holotype, male and allotype female Huachuca Mts., Arizona, July 8, 1932. R. H. Beamer. 19 female and 15 male paratypes same data. 6 female and one male paratypes Chiricahua Mts., Arizona, July —, 1932, R. H. Beamer.

All specimens were taken from *Coenothus fendleri*. Types in Snow Collection, Lawrence, Kansas.

Erythroneura ceonothana new species

Resembling *Erythroneura abluta* McA., but with black spot in basal angles of scutellum and with distinct male genitalia.

Color: General ground color semi-hyaline to greenish yellow. Vertex with two circular velvety black spots on disc separated by more than one of their diameters and semblance of mesal longitudinal brown line. Pronotum with disc darker due to dark underlying membrane. Scutellum with semi-oval black spot in each basal angle. Elytra without distinct markings. Tips more or less fumose. Dorsum of abdomen dark. Venter, stramineous with clypeus, mesosternum and part of abdomen fuscous.

Genitalia: Pygofer with two processes and large spine, one on side smallest with heavy base and slender straight shaft; apical spine heavier and longer, bent near base to 45 degree angle to parallel tip of pygofer. Style with foot typical of western species; heel small and toe with one point. Oedagus large, shaft broad in dorsal view; pair of lateral processes at apex angled retrosely 45 degrees, straight about half their length then evenly curved out, total length almost equal to that of shaft. The length and curving of these processes easily separates this species from *E. huachucana* Beamer.

Holotype male, Chiricahua Mts., Arizona, July 8, 1932, R. H. Beamer. Allotype female, Huachuca Mts., Arizona, July, 1932, R. H. Beamer. Numerous paratypes from both places.

Like *Erythroneura huachucana* Beamer this species was collected from *Coenothus fendleri*. It may be separated from that species by being noticeably smaller, more evenly pale yellowish green in color without so much fumose marking and by distinct inner male genitalia.

Types in Snow Collection, Lawrence, Kansas.

NEW OBSERVATIONS ON MOULTING AND MATING IN TARANTULÆ

By Alexander Petrunkevitch
Professor of Zoology in Yale University

Moulting and especially mating in spiders are now fairly well known owing to the work of several investigators. Little that is really new could be added to the general picture except variants of the process, due to specific differences. Nevertheless there are a few points which still require elucidation, and which, if properly understood, may open up new problems for investigation.

The spiders which I had under observation are two species of West Indian tarantulæ, *Cyrtopholis jamaicola* Strand from Jamaica and *Phormictopus cancerides* (Latreille) from Haiti. Most of the observations refer to *Cyrtopholis* which is the smaller of the two. It is by no means common, but owing to importation of fruit from Jamaica one may get occasionally specimens from wholesale fruit dealers. *Phormictopus* is a much larger, highly irritable spider reputed to be poisonous to man and always ready to strike at the slightest provocation, even at a jet of water poured three or four inches in front of it. I was able to obtain over fifty specimens of various ages and a cocoon with eggs through the courtesy of Dr. Bond who spent several weeks in scientific studies in Haiti. So far, my observations on *Phormictopus* are limited to general behavior and moulting. Although both species are burrowers in the ground and soil was provided for them in the glass jars and terraria in which they are kept, none of them has made an attempt to dig a hole in captivity. Many of the *Phormictopus* disturbed the sand, heaping it up, but without starting anything like a burrow. During the day they sit quiet, but after dark one finds them more active, walking or climbing.

Three specimens of *Cyrtopholis* were obtained in autumn 1930 and kept under observation. One of them was undoubtedly a young individual and proved later to be an immature female, when it was sacrificed for other studies in 1932 and found, on dissection, to possess ovaries. The other two specimens had the appearance of mature females, hairy, light brown in color. I particularly stress this point on account of their subsequent history which caused not a little merriment in our laboratory when they finally proved to be males after the shedding of their last skin in August, 1931. Not even the slightest indication of their sex could be detected previous to the last moult, no swelling either of the terminal joint of the pedipalps or of the distal end of the first tibiæ where the powerful hooks are prominent in mature males. It is well known that in all dipneumone spiders the male sex may be easily recognized in the penultimate instar characterized by the swollen condition of the terminal joint of the pedipalps, while almost all other characters are still of the juvenile or feminine type. Not so in *Cyrtopholis* and *Phormictopus.* The lack of any external difference in appearance between a mature female and an immature male makes one curious to know in how many instances the description of new species of tarantulæ had for type an immature male instead of, as assumed, a mature female? I call this to the attention of arachnologists to guard them against possible and serious error, because with the exception of half a dozen species of dipneumone spiders studied from the first to the last instar, we do not know the external characters by which the sex could be recognized in immature individuals.

But let us return to our observations. The three specimens of *Cyrtopholis* were kept in round glass jars 9 inches in diameter and fed on grasshoppers, cockroaches, crickets and beetles. The specimen which we nicknamed "Isabel" subsisted on the above food until August 22d, 1931, when for the first time food was refused. The spider became sluggish and did not touch food again until after the moult. On the evening of August 27 it started weaving a sheet of silk from 1 to 2½ inches from the bottom of the jar, attaching it to the walls in many places. The sheet, or as I would like to call it, the "moulting bed" was completed on the morning of August 28. It extended over three quarters of the circumference of the jar, consisted of closely woven threads and had the texture of a strong, yet soft sheet. Between 1 and 2:30 P.M., the spider turned on its back and lay motionless, with legs sprawling, holding on to the web by the claws of the first and fourth pairs of legs. Figure 1 is a reproduction of a photograph made a little after three o'clock in the afternoon with an exposure of 1 minute, proving that the spider did not move in the slightest degree. At 4:15 the old skin began to split, first along the anterior edge of the carapace, then along its sides. Next the petiolus split on each side, its tergite remaining attached to the carapace. The abdomen split now on both sides in straight lines for about $\frac{2}{3}$ of its length. Now, still lying on its back with legs sprawling, the spider extracted first its chelicerae which were white on their prolateral surface and had also perfectly white fangs. All through the following performance the old carapace remained in place, completely hiding from view the new carapace. By this time the position of the spider was somewhat shifted, so that it lay almost on its right side. The second and third pairs of legs twitched irregularly, but the first and fourth were still holding on to the moulting bed, exerting an occasional pull on it. Slowly the body became exposed to view through the slit on the left side. At 4:30 the spider began to contract its legs more or less rythmically, now pushing, now pulling with its femora. These contractions were of brief duration and were followed by considerable intervals of rest. Thus the femora were freed of their old skin, while the rest of the legs still remained inside it. The process of pushing and pulling continued for a while until the greater portion of the legs was freed. The hold on the web was now relaxed and the first pair of legs completely liberated. Next the palpi were freed. Then the fourth legs relaxed their hold on the web and the fourth femora extracted. With rythmic contractions all legs were pulled out and as they emerged from the old skin, they flexed in the knee-joint and the tibio-metatarsal joint to right angles. The abdomen was freed next. By now the spider was again flat on its back, but with legs flexed. It began to move slowly and laboriously by stemming its knees against the web and pushing the body forward. At 5:15 the spider was completely free of the old skin which was now removed to a jar of alcohol without disturbing the spider. At this time the color of the spider was pitch black with rufous hair on abdomen and legs.

Sternum and coxæ were black, the maxillary scopulæ red, but the maxillæ themselves, the fangs, the prolateral surface of the cheliceræ and the copulatory apparatus at the end of the palpi still white. The spider remained on its back under observation until 6:30 when observation was discontinued. At 7:15 the spider was found sitting on the web in a normal position, except that its legs were still flexed and held pressed tight against the body. The actual process of moulting took, therefore, at least five hours from beginning to end.

That the method of moulting, as described above, is the normal one not only for *Cyrtopholis,* but for *Phormictopus* as well, is apparent from the fact that I observed it in five cases in the former species and in 25 cases in the latter species. In all cases without exception a moulting bed was first woven and the spider lay motionless on its back. This took place not only in comparatively small jars, but in a large terrarium as well, the only difference observed being that the sheet is sometimes built slightly *above* the ground, but more often directly *on* the ground. It raises an interesting question as to how and where moulting is accomplished in nature? That it cannot be done in the burrow is evident. The spider must find a convenient place for its bed, moreover, one where it would not be exposed in its helpless condition to the attack of enemies, such as toads, lizards and digger-wasps. The creature remains in a helpless condition not only during the process of moulting, but for six or eight hours more, *i.e.,* until the fangs harden and change from white to black.

The color of the spider presents also an interesting feature. A recently moulted individual is almost entirely black. But as time goes on, the color of the hair fades and the spider appears brown or even light brown after several weeks.

"Isabel," who turned out to be a male, was now nicknamed "Ferdinand" and kept under continued observation. At 10:30 A.M., September 23, he started to build a sperm-web which he completed by 11 A.M. The web had the same appearance and structure as that of *Dugesiella hentzi,* described by me years ago. At one end it also had a concave semicircular edge. Figure 2 shows a photograph of the web with a drop of sperm hanging from its underside. As the spider constructed six sperm-webs in the course of 9 weeks all on the same plan and pumped the sperm in the same manner, I shall describe the process from my notes of October 1, when the second sperm web was constructed by him in 20 minutes, between 11:25 and 11:45 A.M. As usual, the spider was lying on its back under the web stemming his knees against the bottom of the jar. The next action cannot be interpreted in any other way than a deliberate measurement of the exact distance from the semicircular edge, at which the sperm should be deposited. Lying on its back the spider moved slowly out from under the web, until the long hairs on his fourth coxæ were abutting against the edge. He does this by a to and fro movement of the body, until the erect hairs, at their base, are actually in firm contact with the edge of the web. The determination of the exact distance is of great importance in view of the final position on top of the web, in which the spider pumps the sperm into its palpi.

Having determined the distance in the above manner, the spider engages now simultaneously in two actions: (1) constant licking of the copulatory bulbs which he moves in and out of his mouth at the same time stroking them with his cheliceræ and (2) secreting from the genital opening a special fluid which he spread on the underside of the web by a lateral motion of the abdomen, pressing the genital opening against the silk. This fluid gives a white opaque color to the silk, adheres to it firmly and, apparently, has the sole function of creating a surface which is capable of holding a drop of sperm in suspension. The field covered by the fluid has the shape of a low trapeze with a base 1 cm. long and a height of 3 mm. This double occupation lasted until 12:16, when the spider stopped suddenly both motions, ejected a drop of sperm about 1/20th of a cc. and of opalescent pearly white color, climbed out from under the web on top of it, turned around, tapped the web from above with his palpi several times, as if trying to find the drop of sperm, brought the bulbs to the underside of the web over the semicircular edge and searched for the sperm for a while. After six or seven attempts he finally located the drop and began pumping it alternately with both palpi at a rate of 95 to 96 times per minute for each palp. The pumping was kept up for 1½ hours. It became slower toward the end of this time. Finally the right palp alone was used. The spider now turned again, so that his head was in the direction opposite to the semicircular edge, and proceeded to destroy the web by pulling it with his legs and palpi and stuffing it into his mouth with his fangs.

As stated, this male constructed a spermweb and pumped sperm six times, namely September 23, October 1, 9 and 16, and November 2 and 30. In all cases the essentials of the process were the same, though some variation occurred. Thus on October 16, having ejected the drop of sperm, he crawled out in the usual manner to the top of the web, but instead of immediately turning around, for some time stroked the edge of the web with the middle joints of the long, posterior spinnerets. No silk was secreted and apparently the motion was one of orientation, for he tried to turn his cephalothorax as far as possible, without losing contact between the spinnerets and the web. After a while he stopped stroking the edge, turned round and started to search for the drop of sperm with his palps.

An attempt was made to mate "Ferdinand" with the other Cyrtopholis which was nicknamed "Sylvia." Naturally the mating did not succeed for the obvious reason that a few days later "Sylvia" moulted and proved to be also a male. But mating was successfully induced in another pair which belonged to the American Museum of Natural History. The process was practically the same as described by me for *Dugesiella* and need not to be further considered here.

There is, however, an important difference in the manner in which the sperm is pumped in *Dugesiella* and *Cyrtopholis.* If my observation was correct, *Dugesiella* ejects the sperm on top of the web and pumps it from below, through the web. *Cyrtopholis* attaches the drop *to the underside* of the web, more or less in the same manner as that described recently by Gerhardt for four other species of tarantulæ (Forschungen und Fortschritte, Berlin, 1933, Vol. 9, No. 9). It is possible that I made an error of observation, although at the time I felt certain that I made no mistake. At any rate the question cannot be settled until further observations are made on *Dugesiella.*

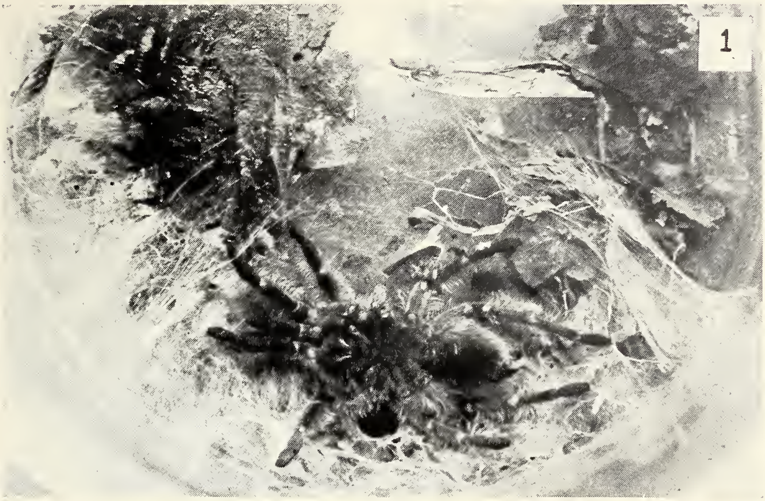
Moulting in *Phormictopus cancerides* was observed by me in some three dozen individuals at the close of the first instar and in 25 cases of much older individuals of different size and age. The greatest deviation from the above described method occurs in the change from the first to the second instar. The spiderlings, between two and three hundred of them, emerged from the eggs in the middle of March, 1933. At that stage they are chocolate brown, with little hair, if any, two claws without a trace of claw-tufts and an eyegroup with small anterior median eyes and situated on a level with the carapace. No eyetubercle is yet developed, and the general appearance of the spiderling is rather that of a Ctenizid than of a Theraphosid.

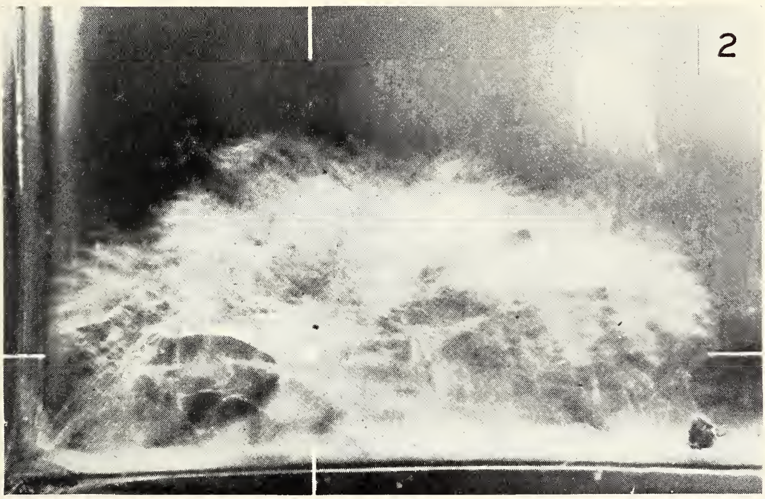
In a couple of days the color of the spiderlings changes to black and in about a week moulting begins. No moulting bed is constructed, as the spiderlings still cling to the old cocoon. After the splitting of the old skin the spiderling gradually withdraws from it. Some lie on their back with legs sprawling, in preparation for the moult; some cling to the cocoon in any position they happen to be in; some climb a vertical wall and hang on to it while moulting. In several cases the moulting was not successful, either a leg or a spinneret being retained in the old skin which was then dragged about for several days. The spiderlings of the second instar have a distinctly blue color, have longer legs, are hairy and have the general appearance of a Theraphosid. The claw-tufts are well developed and 6 spatulate hairs are present on the dorsal surface of each tarsus. The anterior median eyes are larger and the eyetubercle is clearly defined, although as yet very low. Neither the first nor the second instar have the vicious disposition of the older specimens and neither threaten, nor attempt to strike. In nature they must be an easy prey to a number of enemies. In captivity they must be kept in individual jars and are easily fed on Drosophila. The species is quite common in Haiti, but the only security against extinction seems to lie in their fertility and longevity. Female tarantulæ live many years, males die soon after maturity. "Ferdinand" pumped sperm for the last time on the last day of November, 1931, and died of old age July 5, 1932, after refusing food for some time and with an abdomen shrivelled to a small fraction of its original size. A male *Phormictopus* lived several months after attaining maturity.

PLATE XVI

FIGURE 1. Male *Cyrtopholis jamaicola* Strand in the penultimate instar lying on his back on the moulting bed in anticipation of the last moulting process. Notice that his palps show no swelling of the terminal joint, characteristic in true spiders. Notice also that he is holding on to the web with the claws of the first and fourth pairs of legs. Photographed in a direct line from above.

FIGURE 2. Spermweb of the same male, constructed four weeks later. Notice at the left the concave semilunar edge and slightly to the right of it the drop of sperm. It may be located at the intersection of the lines shown in white ink. Photographed at an angle from above.





TARANTULÆ

THE MORPHOLOGY OF COELOIDES DENDROCTONI CUSHMAN (HYMENOPTERA: BRACONIDÆ)

BY DONALD DE LEON
BERKELEY, CALIFORNIA

INTRODUCTION

There can be little doubt that during the last forty years the barkbeetles of the genus *Dendroctonus* have killed, in the United States, more trees beyond the sapling size, and destroyed a greater volume of timber than any other insects. Craighead and Middleton (1930) state that several species of this genus annually destroy 6,000,000,000 board feet of timber valued from $15,000,000 to $20,000,000. The mountain pine beetle (*Dendroctonus monticolae* Hopkins) has been increasing at a rapid rate during the past 10 years in the National Forests of western Montana, Idaho, and eastern Washington. On the Coeur d'Alene National Forest in Idaho, from 1929 to 1932, a total of more than $236,000 was spent on control operations to destroy this beetle in the stands of western white pine (*Pinus monticola* Doug.). On the Beaverhead National Forest in western Montana about $150,000 was spent from 1927 to 1929 combating the same beetle attacking lodgepole pine (*Pinus contorta* Loud.). The number of trees, killed *annually* since 1927 on the Beaverhead Forest, has shown a remarkable increase. During the year 1927, the number of trees destroyed was well under 1,000,000; by 1930 the number had jumped to over 3,800,000, during the year 1931 more than 12,000,000 trees were killed, and during the season of 1932 over 16,000,000 trees were destroyed. Thus a National Forest that once had an estimated amount of more than 1,270,000,000 board feet of merchantable timber has scarcely a stick of it left.[1]

It is seen, therefore, that the destructiveness of this beetle is great, and where losses may run over $1,000,000 in five years, as

[1] These figures have been secured from unpublished reports of Mr. J. C. Evenden and Mr. A. L. Gibson in the files of the Forest Insect Field Station, Coeur d'Alene, Idaho.

on the Beaverhead Forest, any information that can be secured concerning the beetle and its enemies will be of the greatest value in helping to establish on a sound basis a method of control that will largely prevent losses of such magnitude.

Acknowledgments

Acknowledgment is made to Dr. F. C. Craighead of the United States Bureau of Entomology for permission to publish much of the material that had been secured by the author while an employee of the Bureau of Entomology; to Mr. J. C. Evenden of the Bureau of Entomology for his kindness in lending reports of the Forest Insect Field Station, Coeur d'Alene, Idaho; and to Mr. W. D. Bedard of the Coeur d'Alene Station for sending me living larvæ of *Coeloides dendroctoni* Cushm. and *Medetera aldrichii* Wh. Without this material none of the morphological work on these species could have been done; to Mr. H. J. Rust of the same station; to Miss Mary Foley of the Bureau of Entomology for drawing and composing Plate XIX, and to Professor O. A. Johannsen, of Cornell University, who gave much aid and advice, and in whose laboratory most of this work was done.

Technique Followed

The morphological studies were made with both living and fixed material. For the external anatomy, living material was generally best. The internal anatomy was studied both by gross dissections and by sectioning. For the gross dissections fixed material was generally used but living material cut open in glycerine was very helpful for the study of the tracheal arrangement. In the study of the muscles, material anesthetized in chloral hydrate and then placed either in formol, or in 70 per cent alcohol gave good results.

Material to be sectioned was fixed either in Carnoy's fixative or in hot Bouin's fixative. The specimens were then run up to 70 per cent ethyl alcohol, then into one-half 70 per cent ethyl alcohol and one-half normal propyl alcohol, and finally after one or two hours, placed in pure normal propyl alcohol for two or three hours more. From here the specimens were placed in clove oil until they sank to the bottom of the vial; next placed in paraffin for at least four to five hours and then imbedded. Sectioning was usually done at 8 μ. Eosin and Delafield's hematoxylin were used as stains.

The drawings except Plate XIX, were all made by the writer with the aid of either a *camera lucida* or a *camera obscura.*

SYTEMATIC POSITION AND IDENTIFICATION

Coeloides dendroctoni Cushm. belongs to the subfamily Vipiinae. This subfamily was proposed by Gahan (1917) for the Braconinæ of authors when Viereck (1914) showed that *Bracon* F. must be used for the genus *Cremnops* Foerster, belonging to the Agathidinae.

According to Viereck (*l.c.*) Wesmael (1838) proposed the genus *Coeloides* for two species of braconids and Westwood (1840) designated one of them, *initiator* Fabr. as type.

Seventeen species and one variety of *Coeloides* have been described, seven of which are nearctic.

A list of the species occurring in the United States, their author, distribution, and host follow. To the data given by Cushman on the hosts of *C. dendroctoni,* my own records have been added.

Coeloides
- *brunneri* Viereck (1912).
  - Host: *Dendroctonus pseudotsugae* Hopk.
  - Locality: Montana.
- *dendroctoni* Cushman (1931).
  - Hosts: *Dendroctonus monticolæ* Hopk. *Ips oregoni* (Eich.). *Ips emarginatus* (Lec.). *Ips vancouveri* Sw. *Orthotomicus cælatus* (Eich.).
  - Localities: Montana, Washington, Oregon.
- *liopodis* Brues (1910).
  - Hosts: Reared from limb containing *Leiopus alpha* (Say).
  - Locality: Massachusetts.
- *pectinator* (Say) (1836).
  - Locality: probably from Northwest Territory.
- *pissodes* (Ashmead) (1888).
  - Hosts: *Pissodes strobi* (Peck).
  - Localities: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania.

scolyti Cushman (1931).
Hosts: *Scolytus* spp. *Scolytus ventralis* Lec.
Locality: Washington, California, Oregon.

scolytivorus (Cresson) (1873).
Host: *Scolytus quadrispinosus* Say.
Localities: New York, Missouri.

PREVIOUS STUDIES ON THE MORPHOLOGY OF THE LARVÆ OF BRACONIDÆ

A knowledge of the morphology of the larvæ of a group is of considerable importance in studying its phylogeny and of utmost value for field identification and consequently of distinct econoic importance. Unfortunately, few studies have been made on the larvæ of the braconids from a systematic view-point. Many miscellaneous larvæ have been described but to date no one has brought together these descriptions and attempted to work out the characters whereby the subfamilies, at least, could be determined by an examination of the larvæ.

It is beyond the scope of this paper to exhaust the literature on the morphology of the braconid larvae. However, it is believed that the following summary, Table 1, will be of some value in showing the variations of the subfamilies and the need of showing more details in published descriptions so that all the larval structures may be used for purposes of classification. The summary deals chiefly with the number and position of the spiracles for only in the last few years have authors been showing details of the head capsule and internal anatomy in sufficient detail to be of any great value.

The genera in the following summary are placed in the subfamilies according to the classification of Muesebeck (1928).

From the above summary the following key can be made for the subfamilies of the last stage braconid larvæ:

A. Last stage larvæ lacking spiracles ....Aphidiinæ (*Ephedrus*)
AA. Last stage larvæ with spiracles.
B. Larvæ with nine pairs of spiracles.
C. Larvae with eight ventral abdominal tracheal commissures.
Vipiinæ
Doryctinæ
Hormiinæ ?

TABLE 1

SUMMARY OF THE POSITION OF THE SPIRACLES AND ARRANGEMENT OF THE

	Position of Spiracles			Tracheal system Location of Commissures			Authority
	Thor. 1	Thor. 2	Total No.*	Anterior dorsal	Posterior ventral	Ventral abdominal	
Vipiinæ							
Microbracon terebella Wesm.	x	o	9	x	x	x	Salt (1931)
Microbracon brevicornis Wesm.	x	o	9	x	x	x	Genieys (1925)
Cœloides neesi Marshall	x	o	9	x	x	x	Seurat (1899)
Cœloides indagator (Fabr.)	x	o	9		not given		Xambeu (1898)
Doryctinæ							
Doryctes gallicus Rh.	x	o	9	x	x	x	Seurat (l. c.)
Hormiinæ							
Heterospilus cephi Rohw.	x	o	9		not given		Hill & Smith (1931)
Sigalphinæ							
Chelonus annulipes Wesm.	o	x	7	x	o	o	Vance (1932)
Microgasterinæ							
Apanteles thompsoni Lyle	o	x	8	x	o	o	Vance (1931)
Microplitus seurati Marshall	o	x	8	x	o	o	Seurat (l. c.)
Blacinæ							
Eubadizon pallipes Nees	x	o	9		not given		Kojima (1932)
Macrocentrinæ							
Macrocentrus gifuensis Ashm.	o	x	9	x	x	o	Parker (1931)
Opiinæ							
Opius humilis Silv.	o	x	9	x	x	o	Pemberton & Willard (1918)
Diachasma tryoni Cam.	o	x	9	x	x	o	Idem. (1918)
Euphorinæ							
Dinocampus coccinellæ Schr.	o	x	9		not given		Balduf (1926)
Perilitus omophli Lesne	o	x	9		" "		Lesne (1892)
Meteorinæ							
Meteorus nigricollis Thom.	o	x	9	x	o	o	Parker (1931a)
Aphidiinæ							
Aphidius sp.	x	o	9	x	x	o	Seurat (l. c.)
Ephedrus incompletus Prov.	o	o	o	o	o	o	Wheeler (1923)
Alysiinæ							
Dacnusa areolaris Nees	o	x	9	x	x	o	Haviland (1922)
Adelura gahani Baume-Pluvinel	o	x	9		not given		Baume-Pluvinel (1915)

* As the abdominal spiracles, so far as is known, are always in a continuous row beginning with the first abdominal segment, only the total number of spiracles is given as from this data one can easily figure the number of abdominal segments bearing spiracles.

x = presence. o = absence.

CC. Larvæ without ventral abdominal tracheal commissures.
D. Larvæ with a pair of spiracles on first thoracic segment and an anterior dorsal and posterior ventral tracheal commissure
Blacinæ
Macrocentrinæ
Aphidiinæ (*Aphidius*)
DD. Larvæ with spiracles on second thoracic segment.
E. Larvæ with only an anterior dorsal tracheal commissure .... Meteorinæ
EE. Larvæ with both an anterior dorsal and posterior ventral tracheal commissure.
Alysiinæ
Opiinæ
Euphorinæ
BB. Larvæ with eight pairs of spiracles........ Microgasterinæ
BBB. Larvæ with seven pairs of spiracles........ Sigalphinæ.

DESCRIPTION OF THE STAGES OF COELOIDES DENDROCTONI CUSHM.

Egg

The egg is smooth, pearly white in color and elongate oval in outline. Its average length is about 1.2 mm. It is somewhat larger at one end than the other, and is frequently curved at the smaller end. Its surface is smooth and somewhat shining.

Larva

FIRST STAGE

The first stage larva at hatching is approximately the same size, shape, and color as the egg from which it emerges. It is composed of a head, twelve distinct body segments and an anal knob. The cuticula of the larva bears no setae or other structures that are not found in the full grown larva.

LAST STAGE

EXTERNAL ANATOMY

The full grown larva (Pl. XVII, H) averages from 4 to 6 mm. in length. It is composed of a head and 13 body segments. A pair of spiracles are present on the posterior part of the first thoracic segment and the anterior part of the first eight abdominal segments. The characters of the head capsule can best be understood by a study of Plate XVII, F. The terminology used for the parts is that of Vance and Smith (1933). The mandibles (Pl. XVII, E) are 0.066 mm. long. Their apex is strongly sclerotized at the margin. Six smaller teeth are present below the main tooth of the mandible a distinct distance from its inner edge.

The metopic suture and tentorial fossae are wanting.

All of the body segments except the last are covered with minute triangular cuticular spines about 0.016 mm. in length. They form a continuous band around each segment. There are, on the average, 106 to 136 spines per square mm. The mid ventral region is not glabrous as described in Genieys (l.c.) and Salt (l.c.) for other Vipiinæ larvæ. Cephalad and caudad at the body sutures the spines gradually thin out so that in the immediate region of the sutures there are no spines. In segments 11 and 12 the spines thin out farther from the sutures so that the bands on these segments are narrower than on the preceding ones. The terminal segment bears six pairs of setæ or setæ-like spines dorsad and four pairs ventrad.

On each of the body segments except the last there are five pairs of larger bristles located as follows: Two pairs dorsal to the spiracles; one pair on the lateral swellings or where these swellings would be if present; one pair below these swellings, and the fifth pair quite on the ventral surface. These bristles are about 0.03 mm. in length and have a distinct circular base.

There is a lateral swelling below each of the spiracles of the abdominal segments.

A prominent inversible pseudopod is present on the dorsum of the first seven abdominal segments. The eighth abdominal segment bears a small hump which is generally visible only in active larvæ. The anterior part of the dorsum of segments two and three each bear a small rudimentary hump.

Internal Anatomy

Tegumentary Muscles of the Body

In the following discussions the origin of the muscles is considered to be at the anterior margin of the segments. Thus, a ventro-dorsal oblique muscle will extend from the anterior margin of a segment diagonally caudad and dorsad.

The general arrangement of the muscles of the body wall can best be understood by a study of Pl. XVIII, B. The ventral horizontal muscles (vh 1–6) in the thoracic segments tend to coalesce so that in segment 1 the band is usually composed of four muscles and in segment 2, 4 or 5 muscles. All of the ventral horizontal bands of muscles in the abdomen are composed of six muscles except segment 12 where as far as could be determined there are four or five muscles to the band. The muscle arrangement for segment 13 was not worked out but there are only one or two muscles extending into it. The lateral ventro-dorsal oblique muscles (lvdo) often divide to form two separate strands as they extend over the second segment from their insertion. The two strands always reunite before reaching the band of dorso-horizontal muscles.

The muscles forming the dorsal and ventral horizontal bands are the widest of the body muscles. In the middle of the body they are about 0.01–0.008 mm. in width. They narrow posteriorly so that in segment 11 they are from 0.004–0.0058 mm. in width. The total width of the ventral horizontal band in segment 9 in one specimen was 0.058 mm.

Digestive System

The fore-intestine (Pl. XVIII, A) extends back into segment 2 where it unites with the mid-gut. The latter enlarges abruptly and occupies the greater part of the body until it unites with the hind intestine in the posterior region of segment 10. Histologically the epthelium of the mid-gut is composed of large, hexagonal binucleated cells (Pl. XVII, C). The larvæ sectioned were approaching the prepupal stage which may account for the binucleated cells. Unfortunately no larvæ of the earlier stages were available for further investigation. The hind-gut at this point is enlarged and resembles a collar, bearing a ring of papillæ each about 0.007 mm. in length and 0.0028 mm. in width. Though, in one larva 16 papillæ were counted, and in another 12 it seems likely that they are the buds of the adult Malpighian tubules. The papillæ are shown quite a bit larger than they actually are in proportion to the small intestine. The latter tapers rapidly from the collar until it is about 0.1 mm. in diameter. It unites with the colon, about 0.3 mm. in diameter, at the posterior end of segment 12. The colon tapers gradually, to the anus, forming the rectum in segment 13.

The Malpighian tubules are attached to the small intestine anterior to the collar and extend cephalad as a pair of simple tubes about 0.008 mm. in diameter. They terminate in segment 2. Only traces of silk glands could be found in the larvæ. This may be explained by the fact that the larvæ on which the internal anatomical studies were made had spun their cocoons at least four months or more previously. The glands having performed their function probably atrophied during the time between the completion of the cocoon and the time of sectioning. A large silk press is present in the head.

Respiratory System

All the spiracles on three larvæ were measured. They range in diameter from 0.0288–0.0399 mm. with an average of about 0.0355 mm. The following table, Table 2, will show the variations in size.

TABLE 2. DIAMETER OF SPIRACLES OF THREE LARVÆ OF *Cœloides dendroctoni* Cushm.

Segment	Larva		Larva		Larva	
	Side		Side		Side	
	Left	Right	Left	Right	Left	Right
1	0.0355	0.0377	0.0399	0.0388	0.0366	0.0355
4	0.0355	0.0355	0.0377	0.0399	0.0366	0.0355
5	0.0333	0.0333	0.0377	0.0377	0.0355	0.0333
6	0.0288	0.0333	0.0388	0.0355	0.0*	0.0355
7	0.0310	0.0333	0.0377	0.0388	0.0333	0.0333
8	0.0310	0.0333	0.0377	0.0366	0.0333	0.0333
9	0.0310	0.0333	0.0388	0.0288	0.0333	0.0333
10	0.0310	0.0333	0.0388	0.0355	0.0333	0.0333
11	0.0333	0.0310	0.0377	0.0355	0.0355	0.0377

* Not measured.

It will be seen from the foregoing table that there is a tendency for the prothoracic spiracle to be the largest.

The shape of the spiracles varies considerably. They are rarely round, generally of irregular outline and frequently appreciably longer than wide.

The cup part of the spiracle is covered over with a layer of cuticle and only a small oval opening in it allows access of air (Pl. XVII, D). The trachea leading from the spiracle to the lateral tracheal trunks is provided with a valve-like structure (Pl. XVII, G, va), the exact nature of which could not be determined. Its position between the base of the spiracle and the longitudinal tracheal trunk varies considerably but it is generally, often considerably, nearer the tracheal trunk than the base of the spiracle.

The tracheal system can best be understood by a study of Plate XVII, B.

CIRCULATORY SYSTEM

The heart or dorsal vessel (Pl. XVIII, A) originates as the aorta in segment 1 above the œsophagus and behind the brain. It extends abruptly dorsad until it is lying between the two bands of dorsal horizontal muscles in segment 3. In segment 2 it is about 0.036 mm. in diameter. It runs in this position back to segment 12 where it descends slightly towards the colon. As far as could be determined there is a valve near the anterior part of each abdominal segment. None was observed in the aorta. The heart in the abdomen varies in size. In segment 4 it was 0.05 mm. in diameter.

ADIPOSE TISSUE AND URATE CELLS

The fat-bodies (Pl. XVII, A) fill almost all the cavities of the larva, around the internal organs, from segment 1 to 12 inclusive. No segmental arrangement was present. They are composed of rather compact masses of irregular layers. Scattered among the fat bodies from segments 4 to 12 inclusive are numerous yellowish-white bodies, the urate cells (Pl. XVII, A). These are most abundant on the sides of the larva, fewer are present dorsad and none ventrad.

These bodies are quite obvious, especially in the full grown larvæ; none was observed in the first stage larvæ. In field work one can easily distinguish the larvæ of *Cœloides* from chalcid larvæ by the presence of these cells. The chalcid larvæ observed lack any cells that stand out so prominently as the urate cells of *Cœloides*. Prominent urate cells have been observed in other braconid larvae not parasitic on barkbeetles.

Nervous System

The nervous system (Pl. XVIII, A) consists of a bilobed brain (located in the anterior part of segment 1, and the posterior part of the head), a subœsophageal ganglion, and eleven segmental ganglia. The ganglia are connected to each other by paired connectives. The terminal ganglion is larger than the others indicating a coalescing of the ganglion of segments 12 and 13 with that of the proceding ganglion. From each of the ganglia a pair of main nerves runs laterad between the body wall and the integumentary muscles as far as the spiracles. Beyond this point they could not be traced.

Pupa

The female pupæ range from 4.0–5.5 mm. in length and 1.4–1.8 mm. in width.

The caudal extremity of the wing pad extends to slightly beyond an imaginary line drawn half way between the apex of the head and the caudal extremity of the last ventral sternum. The end of the pad is slightly anterior to the mid-part of the third visible abdominal segment (viewed ventrad). The prothoracic legs extend to slightly less than two-thirds the length of the wing pads, the mesothoracic legs extend a slight distance beyond the end of the wing pads, *i.e.*, to a point slightly anterior to the posterior margin of the third visible segment. The metathoracic legs extend almost to the extremity of the last visible abdominal segment, and the antennæ end at a point slightly short of the tip of the metathoracic legs. The ovipositor curves backward over the abdomen and ends at a point midway in the second visible abdominal segment (viewed dorsad). The last larval skin is always found adhering to and covering a good portion of the ovipositor.

There is considerable variation in the specimens examined. In some cases the wing pads extend to the caudal extremity of the third abdominal segment; the prothoracic legs extend fully two-thirds the length of the wing pads; the mesothoracic legs reach beyond the anterior margin of the fourth visible abdominal segment, the antennæ end even with, or extend slightly beyond the extremities of the metathoracic legs, and the extremity of the ovipositor attains the anterior margin of the first visible abdominal segment.

Urate cells are visible through the cuticle but are less numerous than in the full grown larva.

Cocoon

The cocoons range from 4 to 8 mm. in length. They are slightly circular in cross section and oval in shape. They vary in color from tan or dark brown to nearly white.

Adult

The following is copied from the original description by Cushman (*l.c.*).

"*Female.*—Length 4 mm. or less. Head nearly as broad behind eyes as at eyes, the temples strongly convex, the width from front to back about equal to that of eye; the so-called "mouth opening" much narrower than its distance from the eye and about as broad as length of malar space; malar space about half as long as eye; face minutely punctate; clypeal groove distinct medially; antennae slender, third joint of flagellum hardly concave below, very nearly as long as fourth, the latter fully twice as long as thick. Thorax weakly depressed, polished and virtually unsculptured throughout, only the metapleurum sparsely punctate; scutellar fovea minutely foveolate; stigma broad, radius slightly before middle; second cubital cell long, the second abscissa of radius much longer than first intercubitus and parallel with second abscissa of cubitus. First tergite much longer than broad, finely rugulose, the lateral furrows foveolate, the median area about three times as broad as the lateral rims; second tergite shorter than third, more or less emarginate in apical middle, more or less rugose medially and with a more or less distinct raised area in basal middle; sheath about three-fourths as long as body (relatively longer in small specimens).

"Head black, orbits, cheeks, malar space, mandibles, and clypeus testaceous; labium, maxillæ, palpi, and antennæ black; thorax and legs black, trochanters and apices of front femur and tibia more or less reddish, postscutellum and a median streak on propodeum also more or less reddish; abdomen usually testaceous with only the first tergite black, in small specimens more or less blackish with tergites 2 and 3 pale or largely brownish black.

"*Male.*—Essentially like female, but more frequently with abdomen largely blackish and often with apex and lateral areas of scutellum stramineous.

"*Type-locality.*—Sula, Montana.

"*Type.*—Cat. No. 43,635, U.S.N.M.

"*Hosts.* — *Dendroctonus monticolæ* Hopk.; *Ips oregoni* (Eich.)."

LITERATURE CITED

ASHMEAD, W. H. 1888. Descriptions of new Braconidæ in the collection of the U. S. National Museum. Proc. U. S. Nat. Mus. 11: 611–671.

BALDUF, W. V. 1926. The bionomics of *Dinocampus coccinelle* Schrank. illus. Ann. Ent. Soc. Amer. 19: 465–498.

BAUME-PLUVINEL, G. DE LA. 1915. Évolution et formes larvaire d'un braconide: *Adelura gahani* n. sp., parasite interne de la larve d'un phytomyzinæ (Dipt.). illus. Arch. Zool. Exp. et Gén. 55: 5–59.

BRUES, C. T. 1910. Notes and descriptions of North American parasitic Hymenoptera. IX. illus. Bul. Wisc. Nat. Hist. Soc. 8: 67–85.

CRAIGHEAD, F. C., and MIDDLETON, W. 1930. An annotated list of the more important North American forest insects. U. S. Dept. Agr. Misc. Pub. 74. 31 p.

CRESSON, E. T. 1873. *Bracon scolytivorus.* (In C. V. Riley's Fifth Annual Report . . . of Missouri. p. 106.)

CUSHMAN, R. A. 1931. Three new Braconidæ parasitic on bark beetles. Jour. Wash. Acad. Sci. 21: 301–304.

GAHAN, A. B. 1917. Descriptions of some new parasitic Hymenoptera. Proc. U. S. Nat. Mus. 53: 195–217.

GENIEYS, P. 1925. *Habrobracon brevicornis* Wesm. illus. Ann. Ent. Soc. Amer. 18: 143–202.

HAVILAND, M. D. 1922. On the larval development of *Dacnusa areolaris* Nees (Braconidæ), a parasite of Phytomyzinæ (Diptera) with a note on certain chalcid parasites of phytomyzids. illus. Parasitology 14: 167–173.

HILL, C. C., and SMITH, H. D. 1931. *Heterospilus cephi* Rohwer, a parasite of the European wheat sawfly, *Cephus pygmaeus* (L.). Jour. Agr. Res. 43: 597–607.

KOJIMA, T. 1932. Beitraege zur Kenntniss von *Lyctus linearis* Goeze. illus. Zeitsch. Angew. Ent. 19: 325–356.

LESNE, P. 1892. Sur un braconide du genre *Perilitus* Nees. Ann. Soc. Ent. Fr. 61: 305–308. pl. 5.

MUESEBECK, C. F. W. 1928. Braconidæ. (In Leonard, M. D., and others. A list of the insects of New York. Corn. Univ. Agr. Exp. Sta. Mem. 101. 1121 p., 1 map. 1926.)

PARKER, H. L. 1931. *Macrocentrus gifuensis* Ashm., a polyembryonic parasite in the European corn borer. U. S. Dept. Agr. Tech. Bul. 230. 62 p. illus.

————. 1931a. Notes on *Meteorus* (*Zemiotes*) *nigricollis* Thompson, an occasional parasite of the European corn borer. Proc. Ent. Soc. Wash. 33: 93–103.

PEMBERTON, C. E., and WILLARD, H. F. 1918. A contribution to the biology of fruit-fly parasites in Hawaii. Jour. Agr. Res. 15: 419–465. pl. 32.

SALT, G. 1931. Parasites of the wheat-stem sawfly, *Cephus pygmaeus* L., in England. illus. Bul. Ent. Res. 22: 479–545.

SAY, T. 1836. *Coeloides pectinator* n. sp. (*In his* Descriptions of new species of North American Hymenoptera, and some observations on some already described. Boston Jour. Nat. Hist. p. 251.)

SEURAT, L. G. 1899. Hyménopterès entomophages, contributions à l'étude. Ann. des Sci. Nat. (8th ser., Zool.) 10: 1–159. 5 pl.

VANCE, A. M. 1931. *Apanteles thompsoni* Lyle, a braconid parasite of the European corn borer. U. S. Dept. Agr. Tech. Bul. 233. 28 p. illus.

————. 1932. The biology and morphology of the braconid *Chelonus annulipes* Wesm., a parasite of the European corn borer. U. S. Dept. Agr. Tech. Bul. 294. 48 p. illus., 1 pl.

————, and SMITH, H. D. 1933. The larval head of parasitic Hymenoptera and nomenclature of its parts. illus. Ann. Ent. Soc. Amer. 26: 86–94.

VIERECK, H. L. 1912. Descriptions of one new genus and three new species of ichneumon-flies. Proc. U. S. Nat. Mus. 41: 293–295.

WESMAEL, C. 1838. Monographie des braconides de Belgique. illus. Nouv. Mem. Acad. Roy. Sc. . . . de Brux. 11: 1–166, 220–221.

WESTWOOD, J. O. 1840. A synopsis of the genera of British insects. illus. (*In his* An introduction to the modern classification of insects. London. Longman, Orme, Brown, Green, and Longmans. p. 64 of synopsis.)

WHEELER, E. 1923. Some braconids parasitic on aphids and their life-history. illus. Ann. Ent. Soc. Amer. 16: 1–29.

XAMBEU, LE CAPITAINE. 1898. Moeurs et métamorphoses du *Coeloides initiator* Fabr.). Le Naturaliste. 20 ann. (2e ser.) No. 272. p. 153.

EXPLANATION OF SYMBOLS USED IN THE ILLUSTRATIONS

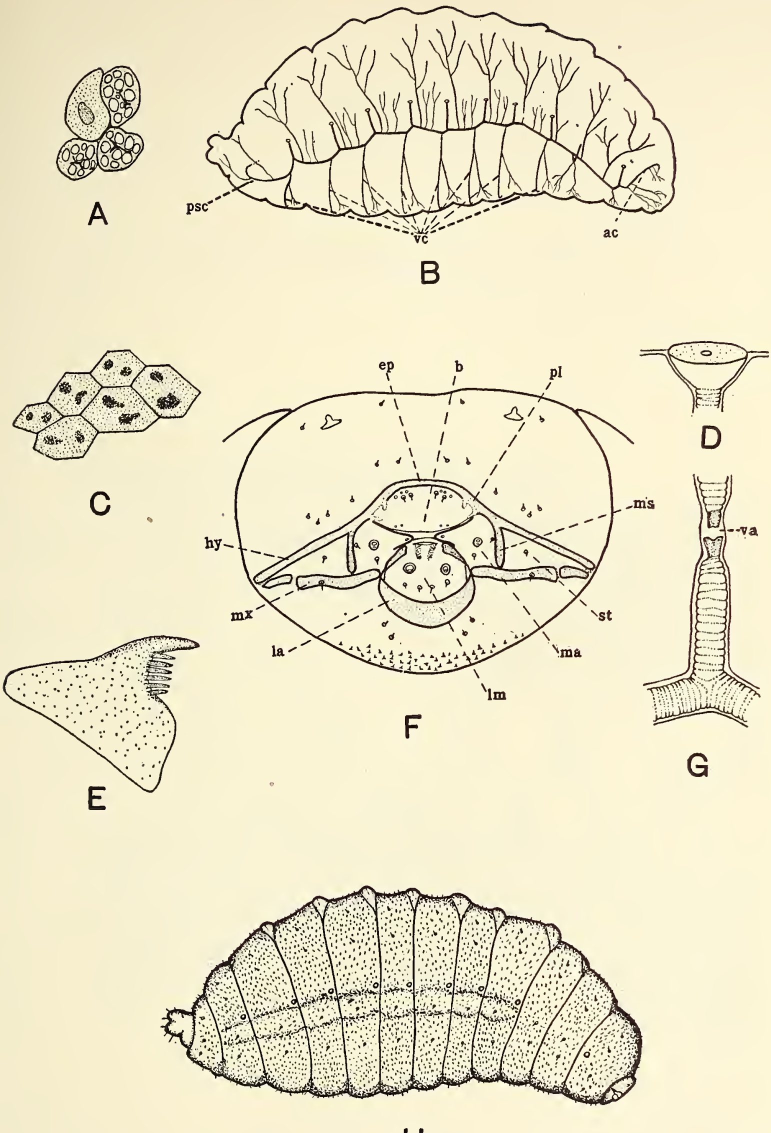
ac, anterior dorsal commissure.
b, labrum.
ddvo, dorsal dorsoventral oblique muscle.
dh_{1-5}, dorsal horizontal band of muscles.
ep, epistoma.
hy, hypostoma.
is, vertical intersegmental muscle.
la, labiostipital sclerome.
ldvo, lateral dorsoventral muscles.
lm, Labiostipites.
lvdo, lateral ventrodorsal muscles.
ma, maxillary stipes.
ms, stipital sclerome.
mx, maxillary sclerome.
pl, pleurostoma.
psc, posterior ventral commissure.
se, vertical segmental muscle.
sh, horizontal segmental muscle.
sp, spiracle.
st, cardo.
va, tracheal ''valve.''
vc, ventral abdominal commissures.
vh_{1-6}, ventral horizontal band of muscles.

PLATE XVII

Coeloides dendroctoni Cushm.

Final Instar Larva

A. 3 fat cells and 1 urate cell.
B. Tracheal system.
C. Epithelium of mid-intestine.
D. Spiracle.
E. Mandible.
F. Head capsule.
G. Portion of trachea connecting main longitudinal trunk with spiracle.
H. Larva.



COELOIDES DENDROCTONI

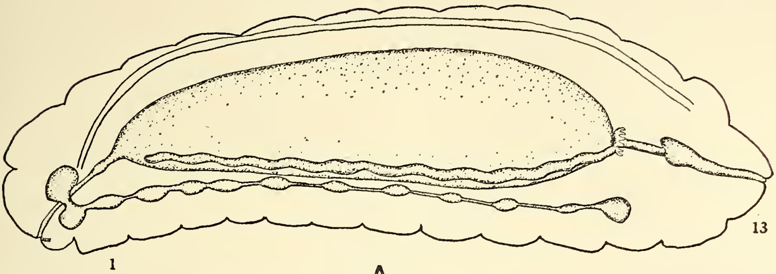
Plate XVIII

Coeloides dendroctoni Cushm.

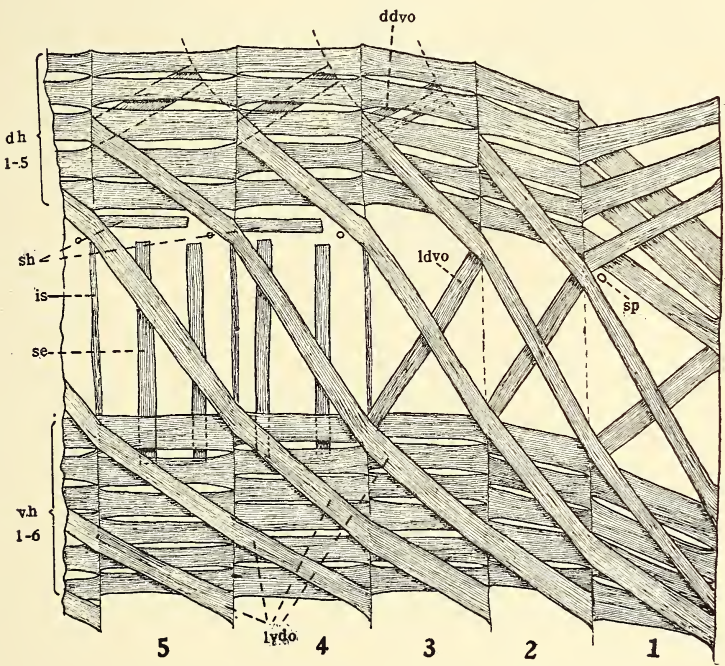
Final Instar Larva

A. Lateral view showing position of main nervous system, digestive tract, Malpighian tubes, and heart.

B. Lateral view of segments 1 to 5 inclusive showing muscle system.



A



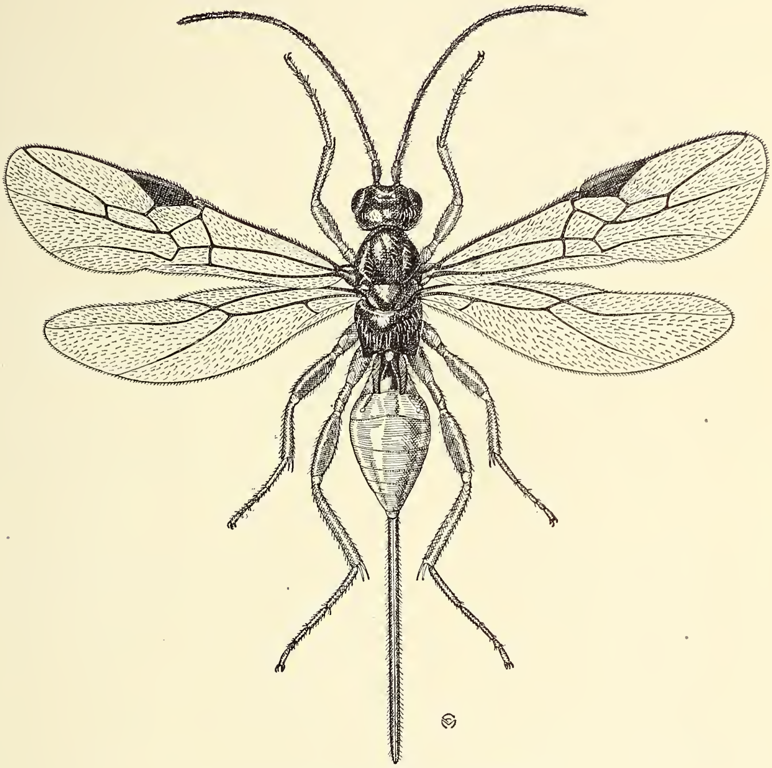
B

COELOIDES DENDROCTONI

PLATE XIX

Coeloides dendroctoni Cushm.

Female.



COELOIDES DENDROCTONI

SOME OBSERVATIONS ON PHALACRUS POLITUS AND OTHER INHABITANTS OF THE HEADS OF THE NEW ENGLAND ASTER

BY ELIZABETH VON LÖBEN SELS

In the damp fields and roadsides around Ithaca, New York, the clustered heads of *Aster Novæ-Angliæ* L. loom up in royal splendor during September and October. Toward the close of the latter month, the purple of the ray florets of the head is faded, and the yellow of the numerous disc florets is succeeded by the soft grey of their seed-pappus, upholding here and there an old corolla. At this season, just before the seeds begin to blow away, certain well-fed little larvæ that live in these heads are also ready to leave their bountifully garnished nursery and seek new homes for the coming winter. The Aster head sometimes supports a large number of uninvited guests throughout the autumn; often enough, it is ruthlessly mutilated by these hungry intruders, but usually there are plenty of seeds left.

The Beetle (*Phalacrus politus* Melsh.)

This little black beetle* is one of the interesting seed-eaters in the group of Aster-head inhabitants. Since its hitherto unidentified larva is encountered annually in a study of seed-eating insects by Cornell ecology classes, this study was made to clear up the recurrent perplexing question, "What is this beetle?" The study was begun November 1, 1929, and continued through September, 1930. Work in the field was limited to November and December of 1929. All collecting was done in the environs of Cornell University, Ithaca, N. Y. No observations have hith-

* Family *Phalacridæ,* or shining flower-beetles. Casey monographed them in 1890, and gave further information in 1916; he reports the genus *Phalacrus* to be wide-spread in the Eastern and Southern regions of the United States. The imagines I raised were determined by Dr. W. S. Fisher (Bureau of Entomology), who had access to Casey's types.

Dr. Adam G. Boving generously lent laboratory equipment and advice during a final phase of this study in Washington, D. C.

erto been reported on the habits of this larva, nor has anything been said concerning the pupa.

In Aster heads the grub is well matured toward the close of October. So, also, is the Aster seed, which, though possessing a well developed pappus, is still firmly attached to the floral disc. The presence of a seed-eater may be detected from the state of the pappus. When, instead of being distinct and fluffy, the hairs stick together in a rather hard cone somewhat more compact than a shock of wheat, that is sure indication that seed-eaters are, or have been, at work. The structure has a central flue which is well stuffed at the top by dark, roughly spherical pellets of frass. Later, when surrounding seeds have been borne away by the wind, this "chimney" (which can be lifted intact with the fingers), standing through the winter, reminds one of a deserted wigwam. I never found more than one beetle in a single flower head, although the head is often shared with other insect inhabitants.

The larva attacks the seeds from the base (Fig. 1), ripping

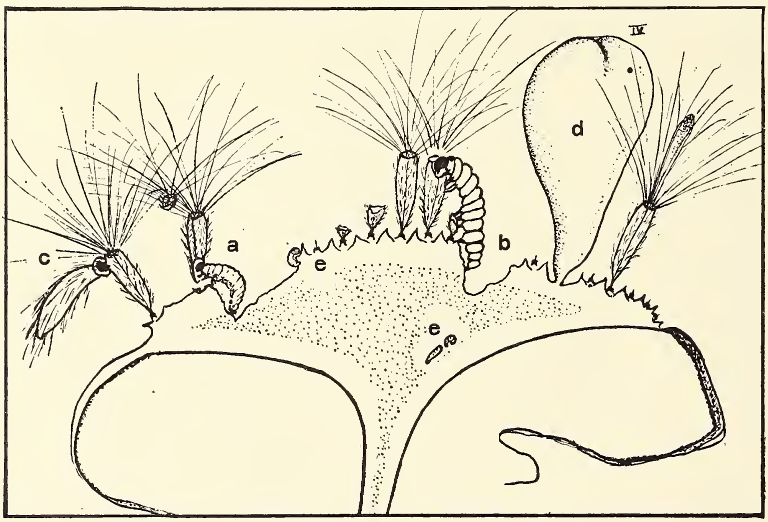


FIG. 1. Diagram of a longitudinal section of an Aster head in early November, showing localization of the infestation. (a) *Phalacrus politus* larva; (b) A caterpillar: three species have this habit; (c) Coleophora larva in case; (d) Cecidomyiid flower-gall; (e) Inquiline Dipterous larva (Cecidomyiidæ).

one up the side and eating it pretty well through before starting another. The pappus is untouched, but in the process the hairs get enmeshed with corolla remnants and form the "chimney." Stuck together by frass as they are, and more or less anchored to the receptacle by a few half-eaten seeds and seed coats, these cones resist the winter winds. The larva often eats holes into the receptacle; these seem usually to be in the shape of wide grooves, and are probably eaten out while the head is still green and soft.

Rearing:—On November 1, 1929, I collected about 100,000 heads of the New England Aster, mostly matured—the seeds just beginning to blow away—and placed them in large paper cones, or funnels. These were approximately 18″ in diameter at the top with an opening ½″ wide at the bottom. Upright, they were stood in boxes which had previously been filled to a depth of six inches with carefully sifted soil of sandy clay from the nearest Aster patch. Clean, dampened excelsior was then matted around the base of the cones and over the soil, as a protection against excessive loss of moisture.

Next day, November 2, on examining carefully the loam in one of the indoor boxes, I found seven Phalacrus larvæ. Six others were caught in the base of the cone, about to crawl into the soil. On November 3, without much disturbing, I saw a few larvæ in the bases of all the cones; on the following day, I unearthed several in the very bottom of a box; on the 5th, I again sifted the contents of the set that had been examined on the 2nd, and found 27 larvæ near the bottom. Three of these were imbedded in rough, crumbly, rather irregular cocoons of a clay-like consistency, fastened together by a viscid substance secreted by the larvæ. As evidenced by the increasing numbers in the bases of cones, and in fresh heads brought in from the field—the downward migration continued, albeit with diminishing force, until early in December.

Pupæ:—On June 22, about a third of the cocoons that I opened disclosed pupæ. These are extremely sensitive to light (much more so than are the larvæ); the abdomen wiggles constantly when exposed to daylight and the pupæ show distinct aversion to light of any kind.

Three days later, June 25, at 2 P.M., four imagines were crawling around above ground in my "forced" jar. I watched one take flight: it climbed to the rim of the jar, rested a moment —as though to gather all forces for a supreme effort—opened its tegmina and spread its wings, rose straight up into the air half way to the ceiling, and then aimed directly for the open window and disappeared through it.

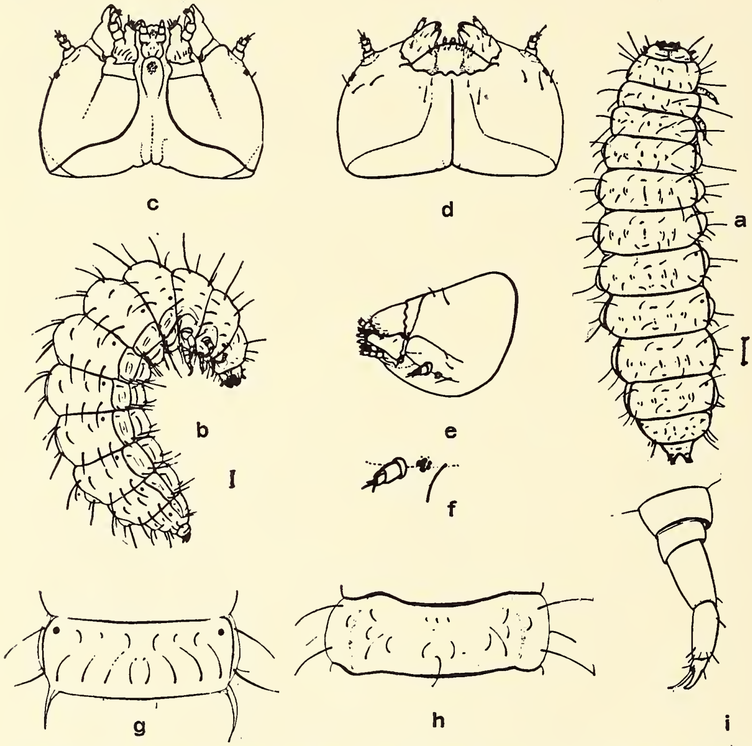


Fig. 2. *Phalacrus politus* larva. (a) dorsal aspect of a full grown larva; (b) lateral aspect of larva in characteristic pose; (c) head, in ventral aspect; (d) head, dorsal aspect; (e) head, lateral aspect; (f) a portion of *e*, further enlarged, showing eye and antenna of left side; (g) dorsal aspect of third abdominal segment, showing distribution of hairs; (h) ventral aspect of same; (i) a mesothoracic leg.

The Cold Room containers produced their first imago July 7, from one of the pupæ that I discovered June 22. Others appeared in succession until early in August.

Of those reared outdoors, the first three adults to emerge appeared August 9, and, curiously enough, were followed by comparatively few others during the course of the month.

Investigation showed a large number of uniform oval cocoons scattered throughout the soil. These were provisionally determined as belonging to a parasitic wasp, possibly a braconid. On September 15 there emerged a tiny wasp, *Apantales* n. sp. Unfortunately, it was the only one reared, and the host is uncertain since other larvæ than those of Phalacrus were in that outdoor box.

Description:—The larva of *Phalacrus politus* is smooth, white, rather small, and quite soft, with long brown body hairs (see Fig. 2). There are nine abdominal segments, the last, or anal segment, having fleshy thick lips. The youngest that I found measured 2.5 mm. long by .5 mm. wide; the shape was cylindrical, and the chitinized portions, except for the tip of the mandibles, were a light tan. The mature larvæ are about 4 mm. long by 1.5 mm. wide across the greatest width. These are not cylindrical, but taper somewhat toward the ends. The thorax is nearly .5 mm. narrower than the central portion of the abdomen. This may be slightly enhanced by the typically curled-in position of the resting larva. The larva is concave ventrally. The spiracles (nine pairs), the paired and hook-shaped claws, the terminal appendages (urogomphi), and the head and mouthparts are well chitinized. As might be expected, the mandibles are short, heavy and strong; they are bifid at the tips, thus forming two teeth of which the outer is the larger.†

The labium and maxillæ have well-developed palpi. The mala —lacina and galea fused—terminate in discs which appear to carry three large and four smaller spines. The mentum is short, with a rather indistinct subgular region. The antennæ are three-segmented, the terminal segments being double. The posterior is the larger of these and supports three bristles. The eyes are small and heavily pigmented. They consist of four

† The mandible of *P. politus* is pictured from one of my specimens in "An Illustrated Synopsis of the Principal Larval Forms of the Order of Coleoptera," by Böving and Craighead, Pl. 35, fig. S, as well as the biforous spiracle, figs. Q, R.

larger ocelli-like structures, two granulated smaller ones, and two dorsal "pin-pricks." The legs are fairly long, consisting of five distinct segments. There are two terminal claws, the posterior one long and slender, and the anterior claw short and heavy, and fused with the tarsal joint into a tarsungulus.

In length, the pupa measures 3 mm.; in width, 2 mm. across the bases of the wing pads. Like the larva, it is more or less depressed in form, but the ventral and dorsal aspects are quite

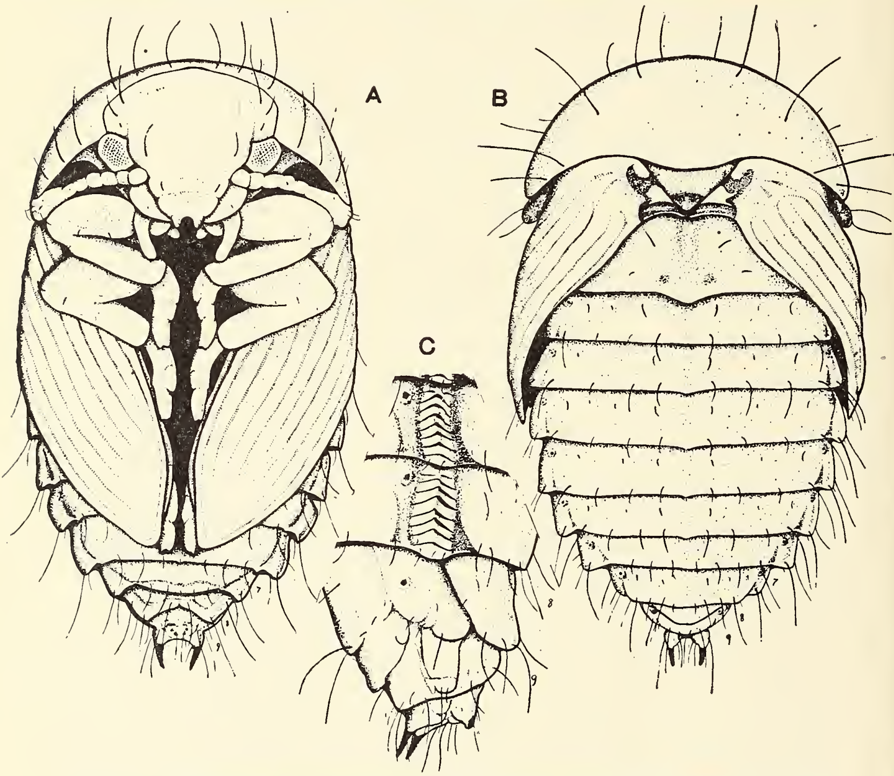


FIG. 3. *Phalacrus politus pupa.* (A) ventral aspect of pupa; (B) dorsal aspect of same; (C) lateral aspect of tip of abdomen.

ovoid (see Fig. 3). The young pupa is white; the more mature show distinct chitinization, especially of the eyes, wing pads, spiracles, and urogomphi.

In *Entomological News,* vol. 5, 1904, p. 140, F. M. Webster notes that he reared the imagines of *P. politus* from heads of rye affected with smut, the same species being said to breed in smut on corn. He observed larvæ on the heads of rye on July 12; the adults emerged August 4. My observations, however, on *P. politus* larva inhabiting the Aster head (which matures later than rye and corn) are not at all in accord with those of Webster. I found mature larvæ occupying heads in October and November, and hibernating in the soil to emerge in late June (forced), July and early August. May there not be a question of identity of the species, or perhaps of two generations with a possible alternation of host?

OTHER INHABITANTS

Besides the Phalacrus beetle, there are representatives of several orders of insects. Four are seed-eating residents, one is a gall maker, five are transients (including a spider), one is a parasite, and two are of uncertain ecological relations.

The Order Lepidoptera is represented by four species of larvæ; all are undetermined, although one is a *Coleophora* and the others may perhaps belong to the genus *Eucosma,* or some allied genus.

Most abundant of all the inhabitants of the mature Aster heads is one of the latter; a smooth caterpillar of a light tan color. When fully developed, this larva measures 9 mm. in length and 2 mm. in width. Like the beetle, it is a ravenous seed-eater; but there are characteristic differences of habit in that more than one smooth caterpillar may be found in a floral head. The caterpillar, being larger, eats larger holes in the receptable and consumes more seeds. These it attacks from the *top* while balanced on its prolegs: first it cuts off most of the pappus and then eats down the seed, stripping off the husk (see Fig. 1, b), and often leaves part of its standing, or pending from the pappus. The "chimney" is a cleaner, prettier structure and as it contains but little frass and is lined and interwoven with silk, this larva seems to find it a comfortable berth between meals. After maturing, the caterpillar lets itself to the ground on a silken strand, buries down a few inches, and sooner or later builds a soft, oval cocoon of silk, gummed externally with sand and earthy particles.

TABLE SHOWING INFESTATION OF 9800 ASTER HEADS

The following table, incorporating the records of counts made as a part of an annual practicum by classes in insect ecology in Cornell University, and in part of counts made by myself in the course of this work, includes what is known of the infestation of New England Aster heads at Ithaca, N. Y.

	Class records			Personal records made in 1929				
Date	Oct. 1927	Oct. 1928	Oct. 1929	Nov. 1st.	Nov. 10th.	Nov. 26th.	Dec. 7th.	Dec. 8th.
Number of heads	2500	3000	2300	100	500	300	1000	100
*Smooth caterpillar	245	716	284	14	50	27	14	1
*Freckled caterpillar	170	38	93	6	15	15	8	2
*Striped caterpillar	0	0	0	0	0	1	0	1
Coleophora larvae				0	15	9	0	0
Cecidomyiid galls	62	51	17	0	7	16	30	3
Inquiline Dipterous larvae				2	0	12	40	4
Phalacrus politus l.	281	132	86	3	30	9	3	0
Anthonomus rufipes a.	0	1	2	0	0	0	0	0
Total	758	938	482	25	117	89	95	11
**% infested	30.4%	32%	21%	25%	23%	29.6%	9.5%	1%
% infested by *P. politus* l.	11.24%	4%	3.74%	3%	6%	3%	.3%	0%

* Undetermined; possibly Eucosma?

** The percentage is computed on the basis that the actual presence of an insect determined an infestation, although frequently over 50% of the Aster heads examined (notably in December), showed evidences of previous infestation.

Another similar caterpillar, distinguishable by faint brownish spots marking the location of the setæ on each segment and looking like pairs of freckles along the dorsum, is a more slender, less abundant larva, of practically the same habits.

Yet another seed-eating caterpillar, with longitudinal dorsal stripes of a tan color, seems rather rare. I found only two specimens.

A fourth Lepidopterous larva, a species of *Coleophora,* is a case-bearer. Its case much resembles the seed in appearance. This likeness is increased when the larva glues bits of pappus to the exterior. The resting position assumed, however, is frequently a revealing one (Fig. 1c).

Another Coleopterous seed-eater is a weevil, *Anthonomus rufipes* Leconte. I found only one adult. It was determined by Mr. L. I. Buchanan of the Bureau of Entomology.

Immature aphids of the genus *Macrosiphum* were found clustered among the floral bracts of several Asters. These were determined by Dr. Edith M. Patch.

Inquiline Diptera, tiny orange-colored Cecidomyiid maggots, were frequently seen in the burrows or among the seed stubble left by Phalacrus or by Lepidoptera larvæ (Fig. 1e).

Cecidomyiid flower-galls were observed on a few of the Aster heads (Fig. 1d). Oval in form and projecting above the florets of the disc, they vary in size and shape. In November, when my work began, all but one of the galls I opened were deserted.

BIBLIOGRAPHY

BOVING AND CRAIGHEAD, 1931. Illustrated Synopsis of the Principal Larval Forms of Coleoptera. Entomologica Americana. Vol. II, No. 2. Pl. 33, figs. Q. R. S.

CASEY, T. L., 1890. Synopsis of Phalacridae. Ann. N. Y. Acad. Sci. 89–144.

CASEY, T. L., 1916. Memoirs on the Coleoptera. Vol. VII.

LE CONTE, 1865. Synopsis of the Phalacridae of the U. S. Proc. Phil. Acad. Nat. Sci. VIII, 15–17.

MELSHEIMER, F. E., 1844. Description of New Species of Coleoptera of the U. S. Proc. Phil. Acad. Nat. Sci. II, 102.

STICKNEY, 1923. Head Capsule Morphology of *P. politus.* Ill. Biol. Mon. VIII, I, figs. 96, 244, 389, 533.

WEBSTER, F. M. Larva of *P. politus* reared from smut of rye. Ent. News Philad. 5, 1894, p. 140.

AN INTERTIDAL MOSS MITE IN AMERICA

BY ARTHUR PAUL JACOT
MONROE, CONN.

It was in 1896 (**1**, p. 77) that this species was first reported (as *Northus* (?) *marinus*) from intertidal rocks at Sea Cliff, Long Island, N. Y. as not uncommon. In 1919 (April 13th) I found numerous specimens on intertidal stones of Hempstead Harbor at Mosquito Cove (between Sea Cliff and Glen Cove), and (May 18th) at Eltingville Beach, Staten Island, New York harbor on rocks submerged at mid-tide and covered with fine algae. In 1926 I found none at Cold Spring Harbor, Centerport, or Stonybrook (Long Island) but (July 4th) a few at Indian Harbor, Greenwich, Connecticut, though not east of that point. I have searched for intertidal oribatids at Bridgeport, New Haven, Conn.; Boston harbor; Cliff Island, Casco Bay, Me.; Vancouver and Victoria, B. C.; and on the coast of Shantung, China, and of northern Japan, without finding any. None are reported from Woods Hole (**2**).

From these records and my experience, it is evident that this species is distinctly marine though mostly restricted to estuaries and harbors, *i.e.* where there is not too much sand scour, and thus where growths of films of unicellular algae may develop. It would therefore not be expected on the exposed headlands between the bays where algal coated rocks are rare or absent. I also suspect that it would be rare or absent where rocks are without crannies and fissures. The rougher the rock (as schist) the better.

Another factor limiting the spread of the species is that of viviparity. This means that there are no eggs for dissemination by water currents, but that the young are born on the parental stone.

After a careful study of this American material, I find it to be closely related to the species now known in Europe as *Ameronothrus spoofi,* which was first reported from spawn of

Lymnaea in subsaline water, and on subsaline algae, near Abo, Finland, under the name *Scutovertex spoofi* (3). Its author later (4, 5) thought this species to be identical with a described English species (6). The two have since been clearly differentiated by Halbert (7) who records his Irish material from "moist limestone flakes on the rocky shore at Malahide in the Orange Lichen and Pelvetia zones, and somewhat doubtfully in the Spiralis zone. In these habitats they were in small colonies round the outer edges of the flakes; . . . also under stones resting on sandy mud at the mouth of a small stream flowing into Malahide estuary. At Mulranny it occurred under stones on the seashore. May to Sept."

Three species occur on the English and North Sea coast with a third as holarctic (*A. lineatus,* the genotype). Thus the genus is Eurasian and the one species found about New York harbor must have been introduced, probably on ship ballast (usually estuarine or harbor rocks) during the sailing-ship days.

Since Banks found it at Glen Cove in 1896, and it had not reached Cold Spring harbor by 1926 it must be a slow migrant. It may be inferred therefore that it was introduced into New York harbor at a very early period to reach Glen Cove by 1896, especially when one bears in mind its viviparous habits. A consideration of its tarsal armature, spine studded body, and strongly developed instinct to snuggle into crannies, lead me to doubt if individuals are carried by currents. Furthermore I know of no records of finding them in tow nets.

As this species, *A. spoofi, A. bilineatus* (6) and *A. schneideri* (8) differ from the other species of the group by a striking loss, namely that of pseudostigmata and its organ, and show as well other indications of development in advance of the other species, as: less wrinkling of the notogaster (it being highly wrinkled in the immature stages), ventral plate well developed so that notogaster does not encroach on its postero-lateral angles, its distinctly aquatic habits; I propose segregating them in another genus which may be known as:

Hygroribates, gen. nov.

Char.: Wingless oribatid mites with notogaster and cephaloprothorax fused and not dorsally demarked, and further united by the character of the longitudinal sculpturing; anal and genital apertures well separated; leg segments distinctly pedicellate; ventral plate well developed so that notogaster does not encroach on it at postero-lateral corners; pseudostigmata not developed.

Type: *Northus (?) marinus* Banks 1896

In this connection is should be noted that these four species, representatives of a moss inhabiting group, have reached "the sea" by way of estuaries and protected bays and harbors, and that the subject of this paper is the furthest from "home," and has developed three hooks to the ungues, areae porosae, and less marked notogastral wrinkling, all greater departures from the immature and primitive condition. The spines are relatively shorter than in some of the related species. It is therefore, a climax species in habitat and in some morphological characters.

In order to supplement the extremely meager description, and render future identification certain and easy, I append a detailed description and figures.

Hygroribates marinus (Banks) comb. nov.

Color blackish; size averaging 0.85 mm. in length of body.

Cephaloprothorax as seen from above (figure 3, upper half): broadly triangular; acetabulæ I forming conspicuous bosses at posterior angles; completely anchylosed to abdomen and without demarkation; as seen from side (figures 1 and 2): high, angled at distal end of lamellae; rostrum, seen from above: somewhat mammelonate, *i.e.* impressed at insertions of rostral bristles, separated from frons by a distinct depression or constriction; lamellae developed as a slight ridge running from lamellar bristles postero-laterad to terminate dorsad of acetabulæ II (figure 3); one or two cross-ridges may occur posteriad to lamellar bristles ("translamellar ridges"); tectopedia entirely undeveloped; bristles (as most body bristles) short, stout, pointed, slightly curved; interlamellar bristles lacking; acetabulae I and II developed as prominent, projecting bosses; pseudostigmata (and organs) entirely lacking, sometimes represented by a bristle (figures 1 and 3); anterior edge of abdomen produced onto cephaloprothorax as low ridges which fray out in various ways, and enclose between them and the lamellar ridges an elongated depression which shows up conspicuously as a pale strip (over acetabulae II) by indirect illumination; vertex with U-shaped ridge similar to that of figure 3, enclosing a slender pair of diverging ridges. This ridge is not exactly the same in all individuals but the base of the U is generally heavier than the arms.

Notogaster sculptured with small, more or less hexagonal areolae (indicated in figure 1); lower rim with muscle strands showing through as dark bands along ventro-lateral portion (figures 1 and 9, the latter showing areolae as seen from side); faint, short ridges developed as indicated in figure 3. These ridges are indeterminate and vary in extent and position in each individual; there are usually two or three transverse ridges posterior to base of the cephaloprothoracic U; bristles short, stout, pointed, arranged in two rows: I: 1–6 and II: 1–7, plus humeral; I: 1 usually on anterior rim of anteriormost transverse ridge; I: 4 most approximate, except possibly the always obliquely set, converging I: 6; II: 1 close behind anterior edge of notogaster; II: 2 far posteriad, *i.e.* II: 1 and II: 2 are the most widely spaced bristles except possibly I: 4 and I: 5; II: 4 and II: 5 very close together as also I: 5 and I: 6; II: 7 very short, oblique and set in a depression so that it is visible only under special conditions. One individual has two II: 1 (and no bristle at Pseudostigmata situs)! A large (sometimes double—figure 1) area porosa (?) on each side on transverse plane between bristles II: 3 and II: 4 but more ventrad; this area porosa looks more like a hole in the chitin with two opposite fingers of chitin more or less dividing the aperture; a diagonally set fissura ventro-posteriad of the areae porosae; two or three fine punctures near ventral rim of notogaster both anterior to and posterior to areae porosae.

Ventral plate (figure 3) not encroached upon by notogaster; posterior edge angularly produced (figure 2) more or less provided with chitin folds, the commoner condition illustrated in figure 3; surface otherwise smooth; anal aperture broadly pyriform, with only a blunt postero-lateral angle; covers each with usually two, sometimes three! bristles close to median edge and within central third; median pair of postanal bristles inserted close to center of cover; lateral pair of postanal bristles inserted at sides of aperture just posteriad to transverse plane of posterior cover bristles; preanal bristles inserted far down on sides of aperture, on transverse plane of anterior cover bristles!; a short fissura at each side of aperture, anterior to preanal bristles; paramesial bristles inserted less than diameter of a genital cover postero-laterad of genital aperture; genital aperture pentagonal, posterior angle fairly square, anterior edge short; each cover with six bristles, all directed backward except the long first (figure 2), spaced as in figures 2 and 3; tectopedia not developed unless the acetabular bulge of legs II is interpreted as a tectopedium but note that the outer chitin does not extend anterior to the acetabulum itself; apodemata rather short, apodemata II the longest, with well developed median process directed posteriad; parasterna III with a rather long bristle inserted near base of leg, directed laterad and thus usually visible from above (as in the Oribatinae); parasterna II also with a "tectopedial bristle"; other parasternal bristles inserted as in figure 3; there appear to be bristle insertions *above* insertions of legs I, II and III! as indicated in figure 1; tectopedia bristles II and III are shown in figure 2 as well as the bristles above insertion of legs I; labial bristles near distal margin; chitin parts of insertion of legs I are indicated by broken lines in figure 2.

Legs fairly long (longer than in the Nothrinae) segments rather cylindrical, though they show a great enough degree of shaping (see figures 4, 6, 8) to regard them as Brachypylina. Certainly the tibiae are constricted at the proximal end; so are the femora (figure 8) while the genuals are very much shorter. All femora with areolar sculpturing (figure 8). Bristles chiefly shorter than diameter of segments, stout, pointed, usually straight. Tarsi highly specialized for grappling and clinging. Ungues triheterohamate, the outer hooks very distinct, somewhat angular, wide spread. Legs I (figure 4) with distal end of femora reaching beyond tip of rostrum (figures 1 and 3); tarsi (figure 4) much shorter than tibiae, dorsal edge subparallel to ventral, distal end of dorsal edge sharply descending to apex, proximal bristle on either side short, inserted greatest diameter of segment from proximal end, fairly close to dorsal edge; these are preceded on median face by a fairly long bristle inserted near dorsal edge and near dorsal angle; a subequally long, curved bristle (major bristle) with hooked tip, inserted on the angle; another bristle resembling the long bristle of median face inserted on dorsal edge just distad of angle. These three form a brush at the dorsal angle (angle brush); another brush (distal) composed of two pairs of long, fine, distally hooked bristles inserted along the dorso-distal slope; ventral edge with a stout spine inserted on median face on transverse plane of dorsal angle, twice as long and stout as a quite short one inserted on the lateral side, but distad of transverse plane of the short bristles near dorsal edge; apex with a fairly long, stout spine (apical spine) slightly curved toward the hooks, a pair of medium long, fine bristles inserted dorso-proximad of the spine; curving about base of unguis and evidently part of it are a pair of strongly curved, compressed spines (sickle spines) which are drawn out into a fine curved point, this curve describing a semicircle and extending half way across curve of the hook (only those of lateral face are presented in figure 4). Tibiae stoutest distad of center, massively pedicelate; dorsal face with two, fairly long bristles inserted close together at distal end of segment, the distal-most the longer, bent toward the tarsus, nearly as long as tarsus, the proximal one curved slightly backward; a spine inserted diameter of segment from distal end of segment; ventral face with a spine inserted near distal end; middle portion of segment with three spines, two on lateral face and one on median face, none on same transverse plane. There seems to be a minute bristle inserted at base of dorso-distal. Genuals stoutly pedicelate; with a whorl of four spines, that of median face very short, that of lateral face fairly long. Femora with well formed, angular pedicel (figure 3), a low carina along dorsal edge (figure 3); dorsal face with a spine inserted laterad of the carina on distal third of body of segment; a lateral spine inserted diameter of segment from distal end; a small median spine inserted slightly more distad than lateral spine; a ventral spine inserted as far from proximal end of body of segment as lateral spine is inserted from distal end. Coxae small, bristleless.

Legs II quite similar but tarsi (figure 5) shorter, lacking small lateral and median bristles; dorsal edge with a *pair* of fairly long bristles bent in opposite directions, inserted shortly proximad of dorsal angle; a longer, distally hooked (major) bristle inserted on angle, with a shorter one at its foot, the angle brush thus formed of four bristles; distal brush formed of two pairs, inserted about center of oblique dorsal edge; the two spines of ventral face subequal, inserted just proximad of transverse plane of dorsal angle; other bristles quite similar. Tibiae shorter; the pair of dorsal face bristles inserted diameter of segment from distal end; a spine inserted shortly proximad of dorsal pair; a lateral spine inserted closely distad of transverse plane of dorsal pair; two ventral spines, the distal inserted less than its length from distal end, the proximal inserted at center of segment. If there are others they are very indistinct. Genuals as genuals I. Femora only slightly shorter; dorsal spine inserted at center of body of segment; ventral spine inserted at proximal fourth, lateral and median spines inserted almost opposite each other, shortly distad of transverse plane of dorsal, thus the relative positions of these three spines are the same but they are all inserted much further proximad.

Legs IV (figures 1 and 7, and compare also with the very similar figure 9) more slender; tarsi with a long (major) bristle (equal to length of tarsus) inserted on distal end of dorsal face, just proximad of angle, the only representative of the angle brush; distal brush includes the usual two pairs of long, fine, distally hooked bristles; ventral edge with usual two, heavy spines inserted: the median one on transverse plane of major bristle the lateral just proximad thereof; curved distal (sickle) spine shorter and stouter than in tarsus I; the pair of shorter, fine, curved bristles similar but inserted on each side of insertion dorsad of distal spine, that is on same transverse plane; curved ungual spine with three teeth along its outer (convex) edge, making it serrate; what in tarsus I is hooked, terminal bristle of the sickle spine is here a distinct bristle inserted at center of base of ungual hook, the sickle spine having a fine point; another hooked bristle not represented in leg I is inserted on dorsal edge of unguis, its hook extending half way across curve of ungual hook. Tibiæ (figures 1 and 7) almost parallel sided, tapering but very little at proximal end; with two dorsal bristles inserted close together less than diameter of segment from its distal end, the distal one being short, the proximal being fairly long and curved proximad; a lateral spine inserted greatest diameter of segment from its proximal end; two ventral spines, the distal inserted on transverse plane of short dorsal, the proximal inserted as far proximad of lateral bristle as ventro-distal is from lateral. Genuals quite short, only slightly constricted at proximal end, armed with two spines, a lateral and a shorter dorso-mesal. Femora obtusely fusiform with very short but strongly constricted pedicel; a dorsal spine inserted near center; a ventro-lateral spine inserted slightly distad of transverse plane of dorsal. Coxæ (figure 1) elongate, semipyriform, distal end drawn out into a crest applied close to abdomen (figure 3); but one (disto-ventral) spine.

Legs III very similar but shorter; tarsi (figures 1, 9, 10) shorter, with an additional, medium long, distally directed bristle inserted just proximad of dorsal (major) which is as long as that of tarsus IV; ventro-proximal spine inserted more distant from its neighbor. Tibiae with dorsal pair of bristles inserted a distance greater than width (height) of segment from proximal end, other bristles practically the same. Genuals similar. Femora with addition of a ventral spine inserted on transverse plane of dorsal. Coxae shorter; with two spines, the additional one inserted near center of lateral face.

Thus this species resembles *H. spoöfi* in having triheterohamate ungues, areae porosae, and similar areolations but very weakly developed to evanescent on top and front. The notogastral wrinklings resemble those of *H. bilineatus* but are more broken (*H. spoofi* and *H. schneideri* have no wrinkles). *H. schneideri* has interspaces between areolae as broad as the areolae while in *H. spoofi* and *H. marinus* they are much finer and resemble the meshes of a net.

H. spoofi differs from *H. marinus* in that:

1. the lamellar bristles are broadly included by the ridges;
2. the transverse ridge posterior to base of the U-ridge is very heavy and sometimes merges with the base of the U so that:
3. the notogaster bristles I : 1 seem to be inserted on base of the U;
4. notogaster bristles II : 4–6 are more distantly spaced;
5. notogaster bristles I : 5 and 6 are not oblique, and almost on the same longitudinal plane, I : 6 appearing much longer (in dorsal view) than I : 5;
6. the notogaster is without ridges (in the three types kindly sent me by Dr. A. C. Oudemans for study);
7. sternal bristles 2 and 3 are in line with bristles of parasterna III;
8. the genital aperture has a broad frame thus shoving sternal bristles 3 out laterally;
9. the paramesial bristles are more distant from genital aperture;
10. the postanal bristles 2 and the preanal bristles are more anteriorly inserted;
11. the postanal bristles 2 are opposite the bulge of the anal aperture;
12. the anal covers have only two pairs of bristles;

13. the mesal bristles of femora I and II are inserted near center of body of segment, while the disto-lateral bristles are also much more distant from distal end of segment.

One specimen from Zeeburg seems identical but is badly mashed down and flattened out.

The question which arises is, from where was *H. marinus* introduced. It may well be that the records from Ireland are this species and not *H. spoofi*.

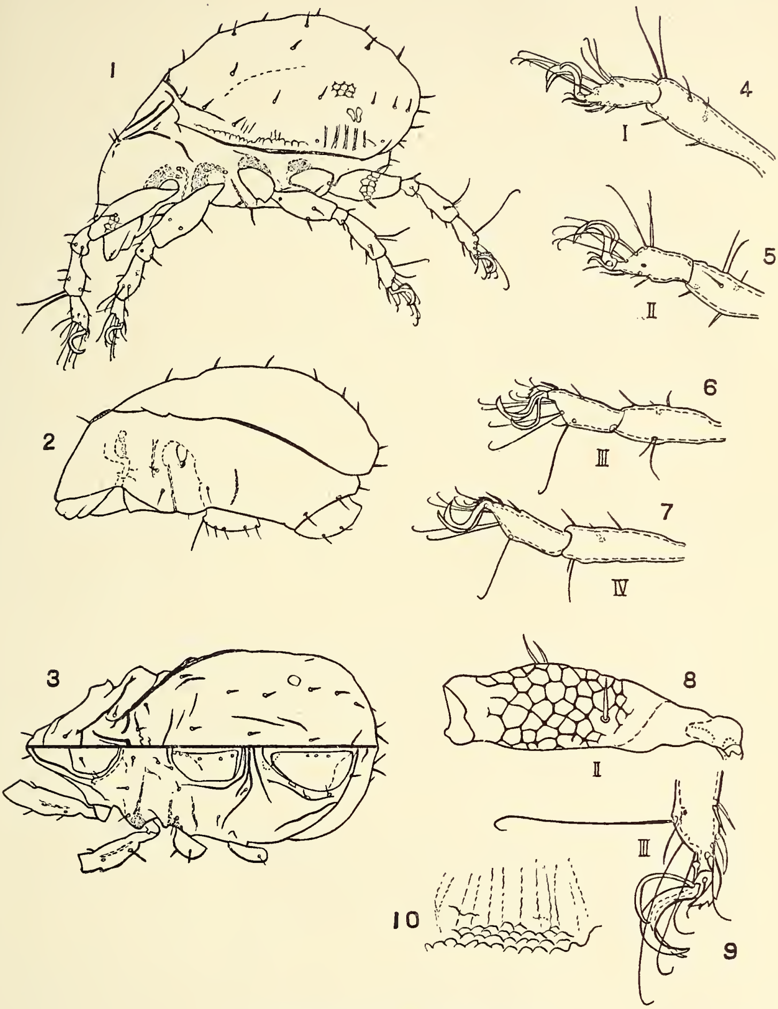
BIBLIOGRAPHY

1. BANKS, NATHAN, 1896 (March), New North American Spiders and Mites, Trans. Am. Ent. Soc., vol. 23, p. 77.
2. SUMNER, F. B., R. C. OSBURN, L. J. COLE, 1911, A Biological Survey of the waters of Woods Hole and Vicinity, sect. 3, A Catalogue of the Marine Fauna, in: Bull. [U. S.] Bur. Fish., vol. 31, pt. 2, p. 676.
3. OUDEMANS, A. C., 1900 (Sept. 5), Further notes on Acari, Tijdschrift voor Ent., vol. 43, p. 112, p. 5, figs. 6–10.
4. Same, 1902f, Notes on Acari, Third Series, Tijd. der Nederl. Dierkundige Vereeniging, ser. 2, vol. 7, p. 79.
5. Same, 1903 (May 12), same, Fifth Series, Tijd. voor Ent., vol. 45, p. 124.
6. MICHAEL, A. D., 1888, British Oribatidæ, vol. 2, p. 571, pl. 54, figs 8–16.
7. HALBERT, J. N., 1920 (July), The Acarina of the Sea Shore, Proc. R. Irish Acad., vol. 35, sect. B, p. 134, pl. 22, figs. 17a and b.
8. OUDEMANS, A. C., 1904 (Sept.), Acariden von Borkum und Wangeroog, Abh. Nat. Ver. Bremen, vol. 18, p. 97, pl. 8, figs. 94–96.

PLATE XX

Hygroribates marinus (Banks) 1896

Fig. 1. Lateral view, seen somewhat from above; sculpturing only indicated; ratio 60.
Fig. 2. Lateral view, seen slightly from below; legs omitted to show ventral covers; ratio 60.
Fig. 3. Dorso-ventral view; legs and sculpturing omitted; ratio 60.
Fig. 4. Tarsus and tibia I, lateral view; ratio 120.
Fig. 5. Tarsus and tibia II, lateral view; ratio 120.
Fig. 6. Tarsus and tibia III, lateral view; ratio 120.
Fig. 7. Tarsus and tibia IV, lateral view; ratio 120.
Fig. 8. Femur II, ventro-lateral aspect; ratio 200.
Fig. 9. Tarsus III, lateral aspect, bristles of median side omitted; ratio 200.
Fig. 10. Sculpturing and muscle strands of side of abdomen; ratio 200.



HYGRORIBATES MARINUS

A NEW AFRICAN MEMBRACID

BY W. D. FUNKHOUSER
UNIVERSITY OF KENTUCKY

Through the courtesy of Mr. H. K. Munro of the Entomological Section of the Division of Plant Industry of Pretoria, South Africa, the author has had the opportunity of examining a considerable number of Membracidæ from the collection of that institution.

In this collection was found a rather remarkable form in which the female undoubtedly belongs in the genus *Platybelus* Stål while the male apparently falls in the genus *Promitor* Distant. Distant erected the genus *Promitor* to accommodate a single species, *P. nominatus,* which differed from *Platybelus* in the absence of pronotal horns. It is evident that if the males and females here described belong to the same species, and we are convinced that such is the case, the presence or absence of horns will not hold as a generic or even as a specific character in this group.

Platybelus brunneus new species

FEMALE: Small, brown, pubescent; suprahumerals long, curved, extending outward and upward; posterior process strongly arcuate at base, impinging on tegmina for posterior half; tegmina wrinkled hyaline with base brown, opaque and pilose; scutellum and sides of thorax strongly white tomentose; abdomen and legs brown.

Head subquadrate, roughly sculptured, wider than long, brown, densely pubescent; base regularly arcuate; eyes brown; ocelli amber-colored, large, conspicuous, equidistant from each other and from the eyes and situated about on a line drawn through centers of eyes; inferior margins of genae curved; clypeus large, extending for half its length below inferior margins of genae; tip rounded, pilose.

Pronotum brown, densely pilose; metopidium sloping, about as wide as high, one each side an irregular foveate spot; median carina strongly percurrent; humeral angles blunt, extending lateral beyond the eyes as far as the width of the eyes; suprahumeral horns long, curved, flattened dorsoventrally, extending upward and outward, longer than the distance between their bases; posterior process slender, sinuate, highly arched over scutellum, touching tegmina along posterior half, not reaching tip of abdomen; scutellum entirely exposed, densely white tomentose, triangular, tip rounded.

Tegmina wrinkled hyaline; veins strong and brown; limbus wide; base brown, opaque and pilose; five apical cells; three large and two very small discoidal cells on left tegmen; two large and two small discoidal cells on right tegmen; veins slightly pubescent.

Legs and undersurface of body uniform brown; sides of thorax densely white tomentose.

Length from front of head to tips of tegmina 5 mm.; width between tips of suprahumerals 3.5 mm.

MALE: Smaller and darker, without suprahumeral horns but otherwise resembling the female. The absence of suprahumerals would throw this form, according to all descriptions and taxonomic keys, into the genus *Promitor* Distant but the fact that it was taken with the female as well as the agreement in all other characters would seem to preclude the possibility of its belonging to an entirely separate genus.

Length from front of head to tips of tegmina 4.5 mm.; width between humeral angles 2 mm.

Type: female.

Locality: Warmbaths TP., Roodekuil, Africa.

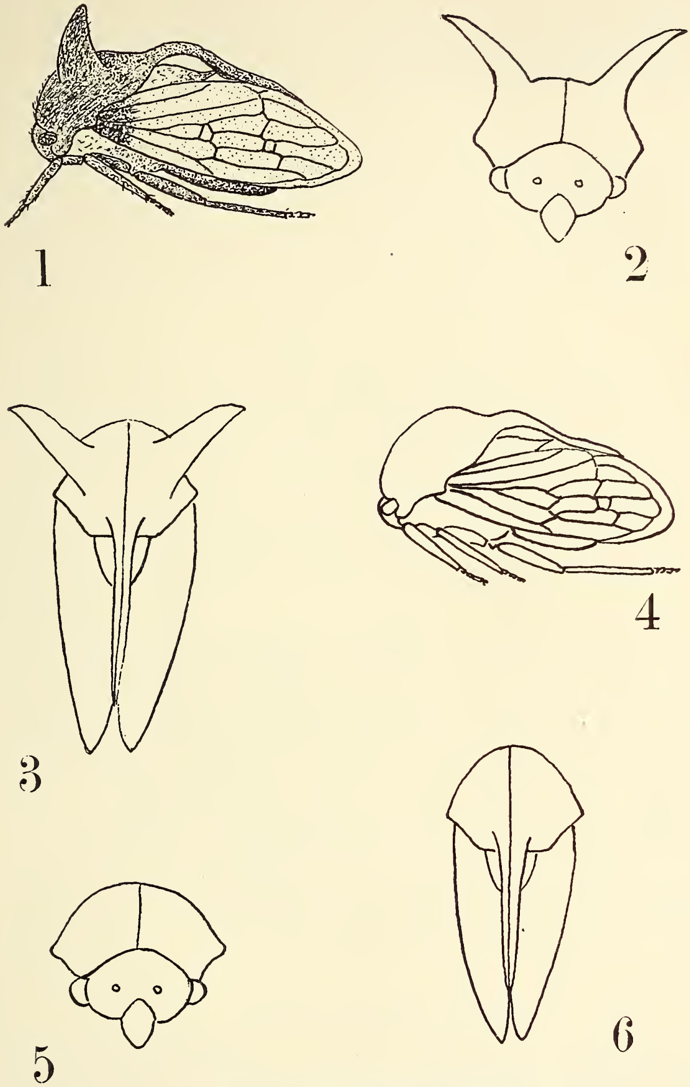
Described from three specimens, one female and two males, all from the same locality, collected by Mr. H. K. Munro on June 12, 1929. Type and paratype in Mr. Munro's collection; allotype in author's collection.

The writer is greatly indebted to Mr. Munro and his associates, not only for permission to study the entomological material in the collection, but also for the many courtesies extended to him on the occasion of his recent visit to Pretoria.

PLATE XXI

Platybelus brunneus new species

1. Lateral view—female
2. Frontal outline—female
3. Dorsal outline—female
4. Lateral outline—male
5. Frontal outline—male
6. Dorsal outline—male



PLATYBELUS BRUNNEUS

NEW SPECIES OF NORTH AMERICAN CERATO-POGONIDÆ AND CHIRONOMIDÆ

BY O. A. JOHANNSEN

The species described below are in part representatives of less well known genera some of which not having been recorded from this country before, and in part members of the genus *Metriocnemus* which are new or insufficiently described.

Ceratopogon Meigen

This genus as now restricted is defined as having microscopically pubescent eyes; humeral pits more or less developed; empodium very short or absent; claws of the female rather large; wings broad, milky white owing to the absence of microtrichia, macrotrichia absent or restricted to a few hairs around apical margin, two subequal radial cells normally present, fork of the media with rather long stem or lower branch widely interrupted at base.

Of the numerous species recorded in earlier years from North America and formerly included in this genus, only two, *C. culicoidithorax* Hoffm. and *C. lacteipennis* Zett., have been left here. Those placed by Malloch (1915) in this genus and those listed by me in "A list of the Insects of New York" save for *C. culicoidithorax*, have been transferred to *Atrichopogon*. *C. culicoidithorax*, previously recorded from Karner, N. Y., also occurs in Johnstown and Ithaca (April and May). *C. lacteipennis* Zett., an European species and previously recorded from Greenland, also occurs at Freeville and Ithaca, N. Y. (May and June).

Neoceratopogon Malloch

Alluaudomyia Kieffer. Voyage Alluaud et Jeannel, 1913: 12.
Neoceratopogon Malloch. Bull. Ill. State Lab. Nat. Hist. 11: 310. 1915.
Thysanognathus Ingram and Macfie. Ann. Trop. Med. 16: 244. 1922. (For *Prionognathus*, preoccupied.)

Prionognathus Carter, Ingram and Macfie. Ann. Trop. Med. 14: 309. 1921.

Isœcacta Garrett. Seventy New Diptera. 1925: 9.

The genus *Neoceratopogon* was erected for *Ceratopogon bellus* Coq., a name which Johnson (1925) later placed as a synonym of *Neoceratopogon splendidus* (Winn). In 1913 Kieffer erected the genus *Alluaudomyia* for *imparunguis* Kieff., later (in Faune de France) placing *C. splendidus* Winn. in the same genus. Should *A. imparunguis* and *C. splendidus* prove to be congeneric as appears to be the case judging from the description, *Alluaudomyia* has precedence over *Neoceratopogon*. Ingram and Macfie (Bull. Ent. Res. 15: 66. 1924–25) acknowledge the synonymy of *Thysanognathus* with *Neoceratopogon*. The description of *Isœcacta poeyi* Garrett applies perfectly to *C. bellus* Coq., so that the name of *Isœcacta* also falls into synonymy.

Pseudobezzia Malloch

This genus, which was erected for *Ceratopogon expolitus* Coq., is represented in the U. S. National Museum by a single male specimen. Dr. Alan Stone of the Museum writes that the posterior branch of the radius is bowed down near the base but not angulate, the r-m cross-vein joining it a short distance distad of its origin and the media forks distad of the cross-vein. The front femora are provided with two spinous bristles on the apical half of underside, the other femora lack bristles. Until the female of the type species is found it is impossible to say whether it is more closely related to *Bezzia* or to *Stilobezzia*.

Parabezzia Malloch

(*Eukraiohelea* Ingram and Macfie)

The genus *Parabezzia* was erected in 1915 with *P. petiolata* Mall. as the type. In the type species femoral spines are lacking and the media is short petiolate. Mr. H. H. Ross of the Illinois State Laboratory of Natural History in a sketch of the wing sent me indicates that in the type and in one paratype the cross-vein is placed at the junction of the two branches of the radius, the posterior branch not being angulate at base; in the second paratype the posterior branch is slightly bowed down near the base, the cross-vein intersecting it a short distance from its origin.

Ingram and Macfie (Ann. Trop. Med. 15: 347, 1921) erected the genus *Eukraiohelea* for two African species which have femoral spines but have a wing venation similar to the type of *Parabezzia petiolata.*

An examination of the paratype of *Bezzia elegantula* Johannsen (1908) shows that the cross-vein of the wing is placed slightly before the junction of the two branches of the radius, the anterior branch being but little longer than the cross-vein, the posterior branch not elbowed near base and ending very slightly distad of anterior branch of cubitus; the petiole of the media shorter than the cross-vein, its anterior branch entering the wing margin very slightly behind the wing tip. The fore femora are armed with two or three short weak spines on the underside near the middle; the last tarsal segment of all feet provided with a single large claw which has a short basal tooth.

On the basis of wing venation and femoral structure *Bezzia elegantula* should be placed in *Eukraiohelea.* It seems, however, that the distinction between *Eukraiohelea* and *Parabezzia* is exceedingly slight, the presence of the feeble spines in the middle of the femora in *B. elegantula* being the only differential character. For the present I prefer to regard *Eukraiohelea* as a subgenus of *Parabezzia,* and both closely related to *Stilobezzia.*

Lasiobezzia Kieffer

This genus differs from *Bezzia* in having hairy wings. The species described below differs from *L. pilipennis* Lundström, the type of the genus, in lacking femoral spines and in having the posterior branch of the radius produced nearly to the wing tip.

Lasiobezzia unica new species.

♀. Head dark brown, eyes separated over the base of the antennæ by a distance about equal to the diameter of three facets. Antennæ, including basal segment, yellow, apical half of flagellum dusky; segments 2 to 9 combined are two-thirds as long as the combined segments 10 to 14; segments 10 to 13 subequal, each about twice as long as the ninth and four-fifths as long as the 14th. Face brown, palpi pale yellow, mouth parts darker yellow. Mesonotum yellowish on anterior half and over base of wings, posterior part of mesonotum, scutellum, pleura and pectus subshining dark brown. Mesonotum with about five rows of sparsely set, short, brownish bristles, with several more bristles on the humeri and scutellum. Abdomen yellow, some of the intermediate tergites darkened. Legs yellow, apical half of all femora, and on the hind tibia a median ring and apex, fuscous; last tarsal segment on all feet fuscous. Femora unarmed. Fifth tarsal segment of all feet about as long as segments 2 to 4 inclusive, underside on basal half with several pairs of stout, blunt spines. All claws elongate, equal, each with a stout tooth at base. Wings hyaline, with microtrichia, and also with sparsely distributed macrotrichia on apical fourth of wing. Veins pale, costa not produced, R_{4+5} ends about as far before wing tip as the media does behind it; R_{4+5} has the same curvature as the costa, the first radial cell therefore of about the same width throughout; R_1 ends in the wing margin a little proximad of the point opposite tip of anterior branch of cubitus; fork of media broadly sessile as in species of Palpomyia; cubital fork under the cross-vein. Halteres pale. Length 2.2 mm., wing length 2.2 mm.

Ithaca, N. Y., July 20. Type in my collection.

Podonomus Philippi

This genus resembles *Pentaneura* (*Ablabesmyia*) in having hairy wings, m-cu cross-vein present and cubital fork sessile, but differs in having the costa distinctly produced. R_{2+3} is lacking in the male but in the female it is fused with R_1 except at the apex where they are slightly separated. It is closely related to *Trichotanypus* (str. sens.) which differs in having a petiolate cubital fork. *Tanypus tenebrosus* Coq. and *Tanypus arietinus* Coq. belong here as well as *Paratanypus kiefferi* Garrett. If we agree with Edwards ('29) in placing *Prosisoplastus* Kieffer as a synonym of *Podonomus, Linacerus* Garrett may also be referred here as the latter genus is congeneric with *Prosisoplastus,* the type species *Linacerus piloala* Garrett having the elongate antennæ described by Edwards for *Prosisoplastus sphagnicola* Kieff.

Podonomus (*Paratanypus*) *kiefferi* (Garrett). This species, described in 1925 from British Columbia, is a small blackish brown insect, the male having the disistyles of the hypopygium bifid, the base of the style bulbous. A male specimen from Ithaca, N. Y. (May), a female specimen from Orono, Me. (Nov.) and another from Ward, Colo. (Aug.), may be further described as follows:

♂. Antennal segments 2 to 13 inclusive more than half again as long as the apical section which is about as long as segments 7 to 13 inclusive. Hairs of thorax and abdomen brownish yellow. Anterior branch of the radius ends about opposite tip of posterior branch of cubitus; costa ends slightly before wing tip; media ends about in the wing tip; first radial cell distinctly narrower at mid-length than the costal cell at this point; m-cu cross-vein very slightly shorter than the r-m cross-vein. Hypopygium as figured by Edwards ('31) for *P. peregrinus.* Styles bifid, one branch of which is long, tapering and curved, the other a little shorter and blunt with a strong bristle at base. Length 2.5 mm.

♀. Costa nearly reaches wing tip; R_1 and R_{2+3} fused except at tip, giving the appearance of a vein thickened at the apex. R_{4+5} well curved; media ends behind apex of the wing; wing broader than in the male. Length 2 mm.

Podonomus arietinus (Coq.) was described by Coquillett as a *Tanypus.* To the original description of the male may be added that the antennal segments 2 to 13 inclusive are about $\frac{1}{7}$ longer than the apical section; anterior branch of the radius ends about opposite the tip of anterior branch of cubitus; costa produced to wing tip; media ends nearly as far behind wing tip as the posterior branch of the radius does before it; first radial cell at mid-length is fully as wide as the costal cell at this point. Length 2.75 mm. Described from the type specimen.

Clinotanypus Kieffer

A tanypodine genus with bare wings and produced costa; R_2 present, appearing in most cases as a free branch of R_1; fourth tarsal segment of each leg shorter than the fifth and cordiform. If the genus is restricted to species having very small acrostichal hairs and the petiole of the cubitus over $\frac{1}{3}$ as long as Cu_2, as defined by Edwards ('31), a number of species occurring in North America would be included; among these are *flavicintus* Lw., *pinguis* Lw., and *caliginosus* Joh. with a petiole about a third as long as Cu_2, and *thoracicus* Lw. in which the petiole is scant half as long as Cu_2.

Cœlotanypus Kieffer

Kieffer ('13) erected the genus *Cœlotanypus* for species resembling Clinotanypus but having a sessile cubital fork designating *humeralis* Lw. as the type and with which *tricolor* Lw. is congeneric. Apparently no sharp line can be drawn between species having a short petiole or in which the petiole is lacking, and therefore the species *scapularis* Lw. and *concinnus* Coq. should also be included here. In all of them the hair-like acrostichals are lacking.

Diamesa Meigen

Diamesa nivoriundus (Fitch). In 1903 (Bull. 68, N. Y. State Museum) I placed this as a synonym of *Diamesa Waltlii* Meigen, but in 1905 (Bull. 86, N. Y. State Museum) in deference to the opinion of D. W. Coquillett, I applied the name to a species of *Orthocladius* instead. In the thirty years which have elapsed since then I have collected numerous specimens of the species during the winter months, some of them near the type locality, while *Orthocladius nivoriundus* was found only in the early spring. In view of this I am reverting to my original opinion and will call the winter species *Diamesa nivoriundus* (Fitch) and therefore must call the early spring species *Orthocladius nivoriundus* Joh. (not Fitch). The recent work of the European entomologists Edwards and Goetghebuer makes it seem clear that *D. nivoriundus* (Fitch) is not identical with *D. Waltlii* Meigen.

The synonymy now stands as follows:

Diamesa nivoriundus Fitch.
  D. Waltlii Joh. '03 (not Meigen).
Orthocladius nivoriundus Johannsen (not Fitch).

This name was first used by Johnson in the List of the Insects of New Jersey but the species was not described until 1905.

Metriocnemus Van der Wulp

Wings hairy, r-m cross-vein short and nearly transverse in position; m-cu cross-vein lacking; style of hypopygium simple as in *Orthocladius*. Fine acrostichal hairs present in the species described by me.

Metriocnemus aequalis new species.

♂. Head, including antennæ, palpi and proboscis, brown. Antennal segment 14 about one and one-half times as long as segments 2 to 13 combined. Eyes bare. Thorax yellow, the three vittæ, pleura, sternum, and metanotum dark brown; scutellum yellowish brown. Abdomen brown, hairs brownish;

hypopygium with the lobe on inner side of basistyle rounded, a little more pronounced than figured by Edwards for *M. subnudus* (Edwards '29, fig. 3 h); anal spur broad and hairy except at tip as in *M. penerasus* Edw. (l. c.). Legs pale brown; proportions of segments of the fore leg to each other are 40, 46, 40, 22, 16, 11, 6; hind basitarsus 0.6 of tibia in length; hind tarsi without spurs. Wings hyaline, hairy on apical half; R_{2+3} ends about half way between tips of R_1 and R_{4+5}; R_{4+5} ends rather close to wing tip, costa not produced; stem vein with one or two bristles; media ends in the wing tip; Cu_1 ends proximad of tip of R_{4+5}; Cu_2 slightly bent forward at tip; cubitus forks distad of the slightly oblique and rather prominent cross-vein; anal vein produced far beyond cubital fork. Membrane tinged with brown by transmitted light, more or less milky by reflected light. Squama completely fringed. Halteres yellow. Length 2.75 mm., wing 2.5 mm.

♀ paler than the male. In some specimens, among them one taken in copula with the type, quite yellow, the thoracic vittæ, sternum and metanotum brownish. In other specimens these parts are nearly as dark as with the male. Venation as with the male but the wing is more uniformly hairy and the veins are stronger.

Ithaca, N. Y. June 28; Chicago, Ill.

The specimen recorded by me in 1905 as *M. lundbecki* var. b. and collected in Chicago, belongs here.

Holotype and allotype in my collection.

Metriocnemus hamatus new species.

Related to *M. lundbecki* Joh. and *innocuus* Curran, but differing from both in the color of the abdomen and form of hypopygium.

♂. Head and palpi brown, base of proboscis paler; scape dark brown, flagellum of antennæ paler brown; antennal segment 14 slightly more than a fourth longer than segments 2–13 combined. Eyes bare, with strong dorsal projection. Thorax yellow, the three broad vittæ, pleura in part, sternum and metanotum dark brown; scutellum paler brown. Abdomen, including hairs, pale brown. Hypopygium with a low lobe on mesal margin of basistyle, the lobe having at its base a slender, claw-like process the tip of which meets the apical spine of the dististyle when this is flexed inwards. Dististyle broad, broadest beyond middle. Spur of apical tergite moderately broad, short, apex rather slender and bare. Legs yellowish brown; the proportions of the fore leg segments are 42, 48, 38, 18, 14, 8, 6; of the hind leg, 42, 48, 32, 16, 10, 7, 5. Wing moderately hairy except towards base and in the anal cell; stem vein with a hair; first branch of the radius about half as long as the third; second branch ends about half way between tips of the other two branches; costa produced well beyond the tip of the posterior radial branch but ending proximad of the tip of the media which terminates only a very short distance behind the wing tip; anterior branch of the cubitus ends distinctly proximad of the tip of posterior branch of radius; posterior branch of cubitus curved forward at tip and ending slightly distad of tip of anterior branch of radius; anal vein ends distinctly beyond the cubital fork; cross-vein slightly oblique. Halteres yellow; squamæ partly fringed. Length 2.5 mm., wing length 2.25 mm.

Ithaca, N. Y. May. Type in my collection.

Metriocnemus innocuus Curran. This species is related to *M. lundbeckii* but differs in having an olive green abdomen. A slide of the hypopygium of the type shows the lobe on the inner margin of the basistyle to be more or less right angled. The costa of the wing is produced.

Metriocnemus lundbeckii Johannsen. Bulletin N. Y. State Museum 86: 302. 1905. ♂. To the original description should be added that the eyes are bare and deeply emarginate, the width between the eyes being only about a fourth the entire width of the head. Antennal segment 14 over a third longer than 2 to 13 combined. Proportions of segments of fore leg are 42, 46, 36, 18, 14, 8, 5; of hind leg are 42, 46, 30, 14, 11, 6, 4. Hypopygium with a large triangular lobe with rounded apex on mesal margin of basistyle, spur of last tergite rather long, slender and bare. Wing disc hairy except for basal fourth, posterior branch of radius ends slightly distad of tip of anterior branch of cubitus; costa far produced; media ends slightly behind the wing tip; cubitus forks a little distad of the nearly erect cross-vein; second branch of radius ends beyond the mid-distance between the tips of the anterior and posterior branches. Squama sparsely fringed.

♀. Wing wider, hairs nearly reaching the wing base; penultimate antennal segment with tapering neck, the proximal segments more fusiform.

The *M. lundbeckii* var. b (Johannsen, '05) from Chicago is *M. aequalis* Joh.

Metriocnemus (*Paraphaenocladius*) *exagitans* Johannsen. Bulletin, N. Y. State Museum 86: 303. 1905. (= *M. brachyneura* Mall. '15). The description of the wing as well as the figure given in the original account are incorrect as a comparison with the type shows. Attention was called to this error in the Kansas University Science Bulletin, page 112, 1908.

♂. Costa scarcely or but very slightly produced, ending far from the wing tip about opposite the mid point between the tips of the two branches of the cubitus; media ends in the wing tip; cubitus forks only very slightly distad of the short cross-vein; anal vein produced beyond the cubital fork; hairs on wing more sparsely distributed toward the base. Eyes bare. Antennal segments 2 to 13 about a fifth longer than segment 14. Lobe on the mesal margin of the hypopygium resembling that of *M. impensus* Walker (fig. 12. Goetghebuer, Faune de France); spur of last tergite rather broad at base, apex bare. Proportion of segments of fore legs are 47, 52, 37, 21, 15, 10, 8; hind basitarsus two-thirds as long as tibia. Squama partially fringed. Coloration as given in the original description. Length 1.75 mm. Holotype in my collection.

♀. Wing wider than that of the male, more uniformly hairy; the costa ends slightly proximad of the tip of the anterior branch of the cubitus. Intermediate antennal segments with distinct necks. Differs from the male in being much paler. Abdomen with pale brownish markings on some of the tergites. Length 1.25 mm. The species closely resembles the European *M. impensus* Walker.

Male and female paratype specimens of *M. brachyneura* Mall. do not differ from *M. exagitans* in either color or structural characters.

Brillia Kieffer

Differs from *Metriocnemus* in having the cross-vein very long and oblique with the diststyles of the male hypopygium bifid.

Brillia parva new species.

♂. Head, including proboscis, yellowish, antennæ and palpi more brownish. Last antennal segment three-fourths longer than segments 2 to 13 combined. Pronotum well developed, divided in the middle, yellow; mesonotum yellow with three dark brown vittæ; scutellum brownish yellow; pleura and pectus brown. Abdomen dark brown; diststyles each with two subequal curved branches; the slightly curved basal appendage nearly half as long as the basistyle. Legs yellow; proportions of segments of fore leg are 50, 60, 56, 28, 20, 15, 8; segment four of hind tarsus nearly twice as long as the fifth; pulvilli minute. Wings hyaline, uniformly hairy; costa produced a little beyond tip of the posterior branch of the radius and ending about as far in front of wing tip as the media does behind it; cubitus forks under the middle of the elongate cross-vein. Halteres yellow. Length 3 mm.; wing length 2.5 mm. McLean Bogs, McLean, N. Y.

August 17. Type in my collection.

Brillia par (Coquillett). Dr. Alan Stone of the U. S. National Museum writes in regard to *Orthocladius par* Coq. that the single specimen in the museum is badly rubbed with the wings nearly denuded, but it appears that more hairs are present on the apical half of the wing than on the basal. My *Metriocnemus par* described in 1905 is the same species. On the basis of wing venation and structure of the hypopygium it should be referred to *Brillia.*

Brillia flavifrons (Johannsen). Originally described as *Metriocnemus flavifrons.*

Orthocladius Van der Wulp

Orthocladius furcatus Kieffer. Some female specimens were reared from larvæ found in May in the soil of a greenhouse at New City, Rockland County, N. Y. The larvæ have the curious habit of bending and jumping in a manner similar to cheese skippers. This is a black species, with shining thorax; antennæ provided with forked sense hairs; squamæ with a few hairs in the fringe. The species belongs to Edwards' group B of the subgenus Orthocladius (Edwards '29).

Pseudochironomus Malloch

Besides the genotype *P. richardsoni* Mall., two species, *P. fulviventris* (Joh.) and *P. pseudoviridis* (Mall.), both originally described under *Chironomus,* should be referred here.

Pentapedilum Kieffer

The members of this genus resemble *Tanytarsus* in possessing more or less hairy wings but resemble *Chironomus* in the form of the hypopygium and in having the cross-vein of the wing obliquely placed.

Of eastern species there are *P.* (*Pentapedilum*) *fulvescens* (Joh.), *P.* (*Phaenopsectra*) *flavicauda* (Mall.), *P.* (*Phaenopsectra*) *obediens* (Joh.) and *P.* (*Phaenopsectra*) *incomptus* (Zett.). The first three were originally described under *Tanytarsus,* the last one more recently listed under *Metriocnemus.* Furthermore, specimens of *P.* (*Sergentia*) *coracinus* (Zett.) have been taken in May by Professor C. Juday at Green Lake, Wisconsin, and by Mr. J. J. Rempel at Cream Lake, Saskatchewan, in June.

A LIST OF THE ANTS OF SOUTH CAROLINA

BY M. R. SMITH, AGENT, U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY, STATE COLLEGE, MISS.

In a previous paper (Ent. News, Vol. 29, pp. 17–29, 1918) I listed 44 species of ants as occurring in South Carolina. This article was based mostly on collections that I had made in the northwestern part of the State (Clemson College and vicinity) during the years 1915 and 1916.

Since the appearance of that paper I have received numerous specimens for determination and am listing herein all of the species known to occur in the State at present. A large number of these were collected by Mr. D. E. Read incidental to the scouting he did in the state for the Argentine ant, while employed by the United States Department of Agriculture, Bureau of Entomology. Specimens have also been sent me by State officials and friends. Those who have collected specimens on which this paper is based are: D. E. Read, A. F. Conradi, Franklin Sherman, Jr., J. A. Berly, O. L. Cartwright, M. H. Brunson, David Dunavan, W. A. Thomas, J. E. Webb, P. K. Harrison, W. C. Nettles, T. M. Williams, E. R. Barber, A. Lutken, H. L. Stoddard, Frances McAllister, and the writer.

It is reasonably certain that some of the ants occurring in the State are unrecorded here. Many species in adjoining States doubtless will eventually be collected in South Carolina. This will be especially true for species belonging to the following genera: *Eciton* (*Acamatus*); *Pheidole, Leptothorax, Strumigenys, Lasius,* and *Camponotus.*

Family *FORMICIDÆ*

Subfamily *Ponerinæ*

1. *Stigmatomma pallipes* Hald. Walhalla (M. R. S.).
2. *Proceratium silaceum* ?Roger. Charleston, Adams Run (D. E. R.).
3. *Sysphincta pergandei* Emery. Clemson College (M. R. S.). One of the rarest of our North American ants.

4. *Ponera trigona* var. *opacior* Forel. Walhalla, Clemson College (M. R. S.); Westminister, Calhoun, Prosperity, Scranton, Charleston (D. E. R.). One of the most common species of *Ponera* in the Southern States.
5. *Ponera opaciceps* Mayr. Jacksonboro (D. E. R.).
6. *Ponera inexorata* Whlr. Walhalla (M. R. S.). Formerly described from Texas, this species is now known to range as far eastward as South Carolina.

Dorylinæ

7. *Eciton* (*Acamatus*) *opacithorax* Emery. Walhalla, Clemson College (M. R. S.).
8. *Eciton* (*Acamatus*) *carolinensis* Emery. Spartanburg (D. E. R.). This species is apt to be mistaken for the one above.

Pseudomyrminæ

9. *Pseudomyrma flavidula* F. Smith. Greeleyville, Myrtle Beach, Summerville, Dorchester, Dillon (D. E. R.).
10. *Pseudomyrma brunnea* F. Smith. Summerville, Pinewood (D. E. R.) This species may easily be recognized by its color.

Myrmicinæ

11. *Monomorium minimum* Buckley. Walhalla, Clemson College (M. R. S.); Florence (O. L. C.); Greer, Fountain Inn, Anderson, Laurens, Calhoun Falls, Greenwood, Woodruff, Spartanburg, Inman, Cowpens, Blacksburg, Cherokee Falls, Johnson, North Augusta, Batesburg, Leesville, Lexington, Columbia, Camden, Sumter, Pinewood, Elliott, Lancaster, Chester, Great Falls, Scranton, Lake City, Johnsonville, Kingstree, Lane, North, Ehrhardt, Port Royal, Charleston, Moncks Corner, Sullivans Island, Conway, Myrtle Beach, McCall (D. E. R.). This tiny black ant is widely distributed not only over South Carolina but over a large part of North America. It is an important house-infesting form.
12. *Monomorium pharaonis* L. Salters Depot (M. H. B.); Calhoun, Clemson College (D. D.); Greenwood, Ware Shoals,

Lexington, Bishopville, Camden, Winnsboro, Kingstree, St. Matthews, Blackville, Allendale, Ridgeville, Beaufort, Ridgeland, Charleston, Meggetts, St. Stephens, Mt. Pleasant, Georgetown, Conway, Marion, Bennettsville, Easley, (D. E. R.). Pharaoh's ant is a serious pest wherever the species occurs. It has become very widely distributed by commerce.

13. *Solenopsis molesta* Say. Clemson College (D. D.); Abbeville, Due West, Spartanburg, Charleston (D. E. R.); Marion (W. A. T.). The tiny thief ant, one of the smallest of the house-infesting ants, shows a decided fondness for meats, oil, nuts, etc.
14. *Solenopsis pergandei* Forel. Walhalla, Clemson College (M. R. S.).
15. *Solenopsis geminata* Fabr. Summerville (J. A. B.); Marion (W. A. T.); Meyersmere, Sumter, Orangeburg, Port Royal (D. E. R.).
16. *Solenopsis geminata* subsp. *rufa* Jerdon. North Augusta, Graniteville, Columbia, Kingstree, Manning, Denmark, Allendale, Walterboro, Beaufort, Jacksonboro, Georgetown (D. E. R.).
17. *Solenopsis globularia* subsp. *littoralis* Creighton. Charleston (D. E. R.) This interesting subspecies is now known to occur from Mississippi eastward to South Carolina.
18. *Solenopsis xyloni* McCook. Abbeville, Pinewood (D. E. R.). This species of fire ant, which is so common in the Gulf States, certainly ranges as far north in South Carolina as the 34th parallel of latitude, or slightly above, in the western part of the State.
19. *Pheidole morrisi* Forel. Marion (W. A. T.); Pawley's Island (O. L. C.); Due West, Leesville, Spartanburg (D. E. R.).
20. *Pheidole dentata* Mayr. Marion (W. A. T.); Walhalla, Clemson College (M. R. S.); Liberty, Spartanburg, Newberry, Edgefield, Leesville, Columbia, Bishopville, Bluffton (D. E. R.).

Pheidole dentata is perhaps the commonest species of *Pheidole* in the State, unless it be *vinelandica*.

21. *Pheidole crassicornis* Emery. Walhalla, Clemson College (M. R. S.); Sumter (D. E. R.).
22. *Pheidole tysoni* Forel. Walhalla (M. R. S.).
23. *Pheidole metallescens* subsp. *splendidula* Whlr. Clemson College (J. E. W.); Florence (O. L. C.); Seneca, Calhoun, Easley, Fountain Inn, Greenwood, Spartanburg, Gaffney, Aiken, Leesville, Columbia, Cameron, Charleston (D. E. R.). Workers are easily recognized by the beautiful violaceous reflections of their bodies.
24. *Myrmecina graminicola* subsp. *americana* Emery. Walhalla, Pendleton (M. R. S.).
25. *Crematogaster lineolata* Say. Clemson College (J. E. W.); Walhalla (M. R. S.); Columbia (D. E. R.).
26. *Crematogaster lineolata* var. *lutescens* Emery. Clemson College (M. R. S.).
27. *Crematogaster laeviuscula* Mayr. Florence (O. L. C.); Calhoun, Piedmont, Abbeville, Batesburg, Sumter, Gaffney, Blacksburg, Edgefield, Lancaster, Charleston, Marion (D. E. R.).
28. *Crematogaster laeviuscula* var. *clara* Emery. Abbeville (D. E. R.).
29. *Crematogaster ashmeadi* Mayr. Fairfax (P. K. H.); Westminister, "The Tunnel" near Walhalla (J. E. W.); Liberty, Fountain Inn, Belton, Spartanburg, Gaffney, Union, Buffalo, Johnson, Pinewood, Rion (D. E. R.).
30. *Crematogaster victima* subsp. *missouriensis* Pergande. Clemson College (M. R. S.).
31. *Crematogaster minutissima* Mayr. Columbia (D. E. R.).
32. *Crematogaster opaca depilis* var. *punctulata* Emery. Rocky Bottom (W. C. N.).
33. *Aphaenogaster mariae* Forel. Walhalla (M. R. S.). A rare species which can easily be recognized by the prominent longitudinal striations at the base of the worker's gaster.
34. *Aphaenogaster treatæ* Forel. Walhalla, Clemson College (M. R. S.); Columbia (D. E. R.). The prominent lobe at the base of the antennal scape clearly distinguishes the worker of this species.

35. *Aphaenogaster lamellidens* Mayr. Walhalla, Clemson College (J. E. W.).
36. *Aphaenogaster lamellidens* var. *nigripes* M. R. Smith. Seneca, Dillon (D. E. R.); Clemson College (J. E. W.); Pendleton (M. R. S.).
37. *Aphaenogaster fulva* Roger. Walhalla (M. R. S.); Pickens, Gaffney (D. E. R.).
38. *Aphaenogaster fulva aquia* var. *picea* Emery. Kingstree (D. E. R.).
39. *Aphaenogaster texana* var. *carolinensis* Whlr. Clemson College (J. E. W.); Walhalla (M. R. S.); Spartanburg, Cherokee Falls (D. E. R.).
40. *Aphænogaster texana* var. *furvescens* Whlr. Adams Run (D. E. R.).
41. *Aphænogaster texana* subsp. *macrospina* M. R. Smith. Navy Yard, at Charleston (D. E. R.). This subspecies was only recently described from the specimens taken by Mr. Read at the above locality.
42. *Pogonomyrmex badius* Latr. North Augusta, Florence (O. L. C.). The Florida harvesting ant is the only species of this genus known to occur in the State. The workers give a very painful sting.
43. *Myrmica punctiventris* subsp. *pinetorum* Whlr. Clemson College (M. R. S.). The workers and queens are characterized by the coarse punctations at the base of the gaster.
44. *Myrmica scabrinodis* subsp. or var. Caesar's Head (M. R. S.).
45. *Leptothorax fortinodis* Mayr. Clemson College (M. R. S.).
46. *Leptothorax fortinodis* var. *melanoticus* Whlr. Clemson College (J. E. W.); Barnwell (D. E. R.).
47. *Leptothorax curvispinosus* Mayr. Clemson College (M. R. S.); Kingstree (D. E. R.). One of the commonest species of *Leptothorax* in the State.
48. *Leptothorax pergandei* Emery. Due West, Landrum (D. E. R.). This and the following species usually nest in the soil.
49. *Leptothorax* (*Dichothorax*) *pergandei* subsp. *floridanus* Emery. Clemson College (J. E. W.).

50. *Tetramorium guineense* Fabr. Laurens, Edgefield, Aiken, Batesburg, Kingstree, Yemassee, Charleston, St. Stephens, Georgetown (D. E. R.). An imported species which is now rather widely and sporadically distributed throughout the Southern States.
51. *Tetramorium cæspitum* L. Clinton, Charleston (D. E. R.).
52. *Tetramorium* (*Triglyphothrix*) *striatidens* Emery. Beaufort (D. E. R.). Formerly known from only one locality in the United States, this species has since been found in Alabama, Florida, and Mississippi.
53. *Strumigenys louisianæ* Roger. Charleston (D. E. R.). This probably represents one of the several species of *Strumigenys* that occur in the State.
54. *Trachymyrmex septentrionalis* McCook. Clemson College (M. R. S.); Pontiac (O. L. C.). The only species of fungus ant yet recorded from the State.

Dolichoderinæ

55. *Dolichoderus* (*Hypoclinea*) *mariæ* Forel. Clemson College (M. R. S.); Rocky Bottoms (J. E. W.). This and all the following species of *Dolichoderus* are honeydew-loving forms, with arboreal habits.
56. *Dolichoderus* (*Hypoclinea*) *taschenbergi* Mayr. Old Fort Prince George, near Pickens (O. L. C.). A very beautiful jet black ant.
57. *Dolichoderus* (*Hypoclinea*) *taschenbergi* var. *atterrima* Whlr. Clemson College (M. R. S.).
58. *Dolichoderus* (*Hypoclinea*) *plagiatus* Mayr. Clemson College (M. R. S.).
59. *Dolichoderus* (*Hypoclinea*) *plagiatus* subsp. *pustulatus* Mayr. Clemson College (M. R. S.).
60. *Dolichoderus* (*Hypoclinea*) *plagiatus pustulatus* var. *beutenmuelleri* Whlr. Clemson College (M. R. S.).
61. *Dorymyrmex pyramicus* Roger. Clemson College (J. E. W.); Pontiac (O. L. C.); Gray Court, Newberry, Bethune, Clio (D. E. R.).
62. *Dorymyrmex pyramicus* var. *flavus* Pergande. Clemson College (M. R. S.); Florence (O. L. C.); Greenwood,

Trenton, Sumter, Elliott, Johnsonville, Denmark, Bamberg, Fairfax, Hampton, Charleston (D. E. R.). One of the most common ants in the State. Usually constructs crater-shaped nests in the soil in sunny spots.

63. *Dorymyrmex pyramicus* var. *niger* Pergande. Marion (W. A. T.).
64. *Tapinoma sessile* Say. Clemson College (M. R. S.); Greenville, Piedmont, Gray Court, Gaffney (D. E. R.). The odorous house ant is the only species of this genus known to occur in the State.
65. *Iridomyrmex pruinosus* Roger. Walhalla (M. R. S.); Pontiac (O. L. C.).
66. *Iridomyrmex pruinosus* var. *analis* Andre. (Greenville (T. M. W.): Clemson College (J. E. W.); Florence (O. L. C.); Calhoun, Simpsonville, Spartanburg, Lyman, Inman (D. E. R.).
67. *Iridomyrmex humilis* Mayr. Charleston (E. R. B.); Spartanburg (M. H. B.); Clifton (A. L.); Gaffney (M. H. B.); Anderson, Calhoun Mills at Calhoun Falls, Greenville, Greer, Fountain Inn, Glenn Ayres Floral Company near Spartanburg, Cowpens, Converse, Eastover, Sumter, Bishopville, Kershaw, Lancaster, York, Lamar, Palmetto Floral Company near Charleston, St. George, Dillon, Greenville Floral Company near Greenville (D. E. R.). The Argentine ant is now known to occur in at least 23 places in the State.
68. *Brachymyrmex heeri* subsp. *depilis* Emery. Columbia, Charleston (D. E. R.).
69. *Prenolepis imparis* Say. Clemson College (D. D.); "The Tunnel" near Walhalla (D. D.); Florence (O. L. C.); Pickens (D. E. R.). There is probably no other North American ant which can be active under such low degrees of temperature as this ant.
70. *Prenolepis imparis* var. *testacea* Emery. Clemson College (D. D.); Walhalla (D. D.); Spartanburg, Gaffney (D. E. R.). A color variety of the preceding species. This ant, and *imparis* also, infests houses.

71. *Prenolepis imparis* var. *minuta* Emery. Clemson College (M. R. S.).
72. *Prenolepis* (*Nylanderia*) *parvula* Mayr. Clemson College (M. R. S.).
73. *Paratrechina longicornis* Latr. Greenwood, Batesburg, Columbia, Charleston (D. E. R.). The crazy ant does not seem to be very widely distributed in the State but wherever it occurs it is a house pest of considerable importance.
74. *Paratrechina bourbonica* Forel var. Summerville, Charleston (D. E. R.).
75. *Lasius niger* var. *neoniger* Emery. Clemson College (D. D.); Rocky Bottom (J. E. W.); Easley, Greenville, Williamstown, Calhoun Falls, Greenwood, Spartanburg, Gaffney, Blacksburg, Buffalo, Newberry, Batesburg, Lexington, Sumter, Camden, Conway, Winnsboro (D. E. R.).
76. *Lasius niger* var. *americana* Emery. Gaffney (D. E. R.); Clemson College (M. R. S.).
77. *Lasius* (*Acanthomyops*) *interjectus* Mayr. Clemson College (M. R. S.); Pickens, Spartanburg (D. E. R.). The largest species of the *Acanthomyops* group, all species of which can be recognized by their pleasant citronella-like odor.
78. *Lasius* (*Acanthomyops*) *claviger* Roger. Clemson College (D. D.).
79. *Lasius* (*Acanthomyops*) *latipes* Walsh. Scranton (D. E. R.).
80. *Formica sanguinea* subsp. *subintegra* Emery. Clemson College (M. R. S.). The only known representative in the State of the slave-making ants of the *sanguinea* group.
81. *Formica truncicola* subsp. *integra* Nyl. Clemson College (M. R. S.); "The Tunnel" near Walhalla (O. L. C.).
82. *Formica pallide-fulva* Latr. Clemson College (M. R. S.).
83. *Formica pallide-fulva* subsp. *schaufussi* var. *dolosa* Whlr. Walhalla (M. R. S.); Clemson College (J. E. W.); Seneca, Inman, Blacksburg (D. E. R.).
84. *Formica fusca* var. *subsericea* Say. Clemson College (M. R. S.); Greenville, Spartanburg (D. E. R.).
85. *Polyergus rufescens* subsp. *lucidus* Mayr. Whitewater Falls (M. R. S.). The above locality probably represents the

most southern point in which the shining slave maker occurs in the Appalachians.

86. *Camponotus castaneus* Latr. Clemson College (M. R. S.); Florence (O. L. C.); Pinewood (D. E. R.).

87. *Camponotus castaneus* subsp. *americanus* Mayr. Clemson College, Walhalla (M. R. S.); Abbeville, Spartanburg (D. E. R.).

88. *Camponotus herculeanus* subsp. *pennsylvanicus* DeGeer. Clemson College (M. R. S.); Walhalla (J. E. W.); Rocky Bottom (W. C. N.); Florence (O. L. C.); Pelzer, Conway (D. E. R.). This is the common black carpenter ant, which is fond of nesting in logs, stumps, trees, etc.

89. *Camponotus caryæ* Fitch. Clemson College (J. E. W.); Westminster, Spartanburg, Batesburg, Camden, Ridgeland, Conway, McCall (D. E. R.).

90. *Camponotus caryæ* subsp. *rasilis* Whlr. Pawleys Island (O. L. C.); Columbia (D. E. R.).

91. *Camponotus caryæ rasilis* var. *decipiens* Emery. Clemson College (F. M.); Pickens, Anderson, Laurens, Spartanburg, Inman, Cowpens, Union, Edgefield, Johnson (D. E. R.).

92. *Camponotus caryæ rasilis* var. *pavidus* Whlr. Due West D. E. R.).

93. *Camponotus abdominalis* subsp. *floridanus* Buckley. Hilton Head Island (H. L. S.). This ant, perhaps the commonest species of *Camponotus* in Florida, certainly ranges as far north as North Carolina.

94. *Camponotus* (*Colobopsis*) *mississippiensis* M. R. Smith. Adams Run (D. E. R.). In Mississippi this species generally nests in the twigs of white ash.

95. *Camponotus* (*Colobopsis*) *pylartes* subsp. *fraxinicola* M. R. Smith. Charleston (D. L.); Williamston (D. E. R.)

96. *Camponotus* (*Colobopsis*) *obliquus* M. R. Smith. Spartanburg (D. E. R.).

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF OCTOBER 3, 1933

A regular meeting of the New York Entomological Society was held on October 3, 1933, at the American Museum of Natural History. President Ernest L. Bell presided, with twenty members and twelve visitors present.

Mr. Curran proposed Mr. W. S. Regan of 125 Cooper Avenue, Upper Montclair, New Jersey, for membership in the Society.

The meeting was then open to the members for discussion of their experiences while collecting during the summer.

Dr. Lutz exhibited a female Phengodes which he had taken at Interstate Park. When seen in the dark, luminescences appeared between the sclerites of the body which made the larva look like a string of green lights. This luminescence is due to the amount of water present in the insect.

Mr. Gertsch said that he had been well rewarded by collecting in Norwalk, Connecticut, and also on a three weeks' trip through the Shenandoah Valley and the Great Smoky Mountains where he had been very fortunate in procuring specimens of *Hypochalus thorelli.*

Mr. Bromley related some of his experiences in the Lower Rio Grande Valley of Texas where he was engaged in working with citrus fumigation in this new and rapidly growing citrus area. The hurricane of September 4 and 5 blew off the fruit in the Eastern Valley so that there was a crop of 1,500 instead of the anticipated 12,000 carloads of fruit. The majority of insects in this region, Mr. Bromley said, were noteworthy more for the discomfort than for the destruction they caused. Mr. Bromley witnessed the large migration of *Libythea backmannia* to the northeast, a migration which continued for more than a week. One of the most annoying insects which he encountered was the cicada, *Queseda gigis,* whose loud song prevailed all through the night thereby destroying sleep. The Pomerine ants found in dead mesquite trees are more venomous than the honeybee. A Nectarina wasp which builds a nest of paper, similar in construction to the wax nest of the white-faced hornet, was observed. The honey in the nest is good although strong. Mr. Bromley observed few grasshoppers in the Rio Grande Valley. The hurricane caused the disappearance of butterflies and cicadas.

Mr. Curran said that Mr. Bell and Mrs. Bell had done his summer collecting. He then exhibited the cancellation mark on the stamp of a letter from Venezuela. This cancellation was a mosquito, one wing of which was that of a Sciara, but the other of some unknown fly! In spite of this error, the cancellation was a symbol showing the importance of flies in this South American country.

Mr. Davis stated that while at Shark River Inlet, New Jersey, June 28, 1933, with Mr. Howard Cleaves, he had visited a colony of bees, *Anthrophora* *abrupta* Say, situated in a nearby vertical cliff of rather hard soil. Some of the entrances were protected by fragile tubes sometimes two or three inches in length constructed of material brought from the interior of the nest. The tubes were generally incomplete and exhibited a narrow opening along the upper surface through which the progress of the bee in entering the nest could be easily followed. The tubes, therefore, even when present, offered but an incomplete protection to the nest, and as more than half of the nests were without them, they really did not appear to be of much importance. It was suggested that as in the case of some ant-mounds, they were merely the result of nest excavation. The photograph of the colony together with specimens of the bees determined by Mr. Herbert F. Schwarz of the American Museum of Natural History, and a book illustrating a colony of European *Anthrophora* were shown.

Dr. Horsfall said that he had spent his summer helping farmers remove spray residue from apples.

Mr. James M. Leonard exhibited a series of twelve photographs of a praying mantis depositing her egg capsule. The photos were taken at 10 minute intervals during the two hours required for the process. This most interesting and unusual group of photographs showed the form of the egg mass at each stage and the changes that took place in the insect and egg mass during the process.

Mr. Moennich remarked on the superior advantages of baiting. With this method he had obtained forty-two specimens of *Glischrochilus obtusus* at Alpine, New Jersey, by using a bait of diluted maple syrup.

Mr. Mutchler stated that he and Mr. Leng had spent the better part of the summer working to complete the Second Supplement to the Leng Catalogue of Coleoptera North of Mexico which is to be published by Mr. Sherman within the next few months.

Species of Dermestes had been put to good use by Dr. Ruckes during the summer. He had employed them to clean the meat particles from vertebrate skulls.

Mr. Safro mentioned the red legged ham beetle, which he had found in a shipment of copra this summer.

Mr. Sherman said that he and his family had had the pleasure of a visit from Mr. Fred Hadden and his charming wife while on a vacation from the Hawaiian Islands.

Mr. Wurster described some of his experiences in feeding Paratenodera females. It seems that the praying mantis will snatch at any moving object which it can overcome, and will then proceed to devour it no matter how highly seasoned with salt, pepper or Worcestershire sauce.

Mr. W. S. Regan remarked that he had taught Mr. Bromley how to collect insects at the Massachusetts State College ten years ago. Since that time Mr. Regan has been working on bait-trapping for codling moths in an effort to establish the relation between the extermination of the moth and the worm activity in the fruit. He uses a bait of high grade molasses with yeast to start fermentation.

Mr. Volck of California expressed his pleasure in being present at a meeting of the Society.

There followed a discussion of the habits of the praying mantis by Mr. Wurster, Mr. Bromley and Dr. Ruckes.

ELIZABETH S. ENGLEHARDT, *Secretary.*

MEETING OF OCTOBER 17, 1933

A regular meeting of the Society was held on October 17, 1933 at the American Museum of Natural History. President Ernest L. Bell presided with twenty-four members and twenty visitors present.

Mr. Hall gave his report as Treasurer for October 1, 1933. He reported $1,647.88 on hand as of Jan. 1, 1933, and $1,139.33 on hand as of Oct. 1, 1933.

Mr. W. S. Regan was elected an active member of the Society.

Mr. Curran made recommendation to incorporate in the By-Laws the statement that any application for membership in the Society must be accompanied by one year's dues. On motion, this matter was referred to the Executive Committee.

It was voted that the secretary should inform those members of the Society in arrears for more than two years on Jan. 1, 1934, that they would be suspended from membership.

It was voted to omit the meeting scheduled for the first Tuesday of November.

The program of the evening "A Symposium on Faunal Zones in North America" was then opened by Dr. Lutz. Dr. Lutz gave a review of his paper on the geographic average of a species, published in the Museum Bulletin for 1922. In this paper, Dr. Lutz develops a method for showing geographical distribution of any fauna, on a mathematical basis. This method is based on the life zones of Allen who made a primary division along the one hundredth meridian and then determined his life zones on the humidity basis.

Dr. Melander, the next speaker in the symposium, spoke on "The Life Zones of the North West." From his observations in the state of Washington, Dr. Melander concludes that altitude and climate are not the only factors responsible for the various life zones of the state. He found that it is the differences of rainfall in the same altitude, longitude and latitude that make for the differences in fauna and flora. Dr. Melander then showed some interesting slides of the type of country typical of the various zones.

Dr. Ruckes then spoke on the "Upper Sonoran and Lower Sonoran Zones of New Mexico." Dr. Ruckes stressed the importance of rainfall in creating the life zones of the state of New Mexico which has its dry season during the winter and its wet season during the summer months. Dr. Ruckes concluded his talk with slides showing the faunal areas of New Mexico.

Dr. Creighton brought the program to its conclusion with a discussion of the life zones in the east and southeast of the United States. From the standpoint of floral distribution, the life zones are distinct in this area. Dr. Creighton found, however, that the distribution of the various species of ants in this area invalidates the life zone theory for faunal distribution. This is due in part to the results of glaciation; and in part to the influx of numerous species from the Sonoran Zone, the Alleghenian Zone and the Tropical Zone.

After a general discussion on the somewhat controversial content of Dr. Creighton's paper, the meeting was adjourned.

ELIZABETH S. ENGLEHARDT, *Secretary.*

MEETING OF NOVEMBER 21, 1933

A regular meeting of the N. Y. Entomological Society was held in the American Museum of Natural History on November 21, 1933. President E. L. Bell presided with eighteen members and eighteen visitors present.

The members were informed of the death of Professor C. F. Curtis Riley who died in July, 1933.

It was moved and seconded that the resignation of W. J. Chamberlin be accepted with extreme regret and that the secretary notify him to this effect.

The speaker of the evening, Mr. George P. Engelhardt, then gave a very interesting address on ''Biological Explorations in the North and South West.'' Using the maps of the region, Mr. Engelhardt described his field investigations in Oregon, Washington, Idaho, and in the southern and eastern parts of Utah. The Stein Mountains and the arid regions surrounding this range in southeastern Oregon were the first objectives. Mr. B. G. Thompson, Mr. John Davis, and Mr. Kwan Lun Wong, all of Corvallis, were Mr. Engelhardt's companions on this first trip by motor. The mountains proved to be inaccessible because of snow but the collecting on the western slope in the canyon of the Donner and Blitzen River was very good. Mr. Engelhardt was impressed with the contrasts of scenery that may be seen in one day's travel in the west. One rides through ''bleak, barren country in the morning, snow-covered mountain passes at noon, and vast, shady forests and verdure-clad valleys before sunset.'' In Washington, Mr. Engelhardt travelled with Dr. Melville H. Hatch of Seattle, and also with Mr. Joseph Wilcox, specialist on robber flies, and Mr. S. E. Crumb, authority on cut worms, both of Puyallup. In a trip over the Cascade Mountains, new life histories of clear wing moths and captures of many other insects rewarded their efforts, particularly at White Swan, near Kakima, and also on their return through the Naches Pass.

Mr. Engelhardt explored the Snake River Canyon with Mr. J. F. Gates Clarke of the the Department of Zoology at the State College in Pullman. Here over-cultivation has obliterated the original prairie flora just as on the mountain slopes in the west, over-grazing has obliterated the native vegetation.

Mr. E. W. Davis, of the U. S. Bureau of Entomology, was Mr. Engelhardt's guide and companion on a trip through southern Utah. Mr. Davis is in charge of the control of sugar-beet insects and is constantly checking up on the distribution of the small leafhopper, *Eutettix tenella,* by which the virus disease known as curly-top is transmitted to the sugar-beet plants. In Utah, ''splendid highways are fast giving access to colorful canyons, natural bridges and surprising monuments, hitherto hidden in mountains and deserts.'' Dr. Vasco Tanner, of Brigham Young University, was host to Mr. Engelhardt at the University camp at Timpanogus Mountain in the Wasatch Mountains.

It was found that ''deserts in midsummer are poor places for collecting, but occasionally one does capture a prize.'' Mr. Engelhardt summed up the biological aspects of his trip, as follows:—

''For studies of the distribution of species, their variations and geographical races, the Aegeriidæ or clear-wing moths offer opportunities equaled by few other families of insects. Their larval habits, with very few exceptions, are limited to one or a few closely related food plants and to some particular part of the plant. Investigations of this kind have shown that species heretofore considered as distinct are in reality only forms or geographical races of one species, whereas others, which have been united because of similarity in appearance are in reality widely separated biologically.''

Mr. Engelhardt illustrated, on a map, the willow and poplar borer *Paranthoene dolli*, arranged to show its various geographical races as they have become established on the North American Continent, differing widely in colors, but unseparable because of structural characters.

Another illustration, similarly arranged, showed the North American clematis root borer of the genus *Alcathœ*, which from two species, one in the east and another in the west, have now been increased to four species—one in the east and three in the west—all exhibiting great similarity in color patterns, yet divisible by definite structural characters.

Mr. Engelhardt also exhibited a box of some fifty specimens of the Pacific Coast wild gourd borer, *Melithis gloriosa*, one of the largest and most beautiful of the North American clear-wing moths. In conclusion, Mr. Engelhardt said that the season of 1933 would stand out as one of the most successful ones for him in many years and that he had never been privileged to travel with more congenial and more helpful companions.

E. S. ENGLEHARDT, *Secretary*.

MEETING OF DECEMBER 5, 1933

A regular meeting of the Society was held on December 5, 1933, at the American Museum of Natural History; President Ernest L. Bell in the chair with twenty-one members and nine visitors present.

The Executive Committee presented its report regarding an amendment to the By-Laws of the Society relative to applications for membership in the Society being accompanied by dues for one year in advance. The Executive committee recommended, for action by the Society: that the first sentence of Article XIV, now reading ''All candidates for membership must be proposed by an active member at a regular meeting'' be amended by adding to that sentence the following words: ''and all applications for membership must be accompanied by dues as provided in Article XV.''

On motion of Dr. Curran the following clause was added to the change in Article XIV as recommended by the Executive Committee: "and all applications received on or after November 1 shall be accompanied by dues for the following year."

Mr. Curran moved that because of the cost of publishing the JOURNAL the price for back numbers should be increased from two dollars to three dollars a volume and that the price for each quarterly issue should be seventy-five cents. The motion was seconded and carried.

Miss Irene D. Dobroscky then gave a very interesting paper on "Collecting Parasites in the Philippines," an abstract of which follows.

ELIZABETH S. ENGELHARDT, *Secretary.*

COLLECTING PARASITES IN THE PHILIPPINES

IRENE D. DOBROSCKY

The importation of parasitic insects into the Hawaiian Islands was started in the last century and has been most successful both biologically and commercially. The two main crops of the Islands are sugar-cane and pineapples. These are grown year after year, on the same ground, in areas covering many square miles. As a result of this concentrated and intensive culture, the insects pests of these crops find conditions ideal for rapid spread and multiplication. But this also holds true for the parasites of these pests, therefore, biological control is very effective, as well as very economical in the long run.

In 1930 the Experiment Station of the Hawaiian Pineapple Canners' Association discovered that the pineapples were suffering from a virus disease which was being carried from plant to plant by the onion thrips, *Thrips tabaci.* Dr. Chapman, the director of the Station, decided to import parasites to control this pest. There are on record only about a half dozen cases of parasites bred from thrips. Fortunately there are two records of parasitism of the onion thrips. In 1911 Russell reported that *Thripoctenus russelli* was a parasite of the bean thrips, *Hercothrips fasciatus,* of *Thrips tritici,* and *Thrips tabaci.* This parasite was imported from California to Hawaii but it was not possible to make it parasitize the onion thrips there. In 1923 there was a report from Java of the parasitism of *Thrips tabaci* by *Thripoctenus bruei.*

On the strength of this report from Java, it was decided to hunt for the parasite in the Philippines. The writer was sent there and landed in Manila on May 19, 1931. Headquarters were established at the Bureau of Science in Manila, and later at the Agricultural College which is 44 miles south of Manila. A parasite was found on a thrips inhabiting the bean plant. This thrips was identified later by Moulton as *Taeniothrips longistylus* and the parasite was described as a new species, *Thripoctenus vinctus,* by Gahan. The life histories of both these insects were worked out in the course of breeding the parasites for shipment to Hawaii. The most serious problem encountered was that of shipping. The pupal stage of the parasite was the only stage in which it could be shipped. This period lasted for 12 days in the Philippines. The trip from the Philippines to Hawaii took 19 days. After several unsuccessful trials of shipping the pupæ, a half-way station was made in Kobe, Japan, which is exactly 12 days' journey from Manila. This arrangement proved satisfactory. The work had to be discontinued suddenly as a result of the serious financial condition of the pineapple industry. A final shipment was brought to Honolulu under the personal supervision of the writer, with the aid of Wardian cages brought on shipboard by a Japanese entomologist at Kobe. The parasite was not found to attack the onion thrips. Specimens were liberated near pineapple fields in the hope that they would find suitable hosts.

MEETING OF DECEMBER 19, 1933

A regular meeting of the Society was held on December 19, 1933, in the American Museum of Natural History. President Ernest L. Bell presided with twenty-four members and twenty-five visitors present.

The Amendment to Article XIV of the By-Laws of the Society was adopted as read. With this amendment Article XIV now reads:

> " All candidates for membership must be proposed by an active "member at a regular meeting and all applications for membership "must be accompanied by dues as provided in Article XV, and all "applications received on or after November 1 shall be accompanied "by dues for the following year. They shall be elected at the follow-"ing regular meeting by an affirmative vote of two-thirds of the "members present, or by ballot if demanded, in which case three "negative votes shall exclude the candidate from membership."

Mr. Curran moved to reconsider and cancel the motion made at the last meeting, which motion having been passed concerned the raising of the selling price of back numbers of the JOURNAL. The current motion was then duly seconded and passed.

President Bell announced that the Nominating Committee would consist of Mr. Curran, Mr. Safro and Mr. Davis.

Dr. J. M. Walter opened the program of the evening on the "Dutch Elm Disease" with a paper entitled "Concerning the Disease and the Organism." The symptoms of the disease are: a sudden wilting at the top of the branches and discoloration of the water vessels. It is now conceded that the disease is caused by the yeast-like fungus, *Graphium ulmi,* which is easily recognized in culture by the budding head of the spores. The disease is a true wilt affecting the water system of the plants. It is estimated that the disease covers approximately 1,500 square miles in New Jersey, New York and Connecticut. In Orange and East Orange, where the infestation is known to be greatest, it does not affect one per cent of the total population of elms. To find all infected trees would be an impossible task but as trees are found they are removed and destroyed before the new growing season begins. The pathological and entomological aspects of the disease show that it must be checked within the next season of 1934 in order to prevent damage to the elms of New England.

Because of governmental regulations Dr. W. D. Buchanan was unable to give his paper on the "Relation of Insects to Its Spread" as the second part of this program. Instead, Dr. Buchanan spoke in a general way on the "Relationship between Insects and Plant Diseases." Dr. Buchanan said that the fields of entomology and plant pathology are now becoming united. He then spoke on the relation of thrips to the spread of the bacterial diseases of beans.

Following considerable discussion of these two papers, the meeting was adjourned.

ELIZABETH S. ENGELHARDT, *Secretary.*

MEETING OF JANUARY 2, 1934

The annual meeting of the Society was held on January 2, 1934, in the American Museum of Natural History. President Ernest L. Bell presided with nineteen members and fourteen visitors present.

The Nominating Committee presented its report as follows:

President: A. L. Melander
Vice-President: Herbert F. Schwarz
Secretary: Elizabeth S. Engelhardt
Treasurer: Gaylord C. Hall
Librarian: Frank E. Watson
Curator: A. J. Mutchler

Executive Committee:

Wm. T. Davis
F. E. Lutz
E. L. Bell
Herbert Ruckes
Henry Bird

Publication Committee:

H. B. Weiss
C. W. Leng
J. D. Sherman, Jr.
C. E. Olsen

The report was accepted as read and on motion the nominations were closed.

On motion, the By-Laws were suspended and the secretary instructed to cast an affirmative ballot for the election of the officers and committees as presented in the above report.

In the absence of Dr. Melander, Mr. Schwarz took the chair.

On behalf of the society, Dr. Ruckes expressed its deep gratitude to Mr. Bell for his untiring efforts during his term of office as President.

Mr. Davis stated that the tropical cockroach from a fruit store, received last April, when it was quite small, matured during the latter part of the summer and died on December 9, 1933. It was ill for several days and finally could move but feebly the tarsal joints on one of its forelegs. The glossy brown specimen was shown, the tegmina expanding two and seven-eighths inches. The species is known as *Nyctobora noctivaga* Rehn and is figured and described as being introduced with bananas and other tropical fruit both by Dr. Blatchley in "Orthoptera of Northeastern America," page 91, and by Prof. Morse in "Orthoptera of New England," page 319.

Dr. Curran opened the discussion of the topic "Faunal Regions in North America." Dr. Curran spoke on the Life Zones of Canada. The Arctic Zone of insects is limited to that area over which salt winds blow. Distribution in this zone is determined by temperature. There must still be salt in the air for the Hudsonian Zone while the Canadian Zone is inland and not touched by the salt winds. In the case of the latter zone it is difficult to explain the similarities in the desert fauna of British Columbia and that of Arizona. In closing, Dr. Curran said that it is difficult to classify into zones those insects living along indefinite edges of the various zones.

Dr. Ruckes spoke of the species which have become isolated in Central Asia and the Gobi Desert. Here humidity is the primary condition.

Dr. Hatt, speaking as a mammalogist, said that mammals do not follow the plant zones closely and that it is necessary therefore to avoid the use of Life Zones in determining and discussing mammal distribution.

Prof. J. C. Bradley, of Cornell University, expressed his interest in the discussion and his pleasure in being present.

Dr. A. E. Brower, of Bar Harbor, Maine, expressed pleasure in being present at a meeting of the Society and said that in his opinion faunal regions could be used in a general way but too much emphasis must not be put on them.

Dr. Curran observed that habitat itself will limit a species within the zone.

There followed a general discussion by Messrs. Engelhardt, Davis, Bell, and Gertsch.

ELIZABETH S. ENGELHARDT, *Secretary.*

MEETING OF JANUARY 16, 1934

A regular meeting of the Society was held on January 16, 1934, in the American Museum of Natural History. President A. L. Melander presided. There were twenty-five members and thirty-seven visitors present.

The following committees for 1933 were reappointed for 1934:

Program Committee:

C. H. Curran, H. B. Weiss, J. L. Horsfall

Auditing Committee:

E. I. Huntington, E. K. Schwarz, E. R. P. Janvrin

Field Committee:

A. L. Nicolay, Herman Moennich

Delegate to the N. Y. Academy of Sciences:
Wm. T. Davis

Mr. Hall read his annual report as Treasurer. The Society had on hand on Jan. 1, 1934, $1,047.87, as against $1,647.88, on Jan. 1, 1933. The receipts for the year 1933 were $1,289.30, and the expenditures were $1,889.31. The Society has 104 Active Members, eight Life Members and one Honorary Member.

The Treasurer's Report, audited by the Auditing Committee, was accepted as read.

Mr. Schwarz opened the program of the evening on "Panama and Northern Colombia." He spoke of his experiences in collecting bees on Barro Colorado Island in Gatun Lake of the Panama Canal. Because of the few natural clearings, collecting is difficult and about seventy species of bees have been found thus far on the island; one third of these are social bees, Meliponidæ, and the rest solitary bees. Mr. Schwarz obtained a large series of nocturnal bees of the genus Megalopta. The study of the flora visited by these nocturnal bees is very interesting. Mr. Schwarz spoke of the essential differences between the nest-building habits of the stingless bees, Meliponidæ, found in the tropics, and those of our own honey bee, Apidæ, of the Old World.

Mr. Huntington then said a few words in regard to collecting Rhopalocera in the tropics. He has found that the wet season and the presence of attractive flowering shrubs were both necessary for successful butterfly collecting in Panama and in Northern Colombia. Mr. Huntington then showed a series of very interesting slides, and movies of the country of Panama and Northern Colombia.

ELIZABETH S. ENGELHARDT, *Secretary.*

The
New York Entomological Society

Organized June 29, 1892—Incorporated June 7, 1893

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Columbus Avenue.

Annual dues for Active Members, $3.00; including subscription to the Journal, $4.50.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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Vice-President, H. F. SCHWARZ........American Museum of Natural History

Secretary, MRS. G. B. ENGELHARDT........27 Commerce St., New York, N. Y.

Treasurer, G. C. HALL........119 E. 19th St., New York, N. Y.

Librarian, F. E. WATSON........American Museum of Natural History

Curator, A. J. MUTCHLER........American Museum of Natural History

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DR. H. RUCKES — HENRY BIRD

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HARRY B. WEISS — CHARLES W. LENG — JOHN D. SHERMAN, JR.

C. E. OLSEN

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A. S. NICOLAY — HERMAN MOENNICH

DELEGATE TO THE N. Y. ACADEMY OF SCIENCES

WILLIAM T. DAVIS

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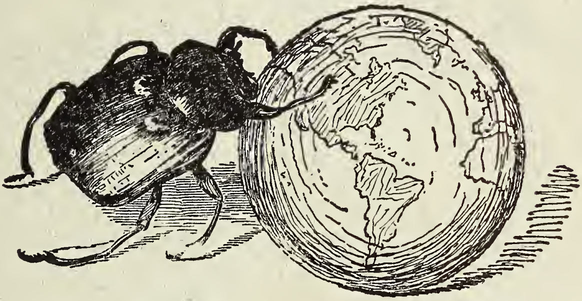

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CLASSIFYING SYMBOLS FOR INSECTS

BY E. P. FELT
DIRECTOR AND CHIEF ENTOMOLOGIST,
BARTLETT TREE RESEARCH LABORATORIES, STAMFORD, CONN.

All dealing with insects of various kinds have experienced difficulties in keeping related forms together, and this is particularly true in large general collections, where not only adult insects, but the immature stages and also the work of insects must be preserved for easy reference. The specialist may easily recall the sequence of orders and certain families, though this is not the case with the general worker and particularly the beginner. The following system was started by the writer in the State Collection of Insects at the New York State Museum as an aid to ready location of material and it is published since it may prove of value to others.

This plan was worked out first to demonstrate the possibilities of a four-letter combination in quickly separating the multitudinous insect genera to families. This is not an attempt to modify the arrangement of orders or to change the grouping of families. A system must be followed in any case, and it is too much to expect that all entomologists would agree on one grouping. Note that these four-letter combinations are by no means all occupied, permitting insertions with no modification of the system in many places. They can be utilized with any grouping if they are worth while. We are more concerned with the principle and possibilities of a systematic arrangement through a combination of letters than in urging one taxonomic grouping.

It is essential in large collections to find the specimens, and until they are found not much can be done in determining natural affinities. We should have a place for everything and a ready means of placing it.

These symbols are the extension of a system of code prefixes originally proposed by Dr. S. C. Bishop, formerly State Zoölogist of New York, and the writer as one means of putting zoölogical nomenclature upon a more logical basis. Its application to insects indicates the possibilities in other groups. An outline of the plan as first conceived is given in the American Naturalist 60: 275–281, 1926.

The following practices have been observed in the assignment of symbols to insects. The first letter, I, designates the class; the second letter in the important orders, such as Coleoptera, Diptera, Hemiptera, Hymenoptera, Lepidoptera and Orthoptera, indicates the order, and in these cases the initial letter in current or older ordinal names has been retained on account of its mnemonic value. It is impractical to continue this, desirable though it may be, in the minor orders, largely on account of the number recognized and the possibility of there being more added, consequently in the small orders the second and the third letters are used for ordinal distinction and the combination of the third and fourth letters indicates the family. In the case of the larger orders, the third and fourth letters differentiate families, the assignments being in alphabetical order to accord with some recognized taxonomic system and so adjusted that the place in the alphabet will indicate the approximate position of the family in the order. An attempt has been made to use only pronounceable and moderately euphonious combinations. In the accompanying reproduction of a label, the symbol ICAC locates the box by the mere process of alphabetic arrangement, the family name is also given and below the genera actually represented in the box. It is all on the outside and easily read by anyone, specialist or not.

ICAC

Carabidæ

Abacidus
Anaferonia

Cryobius
Cylindrocharis
Euferonia
Eumolops
Evarthrus
Gastrellarius
Leptoferonia
Lophoglossus
Lyperopherus
Monoferonia
Omaseus
Pœcilus
Pterostichus
Refonia

Fig. 1. Label on box of insects illustrating the application of classifying symbols.

CLASSIFYING SYMBOLS FOR ORDERS

Iba Thysanura, Bristle-tails
Ibe Collembola, Spring-tails
Io Orthoptera, Grasshoppers and allies
Ifa Zoraptera, No common name
Ife Isoptera, Termites or ''White ants''
Ifi Neuroptera, Dobson fly, aphis-lions, etc.
Ifo Ephemerida, May flies
Iga Odonata, Dragon flies
Ige Plecoptera, Stone-flies
Igo Corrodentia, Psocids
Igu Mallophaga, Bird lice
Ima Embiidina, Embiids
Ime Thysanoptera, Thrips
Imo Anoplura, Body lice
Ira-Irc Homoptera, Cicadas, leafhoppers, aphids, scale insects
Ird-Irw Heteroptera, Bugs
In Dermaptera, Earwigs
Ic Coleoptera, Beetles
Isa Strepsiptera, Twisted winged insects
Ise Mecoptera, Scorpion flies
Iso Trichoptera, Caddice flies
Il Lepidoptera, Butterflies and moths
Id Diptera, Two-winged flies

Ix Siphonaptera, Fleas
Ih Hymenoptera, Bees, wasps, ants, etc.

CLASSIFYING SYMBOLS FOR ORDERS AND FAMILIES

Iba THYSANURA, Bristle-tails

Ibad Machilidæ, Machilids
Ibam Lepismidæ, Bristle-tails
Iban Campodeidæ, Campodids
Ibat Japygidæ, Japygids

Ibe COLLEMBOLA, Spring-tails

Ibed Poduridæ, Snow-fleas
Ibeg Entomobryidæ
Iber Sminthuridæ, Garden fleas

Io ORTHOPTERA, Grasshoppers and Allies

Ioba Tettigoniidæ (Locustidæ authors), Katy-dids
Ioha Gryllidæ (Achetidæ), Crickets
Iome Locustidæ (Acrididæ), Grasshoppers
Iopa Phasmidæ, Walking-sticks
Iosa Mantidæ, Mantids
Iota Blattidæ, Roaches
Iova Grylloblattidæ

Ifa ZORAPTERA

Ifab Zorotypidæ

Ife ISOPTERA, Termites or "White Ants"

Ifed Kalotermitidæ
Ifen Termitidæ

Ifi NEUROPTERA, Dobson

Ifib Sialidæ, Sialids
Ific Raphidiidæ, Snake-flies
Ifid Mantispidæ, Mantoid neuroptera
Ifig Sisyridæ, Spongilla flies
Ifil Sympherobiidæ, Sympherobiids
Ifim Hemerobiidæ, Hemerobiids
Ifin Dilaridæ, Dilarids
Ifip Polystœchotidæ, Giant lace wings
Ifir Chrysopidæ, Lace wings, aphis lions
Ifit Myrmelionidæ, Ant lions
Ifix Ascalaphidæ, Ascalaphids
Ifiz Coniopterygidæ, Mealy-winged neuroptera

Ifo EPHEMERIDA (Plectoptera), May-flies

Ifod Ephemeridæ, May-flies

Iga ODONATA, Dragon flies

Igad Aeschnidæ, Aeschnids
Igag Libellulidæ, Skimmers
Igak Agrionidæ, Damsel flies
Igas Cœnagrionidæ, Stalked-winged damsel flies

Ige PLECOPTERA, Stone-flies

Igea Pteronarcidæ
Iged Perlidæ
Igen Nemouridæ
Igeo Capniidæ

Igo CORRODENTIA, Psocids

Igoc Psocidæ, Psocids
Igon Atropidæ, Book lice

Igu MALLOPHAGA, Bird lice

Igud Trichodectidæ
Igul Philopteridæ
Igun Gyropidæ
Igus Liotheidæ

Ima EMBIIDINA, Embiids

Imab Embiididæ

Ime THYSANOPTERA (Physopoda), Thrips

Imea Aeolothripidæ
Imec Hemithripidæ
Imed Heterothripidæ
Imeg Thripidæ
Imeh Ceratothripidæ
Imek Merothripidæ
Imel Pygothripidæ
Imem Ecacanthothripidæ
Imep Eupathithripidæ
Imer Phlœothripidæ
Imet Hystricothripidæ
Imew Chirothripoididæ
Imez Urothripidæ

Imo ANOPLURA, Body lice

Imob Hæmatomyzidæ
Imod Pediculidæ, Body lice
Imon Hæmatopinidæ, Animal lice
Imor Echinophthriidæ

Ira-Irc, HOMOPTERA, Cicadas, Leaf-hoppers, Aphids, Scale Insects

Irab Fulgoridæ, Lantern flies
Iraf Cicadellidæ (Jassidæ), Leaf-hoppers
Iran Membracidæ, Tree-hoppers
Irat Cercopidæ, Spittle insects
Iraw Cicadidæ, Cicadas
Irba Psyllidæ (Chermidæ), Jumping plant lice
Irbi Aphididæ, Plant lice
Irbu Phylloxeridæ, Phylloxeras
Irca Aleyrodidæ, White flies
Irco Coccidæ, Scale insects

Ird-Irw, HETEROPTERA, Bugs

Irda Corixidæ, Water-boatmen
Irdi Ochteridæ, Ochterids
Irdo Gelastocoridæ, Toad-bugs
Irfe Belostomatidæ, Giant water-bugs
Irfo Nepidæ, Water-scorpions
Irfu Naucoridæ, Creeping water-bugs
Irge Notonectidæ, Back-swimmers
Irgo Saldidæ, Shore-bugs
Irhe Veliidæ, Water-striders
Irho Gerridæ (Hydrobatidæ), Water-striders
Irke Hydrometridæ, Water-measurers
Irko Schizopteridæ, Schizopterids
Irla Dipsocoridæ, Dipsocorids
Irli Isometopidæ, Isometopids
Irma Miridæ (Capsidæ), Leaf bugs
Irmi Termatophylidæ, Termatophilids
Irna Anthocoridæ, Flower bugs
Irni Cimicidæ (Acanthiidæ), Bedbugs
Irno Nabidæ, Nabids
Irpa Mesoveliidæ, Mesoveliids
Irpi Hebridæ, Hebrids
Irpu Reduviidæ, Assassin-bugs
Irra Phymatidæ, Ambush-bugs

Ird-Irw, HETEROPTERA

Irri Piesmidæ, Piesmids
Irru Enicocephalidæ, Enicocephalids
Irsa Tingidæ, Lace-bugs
Irsi Pyrrhocoridæ, Cotton-stainers
Irsu Lygæidæ, Chinch-bugs
Irta Neididæ, Stilt-bugs

Irti Aradidæ, Flat-bugs
Irtu Coreidæ, Squash-bugs
Irva Alydidæ, Alydids
Irvi Corizidæ, Corizids
Irvu Pentatomidæ, Stink-bugs
Irwa Cydnidæ, Negro-bugs
Irwo Scutellaridæ, Shield-back bugs

In DERMAPTERA (Euplexoptera), Earwigs

Inab Arixeniidæ
Inca Hemimeridæ
Infe Pygidicranidæ
Inhe Labiduridæ
Inko Apachyidæ
Inme Labiidæ
Inpa Chelisochidæ
Inso Forficulidæ

Ic COLEOPTERA, Beetles

Icab Cicindelidæ, Tiger beetles
Icac Carabidæ, Ground beetles
Icad Amphizoidæ
Icae Omophronidæ
Icaf Haliplidæ, Crawling water-beetles
Icag Dytiscidæ, Predacious diving beetles
Icah Gyrinidæ, Whirligig-beetles
Icai Hydrophilidæ, Water-scavenger beetles
Icak Platypsyllidæ, Beaver parasite
Ical Brathinidæ
Icam Leptinidæ, Mammal-nest beetles
Ican Silphidæ, Carrion beetles
Icap Clambidæ
Icar Scydmænidæ
Icas Orthoperidæ, Fringe-winged beetles
Icat Staphylinidæ, Rove beetles
Icav Pselaphidæ
Icaw Clavigeridæ
Icax Ptiliidæ
Icaz Scaphidiidæ
Icba Sphæritidæ
Icbe Sphæriidæ
Icbi Histeridæ, Hister beetles
Icbo Lycidæ
Icbu Lampyridæ, Fireflies
Icca Phengodidæ
Icce Cantharidæ, Soldier beetles

Icci Melyridæ
Icco Cleridæ, Checkered beetles
Iccu Corynetidæ
Icda Telegeusidæ
Icde Lymexylidæ, Ship-timber beetles
Icdi Micromalthidæ
Icdo Cupesidæ
Icdu Cephaloidæ
Icfa Oedemeridæ
Icfe Mordellidæ
Icfi Rhipiphoridæ
Icfo Meloidæ, Blister beetles
Icfu Eurystethidæ
Icga Othniidæ
Icge Pythidæ, Pythid bark beetles
Icgi Pyrochroidæ
Icgo Pedilidæ
Icgu Anthicidæ
Icha Euglenidæ
Iche Cerophytidæ
Ichi Cebrionidæ
Icho Plastoceridæ
Ichu Rhipiceridæ
Icka Elateridæ, Snapping beetles
Icke Melasiidæ
Icki Throscidæ
Icko Buprestidæ, Metallic wood borers
Icku Psephenidæ
Icla Dryopidæ
Icle Helmidæ
Icli Heteroceridæ, Mud beetles
Iclo Georyssidæ
Iclu Dascillidæ
Icma Helodidæ
Icme Chelonariidæ
Icmi Dermestidæ, Dermestids
Icmo Byrrhidæ, Pill beetles
Icmu Nosodendridæ
Icna Rhysodidæ
Icne Ostomidæ
Icni Nitidulidæ, Sap beetles
Icno Rhizophagidæ
Icnu Monotomidæ
Icpa Cucujidæ, Cucujids
Icpe Erotylidæ, Erotylids
Icpi Derodontidæ

Icpo Cryptophagidæ
Icpu Byturidæ
Icra Mycetophagidæ
Icre Colydiidæ
Icri Murmidiidæ
Icro Monœdidæ
Icru Lathridiidæ
Icsa Mycetæidæ
Icse Endomychidæ
Icsi Phalacridæ
Icso Coccinellidæ, Lady beetles
Icsu Alleculidæ
Icta Tenebrionidæ, Darkling beetles
Icte Lagriidæ
Icti Monommidæ
Icto Melandryidæ
Ictu Ptinidæ, Drug-store beetles
Icva Anobiidæ
Icve Bostrichidæ, Powder-post beetles
Icvi Lyctidæ, Powder-post beetles
Icvo Sphindidæ
Icvu Cisidæ
Icwa Scarabæidæ, Lamellicorn beetles
Icwe Trogidæ, Skin beetles
Icwi Lucanidæ, Stag beetles
Icwo Passalidæ, Bess beetles
Icwu Cerambycidæ, Long-horned beetles
Icxa Chrysomelidæ, Leaf beetles
Icxe Mylabridæ, Seed weevils
Icxi Brentidæ, Primitive weevils
Icxo Belidæ, New York weevil
Icxu Platystomidæ, Fungous weevils
Icza Curculionidæ, Weevils
Icze Platypodidæ
Iczi Scolytidæ, Bark borers, Ambrosia beetles

Isa STREPSIPTERA, Twisted-winged Insects

Isac Mengeidæ
Isaf Mengenillidæ
Isag Myrmecolacidæ
Isal Stylopidæ
Isam Hylechthridæ
Isap Xenidæ
Isar Stichotrematidæ
Isat Diozoceridæ
Isaw Halictophagidæ
Isax Elenchidæ

Ise MECOPTERA, Scorpion Flies

Isec Choristidæ
Ised Nannochoristidæ
Isef Panorpidæ, Scorpion flies
Isel Bittacidæ
Isem Meropidæ
Isep Boreidæ

Iso TRICHOPTERA, Caddice-flies

Isob Rhyacophilidæ
Isoc Hydroptilidæ
Isod Hydropsychidæ
Isof Philopotamidæ
Isog Polycentropidæ
Isoh Psychomyidæ
Isol Phryganeidæ
Isom Molannidæ
Ison Leptoceridæ
Isop Odontoceridæ
Isor Calamoceratidæ
Isos Limnophilidæ
Isov Sericostomatidæ

Il LEPIDOPTERA, Moths and Butterflies

Ilab Micropterygidæ
Ilac Eriocraniidæ
Ilad Hepialidæ, Swifts
Ilaf Incurvariidæ
Ilah Nepticulidæ, Nepticulids
Ilak Cossidæ, Carpenter-moths
Ilam Pyromorphidæ, Smoky-moths
Ilap Dalceridæ
Ilat Megalopygidæ, Flannel-moths
Ilaw Eucleidæ (Cochlidiidæ, Limacodidæ), Slug-caterpillar-moths
Ilba Epipyropidæ
Ilbe Acrolophidæ
Ilbi Tineidæ, Tineids
Ilbu Psychidæ, Bag-worm moths
Ilce Tischeriidæ
Ilci Lyonetiidæ
Ilco Opostegidæ
Ilda Oinophilidæ
Ildi Gracilariidæ, Gracilarids
Ilfa Coleophoridæ (Haploptilidæ), Case-bearer moths
Ilfe Elachistidæ

Ilfi Heliozelidæ
Ilfo Douglasiidæ
Ilga Oecophoridæ
Ilge Ethmiidæ
Ilgo Stenomidæ
Ilha Gelechiidæ, Gelechiids
Ilhi Blastobasidæ
Ilho Cosmopterygidæ
Ilka Scythrididæ
Ilke Yponomeutidæ (Hyponomeutidæ)
Ilki Plutellidæ, Plutellids
Illa Glyphipterygidæ
Ille Heliodinidæ
Illo Aegeriidæ (Sesiidæ), Clear-winged moths
Ilma Olethreutidæ (Eucosmidæ)
Ilme Tortricidæ, Tortricids
Ilmo Phaloniidæ
Ilna Carposinidæ
Ilne Pyralididæ, Pyralids
Ilno Pterophoridæ, Plume-moths
Ilpa Orneodidæ, Many-plume moths
Ilpe Thyrididæ, Window-winged moths
Ilpo Hyblæidæ
Ilra Sphingidæ, Hawk moths or Sphinx moths
Ilre Geometridæ, Geometrids
Ilri Manidiidæ
Ilro Dioptidæ
Ilsa Notodontidæ, Prominents
Ilse Lymantriidæ, Tussock moths
Ilso Noctuidæ, Noctuids
Ilta Agaristidæ, Foresters
Ilte Pericopidæ
Ilto Arctiidæ, Arctiids
Ilva Euchromiidæ (Syntomidæ)
Ilve Eupterotidæ
Ilvi Epiplemidæ
Ilvo Thyatiridæ
Ilwa Drepanidæ, Drepanids
Ilwe Lacosomidæ
Ilwi Citheroniidæ, Royal moths
Ilwo Saturniidæ, Giant silk-worm moths
Ilxa Bombycidæ, Silk-worm moths
Ilxe Lasiocampidæ, Lasiocampids
Ilxo Megathymidæ, Giant skippers
Ilxu Hesperiidæ, Common skippers
Ilza Papilionidæ, Swallow-tails

Ilze Pieridæ, Pierids
Ilzi Nymphalidæ, Four-footed butterflies
Ilzo Riodinidæ, Metal-marks
Ilzu Lycænidæ, Gossamer-winged butterflies

Id DIPTERA, Two-winged Flies

Idab Tanyderidæ, Primitive crane-flies
Idac Ptychopteridæ, Phantom crane-flies
Idad Anisopidæ, False crane-flies
Idaf Tipulidæ, Crane-flies
Idah Dixidæ, Dixa midges
Idak Psychodidæ, Moth-like flies
Idam Chironomidæ, Midges
Idap Culicidæ, Mosquitoes
Idas Mycetophilidæ, Fungus-gnats
Idat Itonididæ (Cecidomyiidæ), Gall midges
Idaw Bibionidæ, March flies
Idaz Scatopsidæ, Scatopsids
Idba Simuliidæ, Black-flies
Idbe Blepharoceridæ, Net-winged midges
Idbi Thaumaleidæ, Solitary midges
Idbu Tabanidæ, Horse-flies
Idce Stratiomyiidæ, Soldier-flies
Idci Xylomyiidæ
Idco Xylophagidæ
Idcu Cœnomyiidæ
Idda Rhagionidæ, Snipe-flies
Iddi Nemestrinidæ, Tangle-veined flies
Iddo Acroceridæ, Small-headed flies
Idfa Bombyliidæ, Bee-flies
Idfe Therevidæ, Stiletto-flies
Idfi Scenopinidæ, Window-flies
Idfo Asilidæ, Robber-flies
Idfu Mydaidæ, Mydas-flies
Idga Apioceridæ
Idge Dolichopodidæ, Long-legged flies
Idgo Empididæ, Dance-flies
Idgu Lonchopteridæ, Spear-winged flies
Idha Phoridæ, Hump-backed flies
Idhi Platypezidæ, Flat-footed flies
Idho Pipunculidæ, Big-eyed flies
Idka Syrphidæ, Flower flies
Idke Conopidæ, Thick-headed flies
Idki Cordyluridæ, Dung-flies
Idko Clusiidæ
Idla Helomyzidæ

Idle Borboridæ, Borborids
Idlo Phycodromidæ
Idma Sciomyzidæ, Sciomyzids
Idme Sapromyzidæ, Sapromyzids
Idmo Lonchæidæ
Idna Ortalidæ, Ortalids
Idne Trypetidæ, Trypetids
Idno Tanypezidæ
Idpa Micropezidæ
Idpe Sepsidæ, Sepsids
Idpo Piophilidæ, Cheese skippers
Idra Psilidæ, Psilids
Idre Diopsidæ
Idri Canaceidæ
Idro Ephydridæ, Ephydrids
Idsa Chloropidæ, Grain-flies
Idse Asteiidæ
Idso Drosophilidæ, Pomace-flies
Idta Geomyzidæ, Geomyzids
Idte Agromyzidæ, Agromyzids
Idto Milichiidæ
Idva Ochthiphilidæ
Idve Anthomyiidæ, Anthomyiids
Idvo Gastrophilidæ, Horse-bot flies
Idwa Oestridæ, Warble flies
Idwi Phasiidæ
Idwo Megaprosopidæ
Idxa Calliphoridæ, Blow-flies
Idxi Sarcophagidæ, Flesh-flies
Idxo Tachinidæ, Tachinids
Idza Muscidæ, Muscid-flies
Idze Hippoboscidæ, Louse-flies
Idzi Streblidæ, Bat ticks in part
Idzo Nycteribiidæ, Bat ticks in part
Idzu Braulidæ, Bee lice

Ix SIPHONAPTERA, Fleas

Ixab Ischnopsyllidæ
Ixbo Leptopsyllidæ
Ixgo Ceratophillidæ
Ixna Pulicidæ
Ixsa Echidnophagidæ, Chigger flea

Ih HYMENOPTERA, Bees, Wasps, Ants, etc.

Ihab Xyelidæ, Xyelid sawflies
Ihad Pamphiliidæ, Web-spinning sawflies
Ihaf Siricidæ, Horn-tails

Ihak Xiphydriidæ, Xiphydriids
Ihan Cephidæ, Stem sawflies
Ihat Cimbicidæ, Cimbicids
Ihaw Tenthredinidæ, Typical sawflies
Ihba Argidæ, Argid sawfly
Ihbi Oryssidæ, Oryssids
Ihbu Braconidæ, Braconids
Ihca Ichneumonidæ, Ichneumon flies
Ihco Trigonalidæ, Trigonalids
Ihda Aulacidæ, Aulacids
Ihdi Stephanidæ, Stephanids
Ihdo Gasteruptionidæ, Gasteruptionids
Ihfe Roproniidæ, Roproniids
Ihfo Heloridæ, Helorids
Ihfu Vanhorniidæ, Vanhorniids
Ihge Belytidæ, Belytids
Ihgo Proctotrupidæ (Serphidæ), Proctotrupids
Ihke Ceraphronidæ, Ceraphronids
Ihko Scelionidæ, Scelionids
Ihla Platygasteridæ, Platygasterids
Ihli Pelecinidæ, Pelecinids
Ihma Cynipidæ, Gall wasps
Ihmi Chalcidæ, Chalcid flies
Ihmo Encyrtidæ
Ihmu Evaniidæ, Ensign-flies
Ihna Pompilidæ, Spider wasps
Ihni Embolemidæ, Embolemids
Ihno Cleptidæ, Cleptids
Ihnu Chrysidæ, Cuckoo wasps
Ihpa Anthoboscidæ, Anthoboscids
Iphi Sapygidæ, Sapygids
Ihpu Thynnidæ, Thynnids
Ihra Tiphiidæ, Tiphiids
Ihri Mutillidæ, Velvet ants
Ihru Scoliidæ, Scoliids
Ihsa Formicidæ, Ants
Ihsi Bethylidæ, Bethylids
Ihsu Rhopalosomidæ, Rhopalosomids
Ihta Vespidæ, Wasps
Ihti Ampulicidæ, Ampulicids
Ihtu Dryinidæ, Dryinids
Ihva Sphecidæ, Sphecoid wasps
Ihvi Prosopidæ, Split-tongue bees
Ihvu Andrenidæ, Andrenids
Ihwa Megachilidæ, Leaf-cutter bees
Ihwo Bombidæ (Bremidæ), Bumblebees
Ihxa Apidæ, Honey-bees

ALPHABETICAL LIST OF ORDERS AND FAMILIES WITH SYMBOLS

Acroceridæ, *Iddo*
Acrolophidæ, *Ilbe*
Aegeriidæ, *Illo*
Aeolothripidæ, *Imea*
Aeschnidæ, *Igad*
Agaristidæ, *Ilta*
Agrionidæ, *Igak*
Agromyzidæ, *Idte*
Aleyrodidæ, *Irca*
Alleculidæ, *Icsu*
Alydidæ, *Irva*
Amphizoidæ, *Icad*
Ampulicidæ, *Ihti*
Andrenidæ, *Ihvu*
Anisopidæ, *Idad*
Anobiidæ, *Icva*
Anoplura, *Imo*
Anthicidæ, *Icgu*
Anthoboscidæ, *Ihpa*
Anthocoridæ, *Irna*
Anthomyiidæ, *Idve*
Apachyidæ, *Inko*
Aphididæ, *Irbi*
Apidæ, *Ihxa*
Apioceridæ, *Idga*
Aradidæ, *Irti*
Arctiidæ, *Ilto*
Argidæ, *Ihba*
Arixeniidæ, *Inab*
Ascalaphidæ, *Ifix*
Asilidæ, *Idfo*
Asteiidæ, *Idse*
Atropidæ, *Igon*
Aulacidæ, *Ihda*

Belidæ, *Icxo*
Belostomatidæ, *Irfe*
Belytidæ, *Ihge*
Bethylidæ, *Ihsi*
Bibionidæ, *Idaw*
Bittacidæ, *Isel*
Blastobasidæ, *Ilhi*
Blattidæ, *Iota*
Blepharoceridæ, *Idbe*
Bombidæ, *Ihwo*
Bombycidæ, *Ilxa*
Bombyliidæ, *Idfa*
Borboridæ, *Idle*
Boreidæ, *Isep*
Bostrichidæ, *Icve*
Braconidæ, *Ihbu*
Brathinidæ, *Ical*
Braulidæ, *Idzu*
Brentidæ, *Icxi*
Buprestidæ, *Icko*
Byrrhidæ, *Icmo*
Byturidæ, *Icpu*

Calamoceratidæ, *Isor*
Calliphoridæ, *Idxa*
Campodeidæ, *Iban*
Canaceidæ, *Idri*
Cantharidæ, *Icce*
Capniidæ, *Igeo*
Carabidæ, *Icac*
Carposinidæ, *Ilna*
Cebrionidæ, *Ichi*
Cephaloidæ, *Icdu*
Cephidæ, *Ihan*
Cerambycidæ, *Icwu*
Ceraphronidæ, *Ihke*
Ceratophillidæ, *Ixgo*
Ceratothripidæ, *Imeh*
Cercopidæ, *Irat*
Cerophytidæ, *Iche*
Chalcidæ, *Ihmi*
Chelisochidæ, *Inpa*
Chelonariidæ, *Icme*
Chironomidæ, *Idam*
Chirothripoididæ, *Imew*
Chloropidæ, *Idsa*
Choristidæ, *Isec*
Chrysidæ, *Ihnu*
Chrysomelidæ, *Icxa*
Chrysopidæ, *Ifir*
Cicadellidæ, *Iraf*

Gelastocoridæ, *Irdo*
Gelechiidæ, *Ilha*
Geometridæ, *Ilre*
Geomyzidæ, *Idta*
Georyssidæ, *Iclo*
Gerridæ, *Irho*
Glyphipterygidæ, *Illa*
Gracilariidæ, *Ildi*
Gryllidæ, *Ioha*
Grylloblattidæ, *Iova*
Gyrinidæ, *Icah*
Gyropidæ, *Igun*

Hæmatomyzidæ, *Imob*
Hæmatopinidæ, *Imon*
Halictophagidæ, *Isaw*
Haliplidæ, *Icaf*
Hebridæ, *Irpi*
Heliodinidæ, *Ille*
Heliozelidæ, *Ilfi*
Helmidæ, *Icle*
Helodidæ, *Icma*
Helomyzidæ, *Idla*
Heloridæ, *Ihfo*
Hemerobiidæ, *Ifim*
Hemimeridæ, *Inca*
Hemithripidæ, *Imec*
Hepialidæ, *Ilad*
Hesperiidæ, *Ilxu*
Heteroceridæ, *Icli*
Heteroptera, *Ird-Irw*
Heterothripidæ, *Imed*
Hippoboscidæ, *Idze*
Histeridæ, *Icbi*
Homoptera, *Ira-Irc*
Hyblæidæ, *Ilpo*
Hydrometridæ, *Irke*
Hydrophilidæ, *Icai*
Hydropsychidæ, *Isod*
Hydroptilidæ, *Isoc*
Hylechthridæ, *Isam*
Hymenoptera, *Ih*
Hystrichothripidæ, *Imet*

Ichneumonidæ, *Ihca*
Incurvariidæ, *Ilaf*
Ischnopsyllidæ, *Ixab*
Isometopidæ, *Irli*
Isoptera, *Ife*
Itonididæ, *Idat*

Japygidæ, *Ibat*

Kalotermitidæ, *Ifed*

Labiduridæ, *Inhe*
Labiidæ, *Inme*
Lacosomidæ, *Ilwe*
Lagriidæ, *Icte*
Lampyridæ, *Icbu*
Lasiocampidæ, *Ilxe*
Lathridiidæ, *Icru*
Lepidoptera, *Il*
Lepismidæ, *Ibam*
Leptinidæ, *Icam*
Leptoceridæ, *Ison*
Leptopsyllidæ, *Ixbo*
Libellulidæ, *Igag*
Limnophilidæ, *Isos*
Liotheidæ, *Igus*
Locustidæ, *Iome*
Lonchæidæ, *Idmo*
Lonchopteridæ, *Idgu*
Lucanidæ, *Icwi*
Lycænidæ, *Ilzu*
Lycidæ, *Icbo*
Lyctidæ, *Icvi*
Lygæidæ, *Irsu*
Lymantriidæ, *Ilse*
Lymexylidæ, *Icde*
Lyonetiidæ, *Ilci*

Machilidæ, *Ibad*
Mallophaga, *Igu*
Manidiidæ, *Ilri*
Mantidæ, *Iosa*
Mantispidæ, *Ifid*
Mecoptera, *Ise*
Megachilidæ, *Ihwa*
Megalopygidæ, *Ilat*
Megaprosopidæ, *Idwo*
Megathymidæ, *Ilxo*

Melandryidæ, *Icto*
Melasiidæ, *Icke*
Meloidæ, *Icfo*
Melyridæ, *Icci*
Membracidæ, *Iran*
Mengeidæ, *Isac*
Mengenillidæ, *Isaf*
Meropidæ, *Isem*
Merothripidæ, *Imek*
Mesoveliidæ, *Irpa*
Micromalthidæ, *Icdi*
Micropezidæ, *Idpa*
Micropterygidæ, *Ilab*
Milichiidæ, *Idto*
Miridæ, *Irma*
Molannidæ, *Isom*
Monœdidæ, *Icro*
Monommidæ, *Icti*
Monotomidæ, *Icnu*
Mordellidæ, *Icfe*
Murmidiidæ, *Icri*
Muscidæ, *Idza*
Mutillidæ, *Ihri*
Mycetæidæ, *Icsa*
Mycetophagidæ, *Icra*
Mycetophilidæ, *Idas*
Mydaidæ, *Idfu*
Mylabridæ, *Icxe*
Myrmecolacidæ, *Isag*
Myrmelionidæ, *Ifit*

Nabidæ, *Irno*
Nannochoristidæ, *Ised*
Naucoridæ, *Irfu*
Neididæ, *Irta*
Nemestrinidæ, *Iddi*
Nemouridæ, *Igen*
Nepidæ, *Irfo*
Nepticulidæ, *Ilah*
Neuroptera, *Ifi*
Nitidulidæ, *Icni*
Noctuidæ, *Ilso*
Nosodendridæ, *Icmu*
Notodontidæ, *Ilsa*
Notonectidæ, *Irge*
Nycteribiidæ, *Idzo*
Nymphalidæ, *Ilzi*

Ochteridæ, *Irdi*
Ochthiphilidæ, *Idva*
Odonata, *Iga*
Odontoceridæ, *Isop*
Oecophoridæ, *Ilga*
Oedemeridæ, *Icfa*
Oestridæ, *Idwa*
Oinophilidæ, *Ilda*
Olethreutidæ, *Ilma*
Omophronidæ, *Icae*
Opostegidæ, *Ilco*
Orneodidæ, *Ilpa*
Ortalidæ, *Idna*
Orthoperidæ, *Icas*
Orthoptera, *Io*
Oryssidæ, *Ihbi*
Ostomidæ, *Icne*
Othniidæ, *Icga*

Pamphiliidæ, *Ihad*
Panorpidæ, *Isef*
Papilionidæ, *Ilza*
Passalidæ, *Icwo*
Pediculidæ, *Imod*
Pedilidæ, *Icgo*
Pelecinidæ, *Ihli*
Pentatomidæ, *Irvu*
Pericopidæ, *Ilte*
Perlidæ, *Iged*
Phalacridæ, *Icsi*
Phaloniidæ, *Ilmo*
Phasiidæ, *Idwi*
Phasmidæ, *Iopa*
Phengodidæ, *Icca*
Philopotamidæ, *Isof*
Philopteridæ, *Igul*
Phlœothripidæ, *Imer*
Phoridæ, *Idha*
Phyganeidæ, *Isol*
Phycodromidæ, *Idlo*
Phylloxeridæ, *Irbu*
Phymatidæ, *Irra*
Pieridæ, *Ilze*
Piesmidæ, *Irri*
Piophilidæ, *Idpo*
Pipunculidæ, *Idho*
Plastoceridæ, *Icho*

Platygasteridæ, *Ihla*
Platypezidæ, *Idhi*
Platypodidæ, *Icze*
Platypsyllidæ, *Icak*
Platystomidæ, *Icxu*
Plecoptera, *Ige*
Plutellidæ, *Ilki*
Poduridæ, *Ibed*
Polycentropidæ, *Isog*
Polystœchotidæ, *Ifip*
Pompilidæ, *Ihna*
Proctotrupidæ, *Ihgo*
Prosopidæ, *Ihvi*
Pselaphidæ, *Icav*
Psephenidæ, *Icku*
Psilidæ, *Idra*
Psocidæ, *Igoc*
Psychidæ, *Ilbu*
Psychodidæ, *Idak*
Psychomyidæ, *Isoh*
Psyllidæ, *Irba*
Pteronarcidæ, *Igea*
Pterophoridæ, *Ilno*
Ptiliidæ, *Icax*
Ptinidæ, *Ictu*
Ptychopteridæ, *Idac*
Pulicidæ, *Ixna*
Pygidicranidæ, *Infe*
Pygothripidæ, *Imel*
Pyralididæ, *Ilne*
Pyrochroidæ, *Icgi*
Pyromorphidæ, *Ilam*
Pyrrhocoridæ, *Irsi*
Pythidæ, *Icge*

Raphidiidæ, *Ific*
Reduviidæ, *Irpu*
Rhagionidæ, *Idda*
Rhipiceridæ, *Ichu*
Rhipiphoridæ, *Icfi*
Rhizophagidæ, *Icno*
Rhopalosomidæ, *Ihsu*
Rhyacophilidæ, *Isob*
Rhysodidæ, *Icna*
Riodinidæ, *Ilzo*
Roproniidæ, *Ihfe*

Saldidæ, *Irgo*
Sapromyzidæ, *Idme*
Sapygidæ, *Ihpi*
Sarcophagidæ, *Idxi*
Saturniidæ, *Ilwo*
Scaphidiidæ, *Icaz*
Scarabæidæ, *Icwa*
Scatopsidæ, *Idaz*
Scelionidæ, *Ihko*
Scenopinidæ, *Idfi*
Schizopteridæ, *Irko*
Sciomyzidæ, *Idma*
Scoliidæ, *Ihru*
Scolytidæ, *Iczi*
Scutellaridæ, *Irwo*
Scydmænidæ, *Icar*
Scythrididæ, *Ilka*
Sepsidæ, *Idpe*
Sericostomatidæ, *Isov*
Sialidæ, *Ifib*
Silphidæ, *Ican*
Simuliidæ, *Idba*
Siphonaptera, *Ix*
Siricidæ, *Ihaf*
Sisyridæ, *Ifig*
Sminthuridæ, *Iber*
Sphæriidæ, *Icbe*
Sphæritidæ, *Icba*
Sphecidæ, *Ihva*
Sphindidæ, *Icvo*
Sphingidæ, *Ilra*
Staphylinidæ, *Icat*
Stenomidæ, *Ilgo*
Stephanidæ, *Ihdi*
Stichotrematidæ, *Isar*
Stratiomyiidæ, *Idce*
Streblidæ, *Idzi*
Strepsiptera, *Isa*
Stylopidæ, *Isal*
Sympherobiidæ, *Ifil*
Syrphidæ, *Idka*

Tabanidæ, *Idbu*
Tachinidæ, *Idxo*
Tanyderidæ, *Idab*
Tanypezidæ, *Idno*

STUDIES IN THE PYRRHOPYGINÆ (LEPIDOPTERA, RHOPALOCERA)

BY E. L. BELL, FLUSHING, N. Y.

This third and final installment deals with the remaining genera of the *Pyrrhopyginae.*

For a long time Latreille's *iphinous* has been placed by authors as the type of the genus *Mimoniades,* as *ocyalus* Hubner, for which Hubner erected the genus *Mimoniades,* was considered to be synonymous with the Latreille species. Mabille, however, has identified *iphinous* as a *Phocides,* (Bull. Soc. Ent. France, pp. 334, 335, 1909), from a specimen in the Leyde Museum, therefore assuming that Mabille is correct in his determination, the type of *Mimoniades* must necessarily be *ocyalus,* the only included species when the genus was erected.

The genus *Myscelus* as treated by Draudt in "Seitz Macrolepidoptera of the World" contains a number of errors, some of which have been pointed out by Capt. Riley and the writer has endeavored to point out the others in this paper.

In the genus *Oxynetra* confusion has obtained since the original description by Felder, in which it is apparent that two species or forms were confused under the name *semihyalina,* however, Felder amply designated the one to which the name applies when he published the figure in "Reise Novara."

The genus *Dis* Mabille, Bull. Soc. Ent. France, 6th ser. vol. ix, Bull. p. clxxxiv, 1889, has been questionably placed by authors as synonymous with *Oxynetra.* It was based on a female specimen, which Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 269, 1893, state they are inclined to believe may possibly prove to be that sex of *Oxynetra hopfferi* Staudinger. Whether or not this is correct, the writer is unable to determine.

Sarbia

Watson, Proc. Zool. Soc. London, (I), p. 13, 1893.
Orthotype, *Hesperia xanthippe* Latreille.

Genitalia. The uncus is bifid, the basal flanges long and tapering to a sharp point. The girdle varying from short to rather long. The saccus of moderate length. The aedoeagus short or long, more or less curved, somewhat bulbous at the base and tapering at the apex. The claspers are short, the apex turned upward and ending in one or more large, sharp pointed teeth, which are sometimes partly serrate. The inner plate of the disc of the claspers varies in shape among the species and has numerous serrations on the dorsal edge.

S. xanthippe. (Plate XXII, Fig. 1).

Latreille, Enc. Meth., vol. 9, p. 734, 1823.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 199, 200, 201, 202, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 164 f, (?), 1921.

Riley, Trans. Ent. Soc. London, (2), p. 232, 1926.

spixii Plotz, Stett. Ent. Zeit., vol. xl, p. 525, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, vol. vii, pp. 199, 200, 201, 202, pl. xiv, fig. 2, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 845, pl. 164 f, 1921.

Mabille and Boullet, and Capt. Riley have amply settled the identity of the Latreille species and the synonymy of *spixii* Plotz. The Draudt figure of *spixii* fairly well represents *xanthippe,* although the subapical spots are actually more nearly in a straight line than shown in the figure mentioned and the discal band of the secondaries more noticeably angled toward the inner margin of the wing, from below the cell. Some individuals show a small, yellow spot in interspace I of the primaries toward the base; in others it is absent. The yellow spot of the discal band of the secondaries which lies between veins 7 and 8, may be entire and extend well toward the base of the wing or it may be divided into two spots by the black line which divides the cell spot into two parts, thus forming a short sub-basal yellow band, which may be connected with the discal band on the costal margin.

The ventral surface of the abdomen may be entirely red, or with a black line in the center, or nearly all black with a few red hairs. The spots on the sides of the abdomen also vary from being all yellow, to yellow at the base and becoming reddish toward the apex, and from large spots to small spots.

The two sexes are very similar in appearance and if the apex of the abdomen be tightly closed it is often difficult to determine just which sex is before one.

It is uncertain just what the Draudt figure of *xanthippe* represents but it appears very much like the male of what the writer considers to be *pertyi* Plotz.

The uncus is short, the basal flanges very long, far exceeding the apex of the uncus. The terminal arm of the claspers ends bluntly, with a stout tooth curved backward from the base, before which are numerous serrations. The inner plate of the disc is straight on the dorsal edge and prominently serrate.

Distribution. Type locality, Brazil (probably near Rio Janeiro). *Spixii,* Brazil. Passa Quatro, Minas Geræs; Manaos; Hansa Humboldt, Santa Catharina; all Brazil. (B).

S. damippe. (Plate XXII, Fig. 2).

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 200, 201, pl. xiv, fig. 3, 1908.

Doubleday, Westwood and Hewitson, Genera Diurnal Lepid., p. 509, pl. 78, fig. 1, (as *xanthippe*), 1852.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 f, 1921.

In *damippe* the lower three spots of the subapical series are subequal and run in nearly a straight line, the lowest one, therefore, being well separated from the discal band. The bands of the wings are narrower than usual in *xanthippe.* The secondaries above have no sub-basal band, but beneath a large spot which extends from just within the cell to almost the costal margin.

The basal flanges of the uncus are long and sharp pointed but do not reach the apex of the uncus. The aedoeagus is short and slender. The terminal arm of the claspers is very short and rounded at the apex, the dorsal edge produced obliquely backward into a long, stout, sharp pointed tooth. The inner plate of the disc is curved on the dorsal edge and deeply serrate.

Distribution. Type locality, Rio Grande do Sul, Brazil. Rio Grande do Sul; Annaburg; Punta Alegre; all Brazil. (B).

S. antias. (Plate XXII, Fig. 3).

Felder, Wien Ent. Mon., vol. 3, pp. 404, 405, 1859. Reise Nov., p. 506, pl. 70, fig. 4, 1867.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 200, 202, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 f, 1921.

All the bands of the wings of *antias* are narrow and straight, the subapical series a little oblique. The tegulæ and the abdomen on the dorsal and lateral surfaces are entirely black.

The uncus is long and slender, dorsally at the base of the two apical arms with a horn-like projection, the two apical arms short. The basal flanges project upward and then curve forward. The somewhat sinuous ædoeagus carries a small serrate lobe before the apex. The terminal arm of the claspers is broad at the apex, on the dorsal edge rise three tooth-like projections with small serrations, the middle one the smaller. The inner plate of the disc carries heavy serrations on the dorsal edge.

Distribution. Type locality, Brazil. Hans Humboldt; Paraná; Brazil. (B).

S. erythrosoma

Mabille, Ann. Soc. Ent. Belg., vol. xxxv, (C. R., ser. iv, p. cix), 1891.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, pp. 200, 202; pl. xiv, fig. 6, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 f, 1921.

The figure of *erythrosoma* shows only four spots in the subapical series and a broad discal band of equal width, which includes a small triangular spot in the base of interspace 3. The band of the secondaries is sharply angled below the end of the cell and terminates in a sharp point on about the center of the abdominal fold. The head, collar, shoulder-covers and base of the tegulæ are red, as well as the last five abdominal rings and the anal tuft; the red abdominal rings are edged with black.

Distribution. Type locality, "San Paulo."

S. oneka

Hewitson, Trans. Ent. Soc. London, 3rd ser., vol. ii, p. 480, 1866.

Plotz, Stett. Ent. Zeit., vol. xl, p. 526, 1879. (as synonym of *xanthippe* Latreille).

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 200, 202, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, 1921.

Capt. Riley has sent to the writer an excellent photograph, made by Mr. Tams, of the type of *oneka* in the British Museum collection. The photograph shows a large insect with the yellow bands of both wings narrow and broken, the spots rather ill-defined on their outer edge. The three subapical spots of the primaries are in an outwardly curved line; the three spots below them are in an oblique line, slightly curved inward, the upper one placed inside the lowest subapical spot; the discal band is very narrow and ill-defined, the cell spot reduced to a narrow, oblique streak. On the secondaries the spot at the end of the cell is placed noticeably inward and is divided in two by a black line.

The fringes of both wings are yellow; the head red with a small admixture of black; anal tuft bright red; palpi red, the tips black; the ventral surface of the abdomen is spotted with red at the sides; the sides of the abdomen are yellowish; the tegulæ narrowly edged with yellow. The body as shown in the photograph appears to be very heavy and the type may possibly be a female.

Plotz placed *oneka* as a synonym of *xanthippe* Latreille but this synonymy does not appear to be correct.

Distribution. The locality label borne by the type is ''Venezuela.''

S. catomelaena

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, p. 201; pl. xiv, fig. 5, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, 1921.

The Mabille and Boullet figure shows the tegulæ entirely black, the fringe of the primaries paler than the ground color of the wing, of the secondaries apparently white or whitish. The position of the three yellow spots beneath the subapical series of the primaries and the general contour of the discal yellow band of these wings and of the secondaries is very similar to that of *oneka* Hewitson.

The description states that the abdomen and sides are bluish-black; the ventral surface with a red stripe which does not extend to the first rings.

Distribution. Type locality, Minas Geræs, Brazil.

S. hegesippe

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, p. 201; pl. xiv, fig. 4, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, 1921.

The only specimen of *hegesippe* at hand is a female and it well agrees with figure given by Mabille and Boullet. The subapical spots in interspaces 6, 7 and 8 are narrow and elongate; the three spots in interspaces 3, 4 and 5 are much larger, oblong, and not directly under each other; these six spots form a gently curved line, the last spot nearly touching the large spot in interspace 2 of the discal band. The discal band of the secondaries does not present so angled an appearance below the cell as in *xanthippe*. On the under side the secondaries have a short, yellow sub-basal band extending from the costal margin to vein 1 b; there is a short, outward projection of this band, on the costal margin, which almost unites with a similar inward projection of the discal band, which is otherwise broadly separated from the sub-basal band. The discal band is broad beyond the cell and in the interspace below vein 2 it encloses, or nearly so, a spot of the black ground color. The fringes of the secondaries are undulate and sordid yellow on both wings. The pectus is red at the base and outer edge, black internally and at the apex. Mabille and Boullet state that *hegesippe* may be the same as *pertyi* Plotz.

Distribution. Type locality, Bolivia.

S. pertyi. (Plate XXII, Fig. 4).

Plotz, Stett. Ent. Zeit., vol. xl, pp. 525, 526, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 201, 202, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 f, 1921.

The description indicates that *pertyi* is without a basal spot on the upper side of the secondaries and on the primaries the cell spot of the discal band is placed a little more toward the base of the wing than the spot in interspace 2, the spot in interspace 2 and the lowest of the subapical spots closely approach each other. The discal band of the secondaries extends to nearer the border of the wing and from the outer angle to the inner border. Beneath, the basal spot of the secondaries is broad on the costal margin and extends as a narrow spot through the cell.

Mabille and Boulett say that their *hegesippe* and *pertyi* may be conspecific but this seems open to doubt according to the characters given in the descriptions.

The Draudt figure of *pertyi* is presumably from the Plotz drawing and shows the peculiarity of the cell spot of the primaries, mentioned by Plotz. It also shows a small but very distinct yellow dash in interspace 9 of the primaries. The specimens at hand which are identified as *pertyi* agree fairly well with the description and figure; they have the cell spot of the primaries extending a little further toward the wing base than the spot below it, but not so markedly as shown in the Draudt figure, and the dash in interspace 9 is present in only one individual. Beneath, the basal spot of the secondaries extends entirely through the cell and a little below it, sometimes interrupted in the lower part of the cell. The fringes of the primaries are black, sometimes with a yellow spot between veins 1 and 2; of the secondaries yellow.

The uncus is broad at the base and terminates in two slender, pointed arms, the basal flanges long and slender, extending a little beyond the apex of the uncus. The ædoeagus is short. The terminal arm of the claspers is curved upward at the apex and ends in a sharp point, at the base of the terminal arm is a stout, sharp pointed tooth directed backward. The dorsal edge of the inner plate of the disc is serrate and has a strong, serrate, tooth-like projection.

Distribution. Type locality, Brazil. Annaburg; Hansa Humboldt; Massaranduba; Santa Catharina, all Brazil. (B).

S. luteizona

Mabille, Petit. Nouv. Ent., p. 162, 1877. Ann. Soc. Ent. Belg., vol. xxi, p. 15, 1878.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, pp. 259, 260, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 199, 202, pl. xiv, fig. 1, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 e, 1921.

Mabille and Boullet indicate that the differences between *luteizona* and *martyii* Plotz are slight and that the two names may represent the same insect. In case they should be conspecific *luteizona* has priority.

The Mabille and Boullet figure of *luteizona* differs from the specimens of *martyii* at hand, which are all females, in that it has three well defined subapical spots of the primaries against only two in *martyii;* in lacking the oblique yellow stripe at the end of the cell and the diffuse yellow spot in interspace I near the base, which are present in *martyii;* in the longer, oblique yellow spots in interspaces 4 and 5, which are small and irregular in *martyii.* The primaries are more pointed in the figure than in the specimens at hand, although Mabille and Boullet state that their specimen is also a female, so these differences do not appear to be sexual.

Distribution. Type locality, said to be Mexico, but this seems to be doubtful. Sao Paulo, Brazil. (B).

S. martyii

Plotz, Stett. Ent. Zeit., vol. xl, p. 525, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, pp. 199, 202, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 e, 1921.

amoena Rober, Ent. Mitteil., vol. xiv, (1), p. 87, 1925.

There are two female specimens at hand which appear to be *martyii*. In one of these specimens the head is red and in the other black with a few red hairs intermixed; in one the cell spot of the discal band of the primaries is large and quadrate, in the other represented by two small spots; in one the discal yellow band of the secondaries beneath nearly encloses a spot of the black ground color; in the other there is no indication of this black spot although the band is equally broad in both. These differences seem to indicate a considerable range of individual variation in this species.

Rober compares his *amoena* with *luteizona* and his description does not seem to materially differ from the insect which the writer believes to be *martyii*.

Distribution. Type locality, Brazil. *Amoena*, State of Sao Paulo, Brazil. Sao Paulo, Brazil. (B).

Mimoniades

Hubner, Zutr. Exot. Schmett., 2, p. 27, 1823.

Haplotype, *Mimoniades ocyalus* Hubner

Genitalia. The form of the uncus varies considerably, in some species it is bifid at the apex and in other species terminates in a single point; there may be basal flanges or they may be absent. The ædoeagus is long or short. The claspers are usually curved upward at the apex and have two distinct, serrate lobes. The inner plate of the disc usually with serrations, serrate flanges or shagreened.

M. ocyalus. (Plate XXII, Fig. 5).

Hubner, Zutr. Exot. Schmett., 2, p. 27, figs. 353, 354, 1823.
Draudt, Seitz, Macrolep. of the World, vol. 5, p. 846, pl. 166 c, 1921.
iphinous Kirby, (not Latreille), Synonymic Catalogue Diurn. Lepid., p. 586, 1871.

This species is so well known as to require no comment on the superficial appearance.

The uncus extends in a long tapering arm; the basal flanges short and smooth. The termination of the claspers is not symmetrical on the two sides; the terminal arm is short, curved upward at the apex, in the right clasper produced into a rather broad flange with a serrate apex, at the base with a stout, sharp tooth directed inwardly; in the left clasper the broad flange is absent, the entire dorsal edge deeply serrate, with two slender projections from the base. The dorsal edge of the inner plate is irregular and serrate.

Distribution. Type locality, Brazil. Manaos; Passa Quatro, Minas Geræs; Brazil. (B).

M. othello. (Plate XXII, Fig. 6).

Plotz, Stett. Ent. Zeit., vol. xl, p. 522, 1879.
Riley, Trans. Ent. Soc. London, p. 232, 1926.
mimetes Mabille, Bull. Soc. Ent. France, p. 335, 1909.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, 1921.

This species is easily distinguished from *ocyalus* Hubner, which it resembles, by the orange spot in interspace 4 being attached to the subapical series instead of being superimposed upon the spot in interspace 3, the subapical series therefore consisting of five spots instead of four as in *ocyalus*.

The uncus is slender and terminates in a sharp point; the basal flanges short, rounded, serrate on the dorsal side and shagreened on the side. The ædoeagus is short, stout and with a bent apex. The claspers are symmetrical, the terminal arm at the apex with two serrate flanges.

Distribution. Type locality, Brazil. Brazil. (B).

M. eupheme. (Plate XXII, Fig. 7).

Godman and Salvin, Proc. Zool. Soc., London, pp. 152, 153, pl. xiv, fig. 5, 1879.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 202, 203, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 163 f, 1921.

This species closely resembles *versicolor* Latreille but differs principally in having the stripes on the thorax and tegulæ bluish-white, the anal tuft black, the palpi, pectus and legs black striped with white. The original description mentions three subapical spots; in the single male at hand there is an additional minute spot in interspace 8.

The uncus is deeply cleft at the apex, each arm terminating pointedly; the basal flanges are smooth and slender. The claspers are asymmetrical, the right one terminating in a blunt, serrate apex, at the base of the terminal arm is a short upward projection; the left clasper terminates in two short flanges, serrate on the apex and outer edge, with an upward projection from the base of the terminal arm. The inner plate of both sides carries numerous dorsal serrations.

Distribution. Type locality, Cosnipata, Peru; Apolobamba, Bolivia. Marcapata, Peru. (B).

M. versicolor. (Plate XXII, Fig. 8).

Latreille, Enc. Meth., vol. 9, p. 735, 1823.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 202, 203, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 163 e, 1921.
Riley, Trans. Ent. Soc. London, p. 232, 1926.
mulcifer Hubner, Zutr. Exot. Schmett., p. 9, figs. 413, 414, 1825.

In *versicolor* the stripes of the tegulæ are orange, those on the thorax a little paler orange becoming bluish toward the base; the pectus, palpi, anal tuft and a stripe on the legs orange. The three red spots of the discal band of the primaries show considerable individual variation.

The uncus is somewhat similar to that of *eupheme.* The claspers are asymmetrical, but both terminate in two serrate flanges, differently shaped on the two sides back of which is an upward projection. The inner plate of the disc is irregular in shape, that of the left clasper having a prominent dorsal flange with three well defined tooth-like projections, two of which are partly serrate.

Distribution. Type locality, Brazil. Santa Catharina; Minas Geræs; Sao Paulo; all Brazil. (B).

M. sela

Hewitson, Trans. Ent. Soc. London, 3rd ser. (2), p. 479, 1866.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 202, 203, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 163 f, 1921.
pityusa Hewitson, (male), Exot. Butt., vol. 2, Pyrrh. pl. 2, fig. 8, 1857.

The Hewitson figure (no. 8) in "Exotic Butterflies" shows the two outer parallel bands of the upper side of the secondaries very narrow and blue, in the one male specimen at hand the two lowest spots of the inner of these two bands is tinged with fulvous, otherwise agreeing with the figure and the description.

The uncus is rather long, sinuous and tapering to a sharp point. The ædoeagus is long and sinuous. The termination of the claspers is slightly asymmetrical, two projections arising from the dorsal edge, the outer slender, the inner widened into a broad flange, both are partly serrate. The dorsal edge of the inner plate of the disc is narrowly shagreened.

Distribution. Type locality, "New Granada." Bogota, Colombia. (B).

M. sela, form **peruviana.** (Plate XXII, Fig. 9).

Draudt, Seitz Macrolep. of the World, vol. 5, pl. 163 f, 1921.

There is no reference made in the text of the Seitz work in regard to *peruviana.* Dr. Draudt has informed the writer that this and several other *Hesperiidæ* figured but not otherwise mentioned in Seitz Macrolep. of the World, vol. 5, probably were part of the Fassl material before him which he intended to describe, the figures being completed before the text; upon the death of Mr. Fassl he was compelled to return all of the material to the executors of the estate and the writing of the descriptions of these particular insects was overlooked.

The figure of the upper side appears very similar to *sela* Hewitson, the maculation being a little heavier, the inner of the two outer bands of the secondaries above is entirely fulvous, the outer one and the submarginal spots of the primaries of a greenish tinge instead of blue; beneath the two inner bands of the secondaries are tinged with yellowish, instead of entirely blue.

There is a specimen in the collection of the writer, said to have come from Colombia, which fairly well agrees with the Draudt figure other than that the two bands of the underside of the secondaries are not so noticeably tinged with yellow.

The form of the male genitalia, as figured on the accompanying plate, does not differ from that of typical *sela*.

Distribution. Type locality unknown. Colombia (?). (B).

M. aequatorea

Rober, Ent. Mitteil., vol. xiv, pp. 90, 91, 1925.

The description compares *æquatorea* with the Draudt figure of *peruviana,* on the upper side the discal band of the primaries being narrower, the post-discal spots equally large and quadrate; the subapical spots more developed, the bluish overscaling more obsolete, completely absent on the fore border; on the secondaries the submarginal brownish band is shorter, narrower and broken into small spots, the outer blue band shorter, narrower and absent in the fore part of the wing, the brown discal band somewhat broader and longer, broader above than below and outwardly straightened, the inner border stripe clearer; beneath the bands of the secondaries are almost white, the bluish marginal band as above. The brown spots of the sides of the abdomen become white and obsolete toward the rear.

It is probably a form of *sela*.

Distribution. Type locality, Macas, Ecuador.

M. periphema. (Plate XXII, Fig. 10).

Hewitson, Exot. Butt., vol. 5, Pyrrh. V and Eryc. pl., fig. 36, 1874–1875.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 202, 203, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 163 f, 1921.

Hewitson's figure shows no fulvous or greenish-fulvous stripe below vein 1 at the anal angle of the primaries, or spots parallel to the outer margin of those wings and no narrow submarginal band of fulvous spots on the secondaries, but the text states that there are two spots irrorated with green at the anal angle of the primaries and that the submarginal band is present on the secondaries. These are all present in varying degree in the series at hand. The bands on the under side of the secondaries are all fulvous, the submarginal one sometimes tinged a little with greenish.

The form of the male genitalia is somewhat similar to that of *sela,* but differs slightly in detail.

Distribution. Type locality, Bolivia. Bolivia. (B).

M. inæqualis

Rober, Ent. Mittel., vol. xiv, pp. 91, 92, 1925.

The description compares *inæqualis* with *periphema* and there does not seem to be anything in the differences given to indicate that it is other than a form or variation of that species. The description states that the discal band of the hindwing is very irregular, the black basal band narrower, in the hind part cleft and united with the middle band; in the narrower border band six spots of brownish scales between the fore radial and the anal angle. The brown sub-basal band of the fore wings is of equal width and extends from the costa to the inner border; the discal band of equal width, the first of the post-discal spots nearly quadrate, apical spots larger than in *periphema.* The submarginal brownish overscaling extends from the subapical spots to the submedian and shows line-like along the inner border.

Beneath, the submarginal brownish overscaling is more developed than above, the sub-basal band represented by only a spot on the costal border. The ground color of the secondaries is lighter than above; there is no blue in the black border, but a line-like band of interrupted yellowish scales. Legs and palpi yellow, the head with four rows of yellow spots, the eyes edged with yellow behind, shoulder-covers with four yellow spots, tegulæ yellow bordered, abdomen strikingly ringed with yellow.

Distribution. Type locality, Rio Songo, Bolivia.

M. pityusa

Hewitson, Exot. Butt., vol. 2, Pyrrh. pl. 2, fig. 11, (not fig. 8), 1857.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, pp. 202, 203, 1908. (As *pithyusa*).

œmulus Skinner, Ent. News, vol. xxxi, p. 133, 1920.

This species is extremely variable in the extent of the maculation. In some individuals the discal band of the forewing is noticeably angled at the junction of the spots in interspaces 1 and 2, in others this angulation is not evident. In some individuals the black band cutting the fulvous area of the secondaries extends narrowly and evenly through the cell to the costal margin; in others it terminates in or before the cell where it forms a roundish, black spot. The submarginal narrow band of spots on the secondaries may be present or absent.

In the typical form the lowest spot of the discal band of the primaries is of approximately the same width as the one above it, there are two extra-discal spots, one each in interspaces 3 and 4, and from three to four subapical spots; in other forms the lowest spot of the discal band of the primaries is narrow and sharply pointed, the subapical spots or both those and the extra-discal spots may be absent. In the typical form the fringes of the secondaries are black at the end of the veins and white between, but in one form at least they are entirely black.

The Draudt figure of *pityusa* shows entirely black fringes of the secondaries and is therefore not typical in this respect, in this and other characters of maculation it is nearer to the form *punctiger* Mabille and Boullet, which is taken to be synonymous with *porus* Plotz, there being but slight differences in the maculation of the two.

The head, palpi and pectus of *pityusa* are black usually, but in one specimen from Huancabamba, Peru, in the collection of the Academy of Natural Sciences, Philadelphia, Penna., these parts are spotted or striped with fulvous.

There does not appear to be any difference in the form of the genitalia associated with the differences in maculation.

Distribution. Type locality, "New Granada." *Aemulus*, Ambato, Ecuador. Cauca, Colombia. (B). East Colombia; Ecuador; Huancabamba, Peru. (A. S.).

M. pityusa, form **hemitænia.** (Plate XXII, Fig. 11).

Rober, Ent. Mitteil., vol. xiv, p. 91, 1925.

The insect here identified as this form of *pityusa* differs principally from the typical in having the lowest spot of the discal band of the primaries very narrow and sharp pointed, sometimes it is a mere streak. The subapical series usually consists of four spots but sometimes there are only three. The fringes of the secondaries are white between the veins as in the typical form. The fulvous spots of the primaries and the fulvous discal area of the secondaries are somewhat paler in color.

The form of the male genitalia does not differ from that of typical *pityusa*. The uncus is somewhat constricted near the base, from near which there rises a dorsal horn-like flange and then tapers to a pointed apex. The claspers show some asymmetry in the termination; both sides are dorsally produced into a rather long, broad flange, divided into two irregular parts at the apex, with a few serrations. The inner plate of the disc is shagreened along the dorsal edge.

Distribution. Type locality, Ecuador; Magdalena Valley, Colombia. Ecuador. (B).

M. pityusa, form **porus**

Plotz, Stett. Ent. Zeit., vol. xl, p. 523, 1879.

Godman, Ann. and Mag. Nat. History, 7th ser., vol. xx, p. 155, 1907.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 203, 1908. (synonym of *pityusa* Hewitson).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 846, pl. 164 a, 1921.

punctiger Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 200, pl. xiii, fig. 1, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 a, (as *punctigera*), 1921.

According to the original description *porus* is the form in which the lowest spot of the discal band of the primaries is narrow and pointed; the lowest spot of the subapical series often very narrow; the fringes of the secondaries entirely dark colored. The figure of *punctiger* appears to be merely a slight variation of *porus*.

The form of the male genitalia is the same as that of *pityusa*.

Distribution. Type locality, Colombia. *Punctiger*, not given. Colombia; Western Cordilleras, Colombia. (A. S.).

M. pityusa, form **minthe**

Godman and Salvin, Proc. Zool. Soc. London, p. 152, pl. xiv, fig. 4, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, p. 203, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 a, 1921.

This form differs from *pityusa* in lacking the subapical spots and in having entirely dark fringes of the secondaries, which may be a little greyish between the veins. The black stripe dividing the fulvous area of the secondaries above is variable, sometimes extending to the costal margin, or stopping at vein 8, or at the upper margin of the cell. The color of this fulvous area of the secondaries also varies from yellowish to reddish fulvous.

The form of the male genitalia is the same as that of *pityusa*.

Distribution. Type locality, Rio Topo, Ecuador. Ecuador. (B).

M. pityusa, form **egena**

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser. vol. vii, p. 203, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, 1921.

In this form the subapical spots and the extra discal spots are absent. The color of the fringes was not mentioned in the description and there are no specimens at hand.

Distribution. Type locality, Peru.

M. pityusa, ab. chanchamayonis

Strand, Archiv. Naturgesch., vol. 86, (A), Heft 7, p. 141, 1920.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 1046, 1924.

The description indicates that this is a smaller insect (27 mm. expanse), on the forewings of which the bands are broader and on the hind wings narrower than in Hewitson's figure (no. 11), not united at the costal margin and with a well marked sub-limbal line of bluish spots.

Distribution. Type locality, Chanchamayo, Peru.

M. angustifascia

Rober, Ent. Mitteil., vol. xiv, p. 92, 1925.

Said to be similar to *minthe* Godman and Salvin. The primaries above without subapical spots, the discal band terminating pointedly, the sub-basal band reduced, more brownish overscaling on the outer and inner borders. On the secondaries the marginal and sub-basal bands are narrower, the latter proceeding from the wing base instead of the fore border. Beneath the sub-basal band of the primaries is represented by two yellowish spots, the lower half of the post discal spot only brownish scales. The tegulæ and abdominal segments with sparse brownish hairing.

This is probably one of the numerous variations of the form *minthe,* but as there are no specimens at hand exactly agreeing with all of the characters given, the name is kept apart.

Distribution. Type locality, Macas, Ecuador.

Croniades

Mabille, Gen. Insect., Hesp., p. 13, 1903

Logotype, *Pyrrhopyga pieria* Hewitson

C. pieria. (Plate XXII, Fig. 12).

Hewitson, Exot. Butt., vol. 2, Pyrrh. pl. 2, fig. 10, 1857.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 204, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 a, 1921.

Hewitson's type is said to be a female. The description states that the hyaline spots of the primaries are white, in the single male specimen at hand they are tinged with orange-yellow; the bands of the secondaries are more orange, especially in the upper part. Beneath the primaries are a little paler, the base of the secondaries yellow, the other bands orange. The palpi are slightly tinged with pale yellow.

The uncus terminates in two sharp pointed arms; there are no basal flanges. The claspers are very broad at the base, the terminal arm narrow, with stout serrations on the dorsal edge and two stout teeth at the base, projecting inwardly. There are several clusters of spines on the disc of the claspers, some of them very long; the inner plate has a large tooth on the dorsal edge.

Distribution. Type locality, "River Amazon." St. Laurent, French Guiana. (B).

C. auraria

Druce, Trans. Ent. Soc. London, (2), pp. 379, 380, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, 1921.

The description states that *auraria* differs from *pieria* in the position of the discal band of the primaries and in the more conspicuous outer marginal yellow band of the same wings and by the black ultra-median band of the secondaries being much reduced and nearly obsolete at its junction with the subcostal nervure. The outer marginal yellow band of the primaries wider beneath, the anal half of the secondaries richer orange than the costal area.

Palpi pure white, tips black.

Druce states that he has seen another identical specimen from the same locality.

Capt. Riley has informed the writer that *auraria* at first sight appears to be distinct from *pieria,* the yellow markings being larger and more noticeably paler in tone and uniform in color over both wings, with little suggestion of the orange tint that distinguishes *pieria.*

Auraria may eventually prove to be a race of *pieria.*

Distribution. Type locality, Farinas, La Paz, Bolivia (1,500 m).

C. machaon. (Plate XXIII, Fig. 13).

Doubleday, Westwood and Hewitson, Gen. Diurn. Lepid., p. 509, pl. 78, fig. 3, 1851.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 204, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 b, 1921.

The uncus is long and sinuous, the apex provided with a claw-like hook. The ædoeagus is short, stout and sinuous. The claspers are symmetrical, broad, the terminal arm short, the ventral edge curved downward and outward, forming a stout tooth-like projection with a sharp pointed apex, from the dorsal edge arises another broad apical projection slanting backward with a stout tooth at each corner of the apex, with serrations between them, a short rounded flange at the base of the terminal arm; from the lower basal area of the inner side of the disc rises a tooth-like process with a broad base; the inner plate is erose on the dorsal edge.

Distribution. Type locality, Brazil. Hansa Humboldt; Paraná; Brazil. (B).

Microceris

Watson, Proc. Zool. Soc. London, (I), p. 15, 1893.

Orthotype, *Pyrrhopyga variicolor* Menetries

M. variicolor. (Plate XXIII, Fig. 14).

Menetries, Enum. Corp. Anim. Mus. Petrop., Lepid., part 1, p. 96, pl. 4, fig. 9, 1855.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 204, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 e, 1921.

The uncus tapers to a narrow, undivided apex, with a small cluster of fulvous spines projecting from both the dorsal and ventral sides a little beyond the center. The basal flanges are short, broad and irregular, with fine serrations on the outer edge. The claspers short and broad, the very short terminal arm is irregular in shape, with two stout tooth-like projections, the lower one extending forward, the upper one curving a little backward, the lower one with large serrations on the ventral edge and both with smaller serrations on the outer edge. At the base of the terminal arm, from the dorsal edge rises a large flange, narrow at the base and broadening above, projecting forward and terminating in a rounded lobe-like apex with numerous serrations. There is a heavy cluster of long spines projecting from the ventral area of the terminal arm and extending below and beyond the apex of the arm, a few shorter spines extending upward from near the base of the arm and some more short ones on the side of the arm.

Distribution. Type locality, Minas Geræs, Brazil. Chapada, near Cuyaba, Matto Grosso. (A. M.). Chapada. (B).

Agara

Mabille and Boullet, Ann. des Sciences Nat.

Paris, 9th ser., p. 204, 1908

Haplotype, *Tamyris pardalina* Felder

Genitalia. The form is very similar to that of the genus *Myscleus*. The uncus is long, terminating in a single, down curved point. The ædoeagus is long, slender, swelled a little before the base and carries two tooth-like projections toward the apex, one of which extends beyond the apex. The claspers terminate in two irregular arms, with serrations on one or both, at and near the apex.

A. pardalina. (Plate XXIII, Fig. 15).

Felder, Reise Novar., p. 507, pl. 70, figs. 5, 6, 1867.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 204, 205, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 847, pl. 164 g, 1921.

In *pardalina* the two hyaline spots in interspaces 3 and 4 are not placed very far inside the lowest spot of the subapical series, that in interspace 3 being well removed from the large hyaline spot of the discal band lying in interspace 2. The red area of the upper side of the secondaries is decidedly red. Beneath the broad, central bluish-white band and the irregular outer band of the same color, on the secondaries, are very close together at and above the end of the cell.

The lower terminal arm of the claspers projects beyond the apex of the upper arm and has a short, dorsal, triangular projection at the apex, which has some serrations on the edge and short teeth on the side.

Distribution. Type locality, "Nova Granada. Bogota." Santa Cruz, Bolivia. (B).

A. mapirica. (Plate XXIII, Fig. 16).

Strand, Archiv. Naturgesch., vol. 86, (A), Heft 7, pp. 141, 142, 1920.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 1046, 1924.

The Bolivian insect, which was described as a variety of *pardalina,* is specifically distinct from that species. Superficially it may be distinguished from *paradalina* by the hyaline spots in interspaces 3 and 4 being placed further inwardly so that the spot in interspace 3 is much nearer to the spot of the discal hyaline band lying in interspace 2; the two spots lying in interspace 5 are sometimes connected and form one, long, slanting spot. The color of the reddish area of the upper side of the secondaries is more brownish-red. On the secondaries beneath the outer bluish band is sinuous on the outer edge, connected with, or nearly so, the middle blue band at vein 4 and again at vein 7 and at the costal margin; above and below vein 4 the outer band curves outward so that it is much further removed from the middle band in these areas than is the case in *pardalina.*

The females are similar to the males, the secondaries broader and the projection of the outer margin at vein 4 is very prominent.

The lower terminal arm of the claspers ends in a triangular, pointed, serrate apex, projecting a little beyond the upper arm, with numerous serrations on the upper angle of the apex and on the dorsal edge near it. The inner plate of the disc is shagreened along the dorsal edge.

Distribution. Type locality, Mapiri, Bolivia. Santa Cruz, Bolivia; Rio Songo, Bolivia. (B).

A. aurora

Rober, Ent. Mitteil., vol. xiv, p. 92, 1925.

The description states that *aurora* principally differs from *pardalina* in the reduced red area of the two wings; the hind wings more strongly scalloped and rounder; in lacking the spots between the discal hyaline band and the subapical spots of the primaries, of which there are four; in the under side of the primaries being dark brown, apically paler; in the secondaries beneath being very black with little sheen; in the two inner white bands being broader, the outer less developed.

The writer has seen two specimens which very well agree with the description except that the under side has a bluish sheen in certain lights. Both of these specimens are females and the description indicates the probability that the type is also of this sex, although it is not so definitely stated. The reddish area of the two wings in the two specimens mentioned is somewhat more brown tinted than in the Bolivian specimen of *pardalina* at hand.

Distribution. Type locality, Macas, Ecuador. Ecuador. (A. M.). (A. S.).

Azonax

Godman and Salvin, Biol. Centr.-Amer.,
Rhop., vol. 2, p. 267, 1893
Orthotype, *Myscelus typhaon* Hewitson

A. typhaon

Hewitson, Ann. and Mag. Nat. Hist., vol. xx, (Octo.), p. 320, 1877.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 267; vol. 3, pl. 74, figs. 27, 28, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 207, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 849, pl. 165 e, 1921.

This species seems to be very rare in collections and there is no material at hand for study.

Distribution. Type locality, Nicaragua.

Myscelus

Hubner, Verz. bek. Schmett., p. 110, 1820.
Logotype, *Papilio nobilis* Cramer.

Genitalia. The uncus tapers from the base into a single slender arm, curved downward at the top. The girdle is usually rather short; the saccus variable; the aedoeagus long and slender, in some species with a long spine extending beyond the apex; the claspers terminate in two irregular arms, in some species without serrations, in others with serrations at or near the apex of one or both arms.

M. nobilis

Cramer, Pap. Exot., vol. 2, pp. 17, 18, pl. 108, figs. A, B, 1779.

(?) Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

(?) Draudt, Seitz, Macrolep. of the World, vol. 5, p. 848, (not plate 165 a), 1921.

salus Fabricius, Spec. Ins., vol. 2, p. 135, 1781.

The Cramer figure, though rather poor, is ample for the identification of this species. The typical form of *nobilis* has a dark red-brown ground color of the upper side of the wings, the veins of the primaries heavily outlined with black; the discal and sub-marginal bands of the secondaries are rather heavy, comparatively straight, somewhat macular and the outer one not prolonged on the veins toward the outer margin of the wing; there are also short basal and sub-basal bands, some times indistinct. There is considerable blackening of the apical area and costal margin of the primaries. The marginal black band of the secondaries is rather broad. On the under side the color is more yellowish, the hyaline spots of the primaries heavily outlined in black, the bands of the secondaries repeated, the sub-basal band more distinct.

It seems doubtful that the references of Mabille and Boullet, and of Draudt, can apply to this species, as both state that part of the outer band of the secondaries is prolonged along the veins toward the outer margin of the wing. The Draudt figure of *nobilis* is very evidently *hages* Godman and Salvin.

Capt. Riley has made and given to the writer a fine copy of the original Cramer drawing of *nobilis.*

The inclusion here of *salus* Fabricius in the synonymy of *nobilis* follows that of other authors.

Distribution. Type locality, presumably Surinam. Ega; Pebas. (B.M.).

M. nobilis, race **illustris.** (Plate XXIII, Fig. 17).

Mabille, Gen. Insect., Hesp., p. 13, 1903.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 164 g, 1921.

On the upper side this race is paler in color, the veins less heavily outlined in black; the bands of the secondaries less heavy. The pattern of the maculation is the same as in typical *nobilis.*

The lower arm of the claspers is rounded at the apex, the dorsal edge forming a triangular flange without serrations.

Distribution. Type locality, Bolivia. Bolivia; Peru. (M. & B.). Bolivia. (B).

M. flavicollis

Rober, Ent. Mitteil., vol. xiv, p. 158, 1925.

This insect was described from a single female from an unknown locality. It is said to resemble *nobilis* on the upper side, but is larger, browner, the hyaline spot of the secondaries smaller, the veins of the primaries more broadly black, the entire apical half much darkened, the hyaline spots larger in proportion to the size of the insects and more broadly enclosed with black, the outer borders dark brown, not sharply defined proximally. The hind wings broader.

The under side is similar to that of *caucanus,* the yellow basal area of the secondaries extends only as far as the distal border of the hyaline spot; proximally there is the remainder of a black band and a like sub-basal spot; the outer part of the wing is not so dark as in *caucanus* and the dark bands are therefore plainer, and on the border of the wing another similar band. The outer part of the primaries is lighter and the border band narrower.

The body is darker than in *nobilis,* beneath sulphur yellow, as are the extremities except the last joint of the palpi which is black. Head similarly marked.

It is not certain that Rober has correctly identified *nobilis* and it may possibly be that the insect he has used for comparison is in reality one of the various forms of *amystis* Hewitson. *Caucanus* Staudinger is a local race, or perhaps a form, of *phoronis* Hewitson. At any rate, the writer is unable to distinguish *flavicolis* among any of the *Myscelus* species before him.

M. amystis

Hewitson, Descr. Hesp., part, I, pp. 1, 2, 1867. Exot. Butt., vol. 5, Pyrrh. pl. 4, figs. 28, 29, 1873.

Plotz, Stett. Ent. Zeit., vol. xl, p. 538, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Druce, Trans. Ent. Soc. London, (2), p. 376, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 165 a, 1921.

Typical *amystis* is decidedly yellow, the black marking reduced, especially those on the under side of the secondaries; it is a pale form of an insect which presents a wide variation in the ground color of the wings and the extent in which the black markings are present.

The primaries have a discal hyaline band of three spots, the lowest of which may extend to vein 1 or fall far short of reaching that vein; two extra discal spots, usually one and sometimes two, in interspace 5; three subapical spots. The secondaries have a hyaline cell spot and the irregular, outer black band is produced along veins 2, 3, 4, 6, and 7 to or toward the border of the wing. Beneath the color is paler than above, the pattern of the maculation remaining as above but reduced.

The ground color of the wings in the various forms, on the upper side varies from the pale yellow of the typical insect to reddish-brown, both of the extremes sometimes being found in the same territory; for instance in the Cauca Valley, Colombia, both the very lightest and darkest forms are found. Some of these forms have received distinctive names.

Plotz places *amystis* as a synonym of *epigona* Herrich-Schaffer but this is apparently incorrect; the Draudt figure of *epigona*, presumably taken from the Plotz drawing of that species, is certainly not the insect which Hewitson figured as *amystis*.

Druce places *orbius* Mabille as a synonym of *amystis* and this is also evidently not correct as the figure of *orbius* given by Mabille in Genera Insectorum does not at all agree with the Hewitson figure of *amystis*, it is very evidently a synonym of *epigona*.

The Draudt figure of *amystis* is too dark to be typical and represents one of the darker forms of the species.

The termination of the lower arm of the claspers is truncate and without serrations.

Distribution. Type locality, "New Granada." Colombia. (B). Bogota; Santa Marta, Colombia; Venezuela. (B. M.).

M. amystis, race **hages**. (Plate XXIII, Fig. 18).

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 266; vol. 3, pl. 74, figs. 24, 25, 26, 1893.

Mabille and Boullett, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 165 a, 1921.

Kaye, Mem. Dept. Agric. Trinidad and Tobago, p. 121, 1921.

rogersi Kaye, Trans. Ent. Soc. London, p. 582, 1913.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 1046, 1924.

Hages is a darker form of *amystis* Hewitson which seems to occur as a race in Mexico and Central America and as a form, or local race, in some parts of South America. There are intermediate color forms between the pale *amystis* and *hages,* and much darker forms than *hages,* and if a long series be before one they will be found to gradually shade into each other. It does not seem necessary to apply distinctive names to all these color forms and practical purposes will be served just as well if the paler individuals are placed under *amystis* and the darker ones under its form *hages.*

Capt. Riley informs the writer that *rogersi* Kaye is the female of *amystis* and as Kaye records *hages* from Trinidad, whence came the type of *rogersi,* it seems likely that the name should be placed in synonymy here. Whether typical *amystis* occurs in Trinidad, or not, is unknown to the writer.

The form of the genitalia is the same as that of *amystis.*

Distribution. Type locality, not definitely stated, but the following localities are mentioned: Mexico; Guatemala; Panama; Peru. Colombia; Santa Cruz, Bolivia; Santa Catharina, Brazil. (B). Trinidad. (Kaye).

M. amystis, race **meridionalis**

Rober, Ent. Mitteil., vol. xiv, pp. 158, 159, 1925.

This and the following *distinctus* were described as subspecies of *nobilis* Cramer but were compared with the Draudt figure of that species, which, as previously stated under *nobilis,* is very evidently *hages* Godman and Salvin and not *nobilis* Cramer. The characters given in the description could as well apply to either *nobilis* or *hages* and the placing here is on account of the reputed likeness to the Draudt figure.

It is said to have a lighter ground color, the hyaline spots of the primaries less broadly surrounded by black, the outer border of those wings narrower and less sharp.

If this insect is really conspecific with *amystis* and not with *nobilis,* as seems may be the case, the name could be applied to those individuals intermediate in color between typical *amystis* and the form or race *hages.* A specimen in the collection of the writer, from Santa Catharina, Brazil, has the veins heavily outlined with black, the hyaline spots of those wings broadly bordered with black and the outer margin of those wings broad and sharply defined, however much individual variation exists in these details in a series from any locality.

Distribution. Type locality, Santa Catharina, Brazil.

M. amystis, race **distinctus**

Rober, Ent. Mitteil., vol. xiv, pp. 158, 159, 1925.

Although *distinctus* was described as a subspecies of *nobilis* Cramer it is placed here for the reasons stated under the previous insect (*meridionalis*).

Said to have the ground color of the wings a strong orange-yellow, the black markings plain and broad. Under side deep yellow, the black markings sharply contrasted. The dark scaling around the hyaline spots beyond the cell forms a comma-shaped spot.

The writer has no specimens from Ecuador and if the insect from that country constantly differs, the name may apply to the local race, but if the type is merely one of the numerous variations that occur everywhere it might just as well be placed in synonymy.

Distribution. Type locality, Ecuador.

M. orthrus

Hewitson, Ann. and Mag. Nat. History, vol. xx, (Octo.), p. 320, 1877.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, 1921.

The description states that the upper side is rufous, the base and margins darker. Primaries with three discal hyaline spots; three beyond them, one of which is small (minute); two near the apex and one on the costal margin. Secondaries with one transparent spot, followed by three bands of rufous spots. Underside as above except that the base of both wings is dull white. Outer margin of the secondaries strongly dentate.

Distribution. Type locality, not given.

M. sothis

Mabille, Ann. Soc. Ent. Belg., (C. R., p. 57), 1883.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, 1921.
aethras Mabille, Gen. Insect., Hesp., p. 13, 1903.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, 1921.

The description states that the wings are red-fulvous. Primaries with a red-brown marginal band; nine white hyaline spots, three of which are apical, the upper one placed backward; beneath these three in a semi-circular series, the upper one the smaller, the lower one larger and quadrate; three discal, the lower one not reaching vein 1. Secondaries dentate, a round white basal spot; three sinuous black bands connected between, the marginal one shadowy.

Beneath, base of wings sulphur-yellow, secondaries with black lines. Palpi sulphur yellow. Allied to *phoronis* which has four equidistant black lines on the secondaries. Differs also from *epimachia, phoronis,* and *santhilarius,* which it resembles, in having the under side of the secondaries red-fulvous, the base yellow crossed by three sinuous and macular brown lines, of which the two lower ones are close together.

Mabille, in Genera Insectorum, omits reference to Hewitson's *orthrus* in his list of the species in this genus, but includes "*aethras* Hewitson (?) (Equateur)." Capt. Riley, of the British Museum, informs the writer that after a diligent search he has been unable to find a description by Hewitson under the name *aethras.* The writer has also been unable to find one. It is quite probable that this name is merely a misspelling of Hewitson's *orthrus.*

Mabille and Boullet list both *orthrus* and *aethras,* and for some reason place Mabille's *sothis* as a synonym of *aethras,* although *sothis* was described in 1883 and apparently the first mention of *aethras,* without description, was Mabille's own use of the name in 1903, twenty years later.

Distribution. Type locality, Brazil. Mabille gives Ecuador for *aethras.*

M. epigona. (Plate XXIII, Fig. 19).

Herrich-Schaffer, Corresp.-blatt. zool.-mineral. Ver. Regensburg, vol. xxiii, p. 167, 1869. (Prodr. Syst. Lepid., part 3, p. 59, 1869).

Plotz, Stett. Ent. Zeit., vol. xl, pp. 528, 538, 1879.

Godman, Ann. and Mag. Nat. Hist., 7th ser., vol. xx, p. 150, 1907.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 164 g, 1921.

orbius Mabille, Ann. Ent. Soc. Belg. (C. R., p. 57), 1883. Genera Insect., Hesp., p. 14, pl. 1, fig. 2, 1903.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Druce, Trans. Ent. Soc. London, (2), p. 376, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, (not pl. 165 a), 1921.

It is assumed that the Draudt figure of *epigona* is taken from the Plotz drawing of that species. This figure does not differ in any essential detail from the Mabille figure of *orbius*.

The ground color of the upper side of the wings is rather pale orange-yellow, the veins of the primaries narrowly black bordered; a rather broad, somewhat diffuse, dark marginal band on both wings; the secondaries with a darkened basal area, two diffuse, dark bands, the inner of which divides into two parts opposite the hyaline cell spot.

The primaries have the usual hyaline spots more or less narrowly bordered with black.

Beneath, paler yellow, all of the dark markings of the upper side much reduced and often some of them are absent. The secondaries are often nearly immaculate.

The females are red-brown above, beneath paler; the disc of the secondaries between the bands sometimes darker than the rest of the wing; sometimes all the wing is evenly darkened except the base. The wings are broader than in the male and the projection in the outer margin more prominent; the marginal dark band of the secondaries occasionally more indistinct.

Mabille and Boullet were apparently unable to identify *epigona* as it is placed as unrecognized in their paper, which is, of course, not surprising in view of the incompleteness of the Herrich-Schaffer description.

The Draudt figure is a little more orange tinted than any of the series at hand and does not show very well the diffuse, dark marginal band of the secondaries.

Plotz apparently misidentified Hewitson's *amystis* when he placed *epigona* in synonymy with it, and Druce must have similarly erred when he placed *orbius* Mabille as a synonym of *amystis*.

The Draudt figure of *orbius* is very evidently one of the dark forms of *amystis* Hewitson and does not at all agree with the Mabille figure of *orbius*.

The lower arm of the claspers is somewhat more slender than in the preceding species, the apex truncate. The apex of the upper arm is also somewhat truncate and there are no serrations in this part of either arm.

Distribution. Type locality, not given. Godman states that the Plotz figure was taken from a specimen from Venezuela. *Orbius,* Brazil. Venezuela; Peru; southern Brazil. (B).

M. phoronis. (Plate XXIII, Fig. 20).

Hewitson, Descr. Hesp., (1), p. 1, 1867. Exot. Butt., vol. 5, Pyrrh. pl. 4, figs. 30, 31, 1873.
Staudinger, Exot. Schmett., pl. 99, 1888.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 165 a, 1921.

The lower arm of the claspers is a little sinuous, the truncate apex with well developed serrations; the upper arm serrate on the dorsal edge in the apical area.

Distribution. Type locality, "New Granada." Bogota, Colombia; Ecuador. (B).

M. phoronis, form caucanus

Staudinger, Exot. Schmett., pp. 295, 311, 1888.

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 266, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 206, 1908. (as synonym of *persela* Mabille).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, 1921.

persela Mabille, Ann. Soc. Ent. Belg., vol. xxxv, (C. R., pp. cvii, cviii), 1891.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, 1921.

Standinger states that among his specimens of *phoronis,* one from the Cauca Valley, Colombia, appears to be a local form, distinguished by the darker and more unicolorous upper side of the wings and on the under side of the secondaries lacking the transverse band before the hyaline cell spot and the small basal stripe; the outer border of the wing so darkened that the outer bands are hardly distinguishable.

Specimens in the American Museum of Natural History collection and one sent to the writer by Capt. Riley agree with the description. It is very evidently a local form or race of *phoronis.*

Mabille and Boullet place *caucanus* as "*epimachia* var. *caucanus*" in synonymy with *persela* Mabille although the Staudinger description has three years' priority over that of Mabille. The synonymy must therefore be reversed.

Distribution. Type locality, Cauca Valley, Colombia. *Persela,* Cauca. Cauca, Colombia. (B. M.). Mesopotamia, Antioquia, Colombia. (A. M.).

M. belti. (Plate XXIII, Fig. 21).

Godman and Salvin, Proc. Zool. Soc. London, pp. 153, 154, 1879. Biol. Centr.-Amer., Rhopal., vol. 2, pp. 265, 266; vol. 3, pl. 74, figs. 21, 22, 23, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 205, 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 166 c, 1921.

As in other species *belti* varies in the shade of the ground color of the upper side of the wings, the more northern specimens being the darker. The primaries have the usual pattern of hyaline spots. The apical area of the primaries is more or less darkened, especially in the females. The secondaries of the males examined have no hyaline cell spot, but a small one is present in the females. The secondaries have a more or less indistinct discal band and a like sub-basal band.

Beneath, the primaries of the males have the apical area beyond the discal hyaline spots darkened, the basal area pale yellow. The secondaries have a broad marginal brownish-black band, followed inwardly by a short, similarly colored band, which is but narrowly separated from the marginal band by a yellow stripe, and a small blackish spot below vein 2 toward the base; the rest of the wing is pale yellow.

The primaries of the females have a submarginal row of reddish spots, decreasing in size toward the apex of the wing, or all above the anal angle are small and diffuse. Beneath similar to the males, but sometimes with additional black spots on the secondaries in and above the cell. In some specimens the reddish areas of both wings above are much brighter in tone.

The Godman and Salvin figures (21 and 22) are apparently of a female, as is that of Draudt. The secondaries of the male are narrower and more elongate, the projection in the outer margin not so prominent.

In a female from Colombia in the writer's collection, the black bands of the upper side of the secondaries are reduced to three or four small black spots outside of the hyaline cell spot, and the entire wings, except a narrow black marginal band, inner marginal area and basal area below the costa, are bright red.

The lower terminal arm of the claspers is produced well beyond the apex of the upper arm, slightly curved upward to a somewhat pointed apex, with well developed serrations on both ventral and dorsal edges. The upper arm has a few small serrations at the dorsal apical angle. In none of the several specimens examined is the lower arm so narrow and so sharply pointed as in the Godman and Salvin figure (23).

Distribution. Type locality, Chontales, Nicaragua; Polochic Valley, Guatemala. Guatemala; Nicaragua; Costa Rica; Panama. (G. & S.). Colombia. (B). (A. M.).

M. belti, race perissodora

Dyar, Proc. U. S. Nat. Museum, vol. 47, p. 366, 1915.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 1046, 1924.

Perissodora differs from *belti* in the darker ground color of the upper side of the wings; on the under side of the secondaries the short dark band following the broad marginal band is separated from it by scattered yellow scales, instead of a yellow stripe as in *belti,* and in the type the small black spot between veins 1 b and 2 toward the base is absent, but is present in a Mexican specimen at hand, which otherwise agrees with the description, and notes kindly sent to the writer by Dr. Schaus.

The form of the genitalia does not differ from that of *belti.*

Distribution. Type locality, Misantla, Mexico. Jalapa, Mexico. (A. M.).

M. santhilarius. (Plate XXIII, Fig. 22).

Latreille, Enc. Meth., vol. 9, p. 737, 1823.
Herrich-Schaffer, Corresp.-blatt. zool.-mineral. Ver. Regensburg, vol. xxiii, p. 167, 1869. (Prodr. Syst. Lep., (3), p. 59, 1869; as *st. hilarius*).
Hewitson, Exot. Butt., vol. 5, Pyrrh. pl. 4, figs. 24, 25, 1873.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 206, 1908.
Riley, Trans. Ent. Soc. London, (2), p. 232, 1926.

Santhilarius has a dark ground color; the apical area and outer margin of the primaries, the costal and outer margin of the secondaries blackish; the discal area of both wings reddish-brown. The hyaline spots of the primaries have a pale yellowish tinge; the subapical series is curved and below them are from three to five small hyaline spots in an inwardly curved series. The costal margin is more or less striped with yellow. The secondaries have no hyaline cell spot, but two rather broad black bands, one discal and the other sub-basal.

Beneath black, the primaries with transverse basal and sub-basal yellow bands, some yellow spots on the costa; a diffuse pale stripe outside of the hyaline spots as far as vein 1; the veins a little paler than the ground color of the wing. The secondaries with a very narrow basal and a broader sub-basal pale yellow band; a broad discal band of the same color which is split into two spots above vein 7 and followed outwardly by a very narrow stripe which is connected with the outer of the two spots above vein 7.

Female similar, the black areas of the upper surface less pronounced; beneath with a brownish area between the discal hyaline band and the other hyaline spots in the apical area of the primaries. Secondaries broader and the projection of the outer margin more pronounced than in the male.

As pointed out by Capt. Riley, the Draudt figure of *santhilarius* is really *epimachia* Herrich-Schaffer. It is doubtful that the text in Seitz Macrolep. of the World can refer to this species.

The lower terminal arm of the claspers is curved upward toward the apex and ends in a sharp point, with well developed serrations on both edges in the apical area. The upper arm is serrate in the apical area of the dorsal edge.

Distribution. Type locality, Brazil. Hansa Humboldt; Massaranduba, Santa Catharina, Brazil. (B).

M. epimachia. (Plate XXIII, Fig. 23).

Herrich-Schaffer, Corresp.-blatt. zool.-mineral. Ver. Regensburg, vol. xxiii, p. 167, 1869. (Prodr. Syst. Lep., (3), p. 59, 1869).

Hewitson, Exot. Butt., vol. 5, Pyrrh. pl. 4, figs. 26, 27, 1873.

Plotz, Stett. Ent. Zeit., vol. xl, p. 527, 1879.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 206, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 848, pl. 164 g (as *santhilarius*), 1921. (not plate 165 a).

Riley, Trans. Ent. Soc. London, (2), p. 232, 1926.

Epimachia somewhat resembles *belti* Godman and Salvin in superficial appearance. The color of the wings is fulvous, in some individuals there is a heavy suffusion of black, especially toward the apex and on the outer margin of the primaries, in others this is entirely absent. The veins of the primaries are blackened, sometimes heavily and other times but slightly. The secondaries are without the blackened veins, but these wings have two black bands, usually plain, but sometimes a little indistinct; one of these is discal and the other sub-basal. No hyaline cell spot of the secondaries. Beneath the primaries are mostly pale brown, yellow at the base, a stripe of that color above the discal hyaline band and a pale diffuse stripe outside the hyaline spots, and along the inner margin. Secondaries beneath yellow with a broad marginal black band, a discal black band beginning on vein 7, a sub-basal black band beginning close to the costal margin and a very slender basal black band.

The lower arm of the claspers terminates in a short, sharp pointed, serrate flange with another short, serrate flange arising from the dorsal edge. The upper arm is shorter and not serrate.

Distribution. Type locality, not given. Plotz gives Peru. Santa Cruz, Bolivia; Peru; Amazons. (B).

M. draudti. (Plate XXIII, Fig. 24).

Riley, Trans. Ent. Soc. London, (2), p. 233, 1926.

epimachia Draudt, Seitz Macrolep. of the World, vol. 5, pl. 165 a, 1921.

This species resembles *epimachia* Herrich-Schaffer but differs in having the veins of the secondaries noticeably black and these wings have a more oblong appearance; the discal black band is broad, the basal area suffused with black as far as the hyaline cell spot (which is sometimes absent). Fringes of these wings yellowish-white between the veins. Underside similar to *epimachia* but the outer of the two black bands expands and converges toward the second band, the two together filling area 1, b. The marginal black band is wide.

The form of the male gentalia is somewhat similar to that of *epimachia,* but in the single specimen available for examination the lower arm of the claspers does not have the prominent dorsal flange near the apex.

Distribution. Type locality, Chairo, Bolivia. Peru. (B. M.).

M. assaricus

Cramer, Pap. Exot., vol. 3, pp. 120, 121, pl. 261, figs. F, G, 1782.

Watson, Proc. Zool. Soc. London, (1), p. 15, 1893.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, pp. 187, 188, 1908. (*Yanguna*).

Draudt, Seitz Macrolep. of the World, vol. 5, p. 842, pl. 164 c, 1921. (*Yanguna*).

alsarius Fabricius, Ent. Syst., vol. 3, (1), p. 343, 1793.

The Cramer description states that the thorax, part of the primaries and nearly all of the secondaries are covered with yellow-brown scales, extending on the secondaries as far as the black spots. The posterior part of the body is blue-black annulated with white and orange, the anal tuft orange. The spots of the primaries are white hyaline; the ground color of the wings shining indigo. Beneath, the blue spots of the secondaries are a little transparent.

From the figure *assaricus* must resemble *Agara mapirica* Strand but differs in having an orange anal tuft.

This species has usually been placed by authors in the genus *Yanguna* but it seems more nearly allied here than in that genus. Watson placed it in his paper in the genus *Myscelus*. *Alsarius* Fabricius appears to represent a misspelling of the name.

Butler, in Cat. Diurn. Lep., Fabr., B. M., p. 264, 1869, states that there is a specimen which bears a label on which is inscribed the name "P. Janthibaris Latr."

Distribution. Type locality, Surinam.

M. pegasus

Mabille, Gen. Insect., Hesp., p. 14, pl. 1, fig. 3, 1903.

Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 206, 1908.

Draudt, Seitz Macrolep. of the World. vol. 5, p. 848, pl. 165 b, 1921.

The description states that this species is near *epimachia*. The wings rufous; the hyaline spots white, the subapical series consisting of four elongate spots; one sagittiform beneath and two larger ones in interspaces 4 and 5 forming an oblique series; three large discal spots. Secondaries elongate and not scalloped, two black bands scarcely reaching the middle of the wing. Beneath, the basal third of the wing is pale luteous. Legs and palpi luteous.

The figure shows a dark reddish-brown upper surface of the wings. The secondaries long, narrow and broadened at the anal angle. The series of hyaline spots formed by the subapical and extra discal spots is somewhat like that of *santhilarius* but more oblique than curved. Beneath, the secondaries have a faint dark band extending through the cell.

Distribution. Type locality, Cayenne.

Oxynetra

Felder, Wien Ent. Mon., vol. vi, p. 179, 1862.
Haplotype, *Oxynetra semihyalina* Felder.

O. semihyalina. (Plate XXIII, Fig. 25).

Felder, Wien Ent. Mon., vol. vi, p. 180, 1862. Reise Novar., Lepid., vol. 2, p. 507, pl. 70, fig. 9, 1866.
Hopffer, Stett. Ent. Zeit., vol. xxxv, pp. 367, 368, 1874.
Staudinger, Exot. Schmett., p. 294, 1888.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 207, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 849, pl. 165 b, (?), 1921.
confusa Staudinger, Exot. Schmett., p. 294, 1888.
Mabille, Gen. Insect., Hesp., p. 14, 1903.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 207, 1908.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 849, pl. 165 b, 1921.

Felder's figure must be taken to represent *semihyalina* and it is unfortunate that Dr. Staudinger renamed the insect *confusa,* applying the name *semihyalina* to the other of the two insects confused by Felder in his description. He apparently did not consider that Felder had amply shown to which one his name applied when he published his figure.

Semihyalina has the subapical hyaline band of the primaries, broad and somewhat oval, the glaucus scaling below it along the outer border of the wing probably varies to some extent, as does the maculation of the secondaries. The tegulae have a large blue spot at the base. The outer margin of the secondaries is rounded.

The Draudt figure of *semihyalina* shows a red abdominal ring, although it is stated in the text that there is none; whether the figure represents a form of this species or some other species, the writer is unable to say. The Draudt figure of *confusa* represents *semihyalina*.

Draudt places *annulatus* Mabille as a synonym of *confusa*, probably following Mabille, in Genera Insectorum, where the synonymy of the two is reversed if they are actually the same species.

The short uncus terminates in two claw-like hooks. The saccus is short. The claspers terminate in a sharply upturned tapering arm, which has near its base, and lying well within the disc of the clasper, a stout upward projection with a bent, hook-like apex. The inner plate of the disc carries two teeth on the irregular dorsal edge. The aedoeagus has a curved apex. A shagreened scaphium is present. The form of the genitalia is the same as that of *felderi*, as figured by Godman and Salvin in the Biologia.

Distribution. Type locality, given by Felder as Mexico, but this is doubtfully correct. *Confusa*, Staudinger states that he had specimens from Chanchamayo. Ecuador. (A. S.). Alto Jurua, Brazil. (B).

O. felderi

Hopffer, Stett. Ent. Zeit., vol. xxxv, pp. 367, 368, 1874.

Staudinger, Exot. Schmett., p. 294, 1888. (not plate 99).

Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 268, (in remarks under *hopfferi*); vol. 3, pl. 74, fig. 19, 1893.

Mabille and Boulett, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 207, 1908.

Draudt, Seitz Macrolep. of the World, vol. 5, p. 849, pl. 165 b, 1921.

Hopffer recognized the fact that Felder's description of *semihyalina* was apparently based on two different insects and properly considered that the later Felder figure definitely fixed the one to which the name applied. He then gave the name *felderi* to the other one. Unfortunately in his description he did not entirely conform to the characters given by Felder, as he states that the second abdominal segment is fulvous margined above and that the scapulae (tegulae) are spotted in front with fulvous. Felder said that the abdomen was bluish-black and that the tegulae had a white spot at the base, intermixed with rufous.

Felderi is distinguished from *semihyalina* by the narrow, triangular, subapical hyaline band narrowly separated from the broad discal hyaline band, the second abdominal segment ringed with fulvous and the tegulae with a fulvous spot at the base.

There are several specimens before the writer, from Ecuador; Obidos, Brazil, and Chanchamayo, Peru, which agree with Felder's description but not with Hopffer's, in that they lack the fulvous abdominal ring and have the tegulae at the base spotted with white interspersed with fulvous. These may be a form of typical *felderi* as described by Hopffer.

The form of the male genitalia in these specimens does not differ from that of *semihyalina*.

Distribution. Type locality, Rio Negro, Brazil; Chanchamayo, Peru.

O. hopfferi

Staudinger, Exot. Schmett., p. 294, pl. 99 (as *felderi*), 1888.
Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, p. 268; vol. 3, pl. 74, fig. 18, 1893.
Draudt, Seitz Macrolep. of the World, vol. 5, p. 849, pl. 165 b, 1921.

Hopfferi is distinguished from the other species in this genus by the single hyaline band of the primaries and in having the five abdominal segments, 3 to 7 inclusive, ringed with orange and an orange spot at the base of the tegulae.

Distribution. Type locality, Chiriqui, Panama.

O. annulatus

Mabille, Ann. Soc. Ent. France, 6th ser., vol. ix, (Bull. p. clxxxiv), 1889.
Godman and Salvin, Biol. Centr.-Amer., Rhopal., vol. 2, pp. 268, 269; vol. 3, pl. 74, fig. 20, 1893.
Mabille, Genera Insect., Hesp., p. 14, 1903.
Mabille and Boullet, Ann. des Sciences Nat. Paris, 9th ser., vol. vii, p. 207, 1908.

This insect, for which Mabille erected the genus *Dis,* is described as being deep black above with a blue reflection. Beneath the primaries with a purplish reflection; the secondaries very black. The secondaries are not lobed. Fringes whitish at anal angle. Body black, first ring of the abdomen bordered with red, the second red. Head small, blue black with a white dot behind each eye and another between the antennae. Palpi white beneath.

Godman and Salvin indicate the possibility of *annulatus* being the female of an *Oxynetra* species, perhaps *hopfferi.* Until some definite information is obtainable it seems better that *annulatus* be kept separate.

Distribution. Type locality, Chiriqui, Panama.

Unrecognized species

Pyrrhopyge aethiops

Zschach, Mus. Lesk. Ent., p. 94, 1788; (*Papilio*). Gmel., Syst. Nat. vol. 1, (5), p. 2360, 1790.

Mabille, in Junk's Lepidopterorum Catalogus, part 9, p. 7, 1912, lists this name in the genus *Pyrrhopyge.* The writer is unable to recognize the species from the description but if it belongs in this sub-family it is possibly a *Jemadia.* The type locality is given as "extra European."

Pyrrhopyge iphimedia

Plotz, Stett. Ent. Zeit., vol. xlvii, p. 117, 1886.

The description states that the wings are glazed with dark green. The primaries have a broad dicsal hyaline band and a narrow subapical band of five spots, inner margin of the wings haired red-yellow, the fringes black. The secondaries with a large hyaline spot in interspace 7 and another one near it in the cell. Two small ones in cells 2 and 1c near each other, all are white. The shoulder-covers (tegulae ?) have two orange spots. Base and middle joint of the palpi red. The last abdominal rings are red with black indentations. The secondaries beneath are sulphur-yellow at the base; the fringes white.

The writer has been unable to recognize this insect or to obtain any information regarding it.

Type locality, Brazil.

Addenda

Pyrrhopyge garata Hewitson. (Plate XXIII, Fig. 26).

The form of the male genitalia of this species is somewhat similar to that of *hyperici* Hubner.

Pyrrhopyge guianae (Plate XXIII, Fig. 27).

Ent. News, vol. xliii, p. 68, 69, fig. 1, male genitalia, 1932.

This species is allied to the group containing *zenodorus* Godman and Salvin and somewhat resembles that species, the color of the red parts being darker in shade. The form of the genitalia readily distinguishes *guianae* from the other members of the group.

Pyrrhopyge cressoni Bell. (Plate XXIII, Fig. 28).

Ent. News, vol. xliii, pp. 69, 70; p. 68, fig. 2, male genitalia, 1932.

This species is allied to the group containing *phidias* Linnaeus, from which, and all the other members of the group, it may be distinguished by the entirely red pectus. The form of the male genitalia is somewhat similar to that of *draudti* Bell in the termination of the claspers, the basal flanges of the uncus are very large and deeply serrate on the dorsal edge and apex, in *draudti* they are narrower and more elongate.

Pyrrhopyge draudti Bell

A specimen in the collection of the Academy of Natural Sciences of Philadelphia, from Banos, Ecuador, and another one in the collection of the writer, from Bogota, Colombia, lacks the white basal area of the secondaries and the white stripes near the costal margin of the primaries. The form of the genitalia appears to be the same as in typical *draudti*.

Pyrrhopyge amythaon Bell

There is a specimen from Iquitos, Peru, in the writer's collection and another one from East Colombia, in the Academy of Natural Sciences of Philadelphia, with a rather broad, white basal area of the secondaries beneath, and which appear to have the same form of genitalia as the typical form without the white basal area.

Pyrrhopyge kelita, form **tristis** Mabille and Boullett

Capt. Williams has called the attention of the writer to the fact that the type locality of this form is "1 male, Bolivia, 1 male, Ecuador."

Pyrrhopyge fluminis Butler

The Plotz reference to *tiribazus* is "Stett. Ent. Zeit., vol. xl, p. 533, 1879," where Plotz himself places the name as a synonym of *fluminis*. This reference was omitted from the first of the series of these papers.

Pyrrhopyge aesculapus Staudinger

Additional reference: Staudinger, Exot. Schmett., p. 295, pl. 99, 1888.

Apyrrothrix araxes, race **arizonae** Godman and Salvin

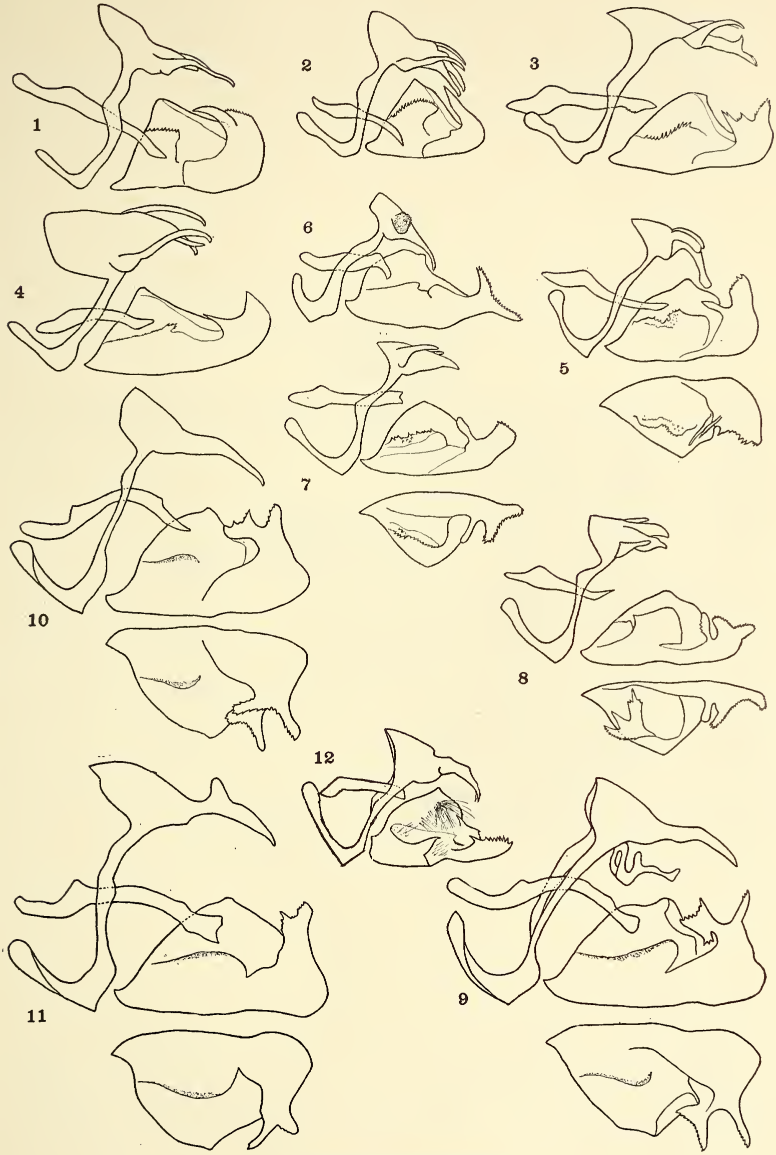
Additional references:

Holland, Butterfly Book, p. 319, pl. xlv, fig. 9, 1898.
Wright, Butt. West Coast, p. 255, pl. xxxii, fig. 481, 1906.
Holland, Butt. Book, (Revised Edition), p. 326, pl. xlv, fig. 9, 1931.

PLATE XXII

Male Genitalia

Figure 1. Sarbia xanthippe Latreille.
Figure 2. Sarbia damippe Mabille and Boullet.
Figure 3. Sarbia antias Felder.
Figure 4. Sarbia pertyi Plotz.
Figure 5. Mimoniades ocyalus Hubner.
Figure 6. Mimoniades othello Plotz.
Figure 7. Mimoniades eupheme Godman and Salvin.
Figure 8. Mimoniades versicolor Latreille.
Figure 9. Mimoniades sela form peruviana Draudt.
Figure 10. Mimoniades periphema Hewitson.
Figure 11. Mimoniades pityusa form hemitaenia Rober.
Figure 12. Croniades pieria Hewitson.

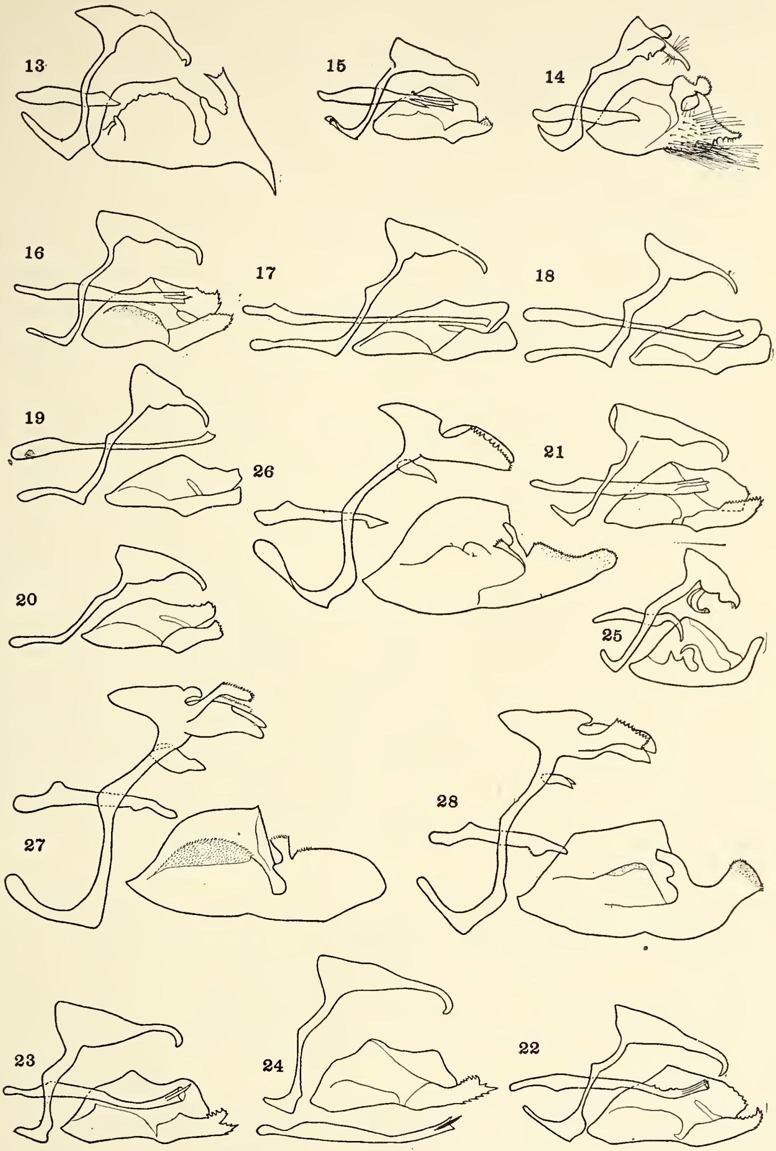


PYRRHOPYGINÆ

PLATE XXIII

Male Genitalia

Figure 13. Croniades machaon Doubleday, Westwood and Hewitson.
Figure 14. Microceris variicolor Menetries.
Figure 15. Agara pardalina Felder.
Figure 16. Agara mapirica Strand.
Figure 17. Myscelus nobilis race illustris Mabille.
Figure 18. Myscelus amystic race hages Godman and Salvin.
Figure 19. Myscelus epigona Herrich-Schaffer.
Figure 20. Myscelus phoronis Hewitson.
Figure 21. Myscelus belti Godman and Salvin.
Figure 22. Myscelus santhilarius Latreille.
Figure 23. Myscelus epimachia Herrich-Schaffer.
Figure 24. Hyscelus draudti Riley.
Figure 25. Oxynetra semihyalina Felder.
Figure 26. Pyrrhopyge garata Hewitson.
Figure 27. Pyrrhopyge guianae Bell.
Figure 28. Pyrrhopyge cressoni Bell.



PYRRHOPYGINÆ

DR. FREDERIC WEBSTER GODING
MAY 9, 1858—MAY 5, 1933

By Chris E. Olsen

It is with deep regret for the loss of an esteemed friend and entomologist that I have acceded to complete the editing of the following paper, which was to be the last of a long series of papers on Membracidæ and the crowning of the life work in entomology of the late Dr. Frederic Webster Goding.

Dr. Goding's last wish, in his aged and infirm condition, was to be spared long enough to see this work completed and in print. This wish he practically attained. He saw the paper accepted by the New York Entomological Society and the first installment of it in galley proof, while the rest of the manuscript, still in his possession, required but little attention; he had completed the study of all material.

It has been my great privilege and pleasure for a number of years to assist Dr. Goding in supplying translations of articles in foreign languages with which he was unfamiliar, with transcriptions of articles from more or less rare volumes that were not accessible to him, and with photographs of published plates on Membracidæ for many of his later papers. Through this we formed a close friendship and many noteworthy characteristics were revealed to me of his otherwise retiring and quiet personality.

As an entomologist Dr. Goding was remarkable in many ways. The outstanding part of his lengthy entomological bibliography is his work on the membracid group. He spent close to half a century in the study of this insect family. Early in his career, and to the end, he was regarded as a prominent student in this field of research.

His entomological career dates back to 1884 when he became assistant state entomologist of Illinois; this position he held until 1895. During 1885–86 he also held the chair of Natural Sciences at Louden College, Tennessee.

In 1898 he entered the U. S. diplomatic service, in which he continued for nearly thirty years, first as consul to New South Wales and Queensland in Australia, later to Uruguay and Ecuador, South America. During these years, membracid taxonomy was his hobby and recreation, and in the last few years that he spent in Livermore Falls, Maine, the homestead of the Goding family for generations, this study became his only remaining love in life.

In observing Dr. Goding as I did, it was obvious that his thirty years of foreign service, although grand and glorious to begin with, had left a very unpleasant effect upon his retirement. In this period, when considerable changing of his early surroundings had taken place, he found himself alone, having lost his wife in South America. Most of his entomological colleagues, many of whom he had splendidly lauded in his pen sketches, were now only memories. New friends were strangers and strangers were not cognizant of the return of a former mayor, or a once practising physician, or a past assistant state entomologist, but just of the return from foreign service of an old-time resident. However, while all his old-time pals had changed, scattered, or were gone, the ''Bugs'' were and still remained the same unchanged loyal pals.

Within his remaining family circle he was particularly sad to discover that his very own son and daughter had lost the ability of paternal recognition, the affection that a father expects his children to maintain. He tried in various ways to compensate for what he thought was his own parental negligence, but it was too late. His children were children no longer, but belonged to the men and women who, by fate or failure, are destined to carve a meager livelihood for the mere privilege of existing in this, we are prone to call, ''advanced age of civilization.''

Dr. Goding wrote many biographical sketches, ''pen sketches,'' and memoriæ. One has but to read one of these to form an opinion of his splendid character and exceptionally friendly personality.

To those of his friends that remain he leaves a lasting memory and his name in membracid literature will never die.

The ancestry of Dr. Goding on both sides dates from the Pilgrim Fathers. He is survived by a son and a daughter, both living in Livermore Falls, Maine.

Some of Dr. Goding's Various Activities

Early education was received in Public School, Chicago. Later he became a public-school teacher in the state of Illinois.

Received his M.D. degree from Northwestern University in 1882. Practiced medicine until 1898.

He was a delegate to the Republican State Convention of Illinois when Governors Fifer and Tanner were elected 1886–1896. Mayor of Rutland, Ill., for nearly ten years, 1887–1897.

During his service as American Consul to New South Wales and Queensland he wrote many valuable reports on commerce and industry of Australia. These reports were in a great measure responsible for increased trade between Australia and the U. S. A.

Published Corporation Ordinance of Rutland, Ill., 1880. A long list of entomological papers, biographical sketches, memoriæ, and the genealogy of the Goding family.

Discovered the secret of tempering copper similar to the method used by the ancients, also devised means for welding copper to iron and steel. These inventions were turned over to the U. S. Government.

Bibliography of Entomological Papers

By Dr. F. W. Goding

1890. A new orthopteron from Tennessee. Entomologica Americana 6, 1890, 13–14.

1890. A new apple pest. Ent. News 1, 1890, 123–124.

1892. A synopsis of the subfamilies and genera of the Membracidæ of North America. Amer. Ent. Soc. Trans. 19, 1892, 253–260.

1892. Studies in North American Membracidæ II. Ent. News 3, 1892, 108–111; 200–201.

1893. Food plants of some North American Membracidæ (1892). U. S. Div. Ent. Insect Life 5, 1893, 92–93.

1893. The Membracidæ of St. Vincent Island, W. I. Can. Ent. 25, 1893, 53–56.

1893. Fitch's types of North American Membracidæ. Can. Ent. 25, 1893, 171–172, 196.

1895. Studies in North American Membracidæ III. Can. Ent. 27, 1895, 274–277.

1896. Bibliographical and synonymical catalogue of the described Membracidæ of North America (1894). Ill. Sta. Lab. Nat. Hist. Bull. 3, 1896, 391–482.

1896. Synopsis of the subfamilies and genera of the North American Cercopidæ with a bibliographical and synonymical catalogue of the described species of North America, 1895. Ill. Sta. Lab. Nat. Hist. Bull. 3, 1896, 483–501.

1897. *Ledra perdita vs. Centroshus Liebeckii.* Can. Ent. 29, 1897, 245–246.

1898. A preliminary study of the Membracidæ described from Australia and Tasmania. Proc. Linn. Soc. N. S. Wales 23, 1898, 85–90.

1903. Insects and Disease. Newcastle Morning Herald, May 13, 1903.

1903. A Monograph of the Australian Membracidæ. Proc. Linn. Soc. N. S. Wales, pp. 2–41, pl. 1, 1903.

1904. (Goding and Troggart) Monograph of Australian Cicadidæ. Proc. Linn. Soc. N. S. Wales XXIX, 561–669.

1914. Catalogue of the Membracidæ of Uruguay. Ent. News 25, 1914, 397–403.

1920. The known Membracidæ of Ecuador. Ent. News 31, 1920, 135–136, 155–159.

1920. Sinopsis de los Membracidas del Ecuador. Bol. de Medicina y Cirugia 18, 1920, 31–37.

1921. Sinopsis de los Membracidas del Ecuador. Rev. Colegio Nacional Vicente Rocafuerte, Sept., 1921, 1–15.

1923. Sinopsis de los Cercopede del Ecuador. Rev. Colegio Nacional Vicente Rocafuerte 5, 1923. (Reprint, pp. 1–8.)

1923. Synopsis of the Membracidæ of Chile. Rev. Chilean de Historia Natural. 27, 1923, 118–123.

1925. Synopsis of the Cicadidæ of Ecuador. Rev. Colegio Nacional Vicente Rocafuerta Guayaquil 19–20, 1925, 1–34.

1925. The described Cicadidæ of Chile. Rev. Chil. Hist. Nat. Santiago 29, 1925, pp. 232–285.
1926. New genera and species of Membracidæ. Trans. Amer. Ent. Soc. 52, 1926, 103–110.
1926. Synonomy of Buckton's Australian Membracids. Jour. N. Y. Ent. Soc. 34, 1926, 207–208.
1926. New Membracidæ I. Jour. N. Y. Ent. Soc. 34, 1926, 243–246.
1926. New Membracidæ II. Jour. N. Y. Ent. Soc. 34, 1926, 279–281.
1926. Classification of the Membracidæ of America. Jour. N. Y. Ent. Soc. 34, 1926, 298–317.
1927. Revision of the Membracidæ of South America and Antilles. Jour. N. Y. Ent. Soc. 35, 1927, 183–191.
1927. New Membracidæ III. Jour. N. Y. Ent. Soc. 35, 1927, 167–170.
1927. Synonymic Notes on Jassoidæ and Membracidæ. Ann. Mag. Nat. Hist. 20, 1927, 541–542.
1927. The Membracidæ of South America and Antilles II, Subfamily Centrotinæ. Jour. N. Y. Ent. Soc. 35, 1927, 391–409.
1928. New Membracidæ IV. Jour. N. Y. Ent. Soc. 36, 1928, 37–41.
1928. New Membracidæ V. Jour. N. Y. Ent. Soc. 36, 1928, 43–45.
1928. New Membracidæ VII. Bull. Brook. Ent. Soc. 23, 1928, 137–142.
1928. Membracidæ of South America and Antilles III. Jour. N. Y. Ent. Soc. 36, 1928, 201–234.
1929. New Membracidæ VI. Jour. N. Y. Ent. Soc. 37, 11–12.
1929. The Membracidæ of South America and the Antilles IV. Trans. Amer. Ent. Soc. 55, 1929, 197–330.
1929. New Membracidæ VIII. Jour. N. Y. Ent. Soc. 37, 1929, 167–168.
1929. New Membracidæ IX. Jour. N. Y. Ent. Soc. 37, 1929, 171–174.
1929. Notes on some South American Membracidæ. Jour. N. Y. Ent. Soc. 37, 1929, 7–9.

1930. An injurious Membracid. Jour. N. Y. Ent. Soc. 38, 1930.
1930. Synonymical notes on Membracidæ. Jour. N. Y. Ent. Soc. 38, 1930, 39–42.
1930. New Membracidæ X. Jour. N. Y. Ent. Soc. 38, 1930, 89–92.
1930. Membracidæ in the American Museum of Natural History. Am. Mus. Novitates #421, 1930, 1–27.
1931. Synonymical notes on Membracidæ II. Am. Ent. Soc., Amer. 24, 1931, 935–936.
1931. Classification of the Old World Membracidæ. Jour. N. Y. Ent. Soc. 39, 1931, 299–313, 606.
1934. The Old World Membracidæ. Jour. N. Y. Ent. Soc. Vol. XLII, No. 4, pp. 451–480 (posthumous).

Bibliography of Miscellaneous Writings

1885. Biographical Sketch of William Le Baron. Ent. Amer. Vol. I, #7, pp. 122–125.
1886. A Pen Sketch of Dr. William Le Baron. Trans. Ill. St. Hort. Soc. 1886, 20, pp. 176–178.
1887. A Pen Sketch of Benj. D. Walsh, First State Entomologist of Illinois. Trans. Ill. St. Hort. Soc. 21, 1887, 152–155.
1888. A Pen Sketch of Prof. C. V. Riley, Formerly State Entomologist of Missouri. 31st Ann. Rpt. of State Hort. Soc. Missouri, 265–269.
1888. A Pen Sketch of Prof. A. J. Cook. 18th Ann. Rpt. of St. Hort. Soc. Michigan, 1888, 338–339.
1888. A Pen Sketch of Prof. F. H. Snow, Acting State Entomologist. Kan. State Hort. Soc. Rept., Vol. 17, 1887–88, p. 226.
1888. A Pen Sketch of Cyrus Thomas, Third State Entomologist. Trans. Ill. St. Hort. Soc. 22, 1888, pp. 106–108.
1889. A Pen Sketch of Prof. S. A. Forbes, Fourth State Entomologist. Trans. Ill. St. Hort. Soc. 1889, 1882–1886.
1889. In Memoriam: George John Bowles. 20th Ann. Rpt. Ent. Soc. Ont. 1889, pp. 20–21.
1890. A Pen Sketch of Dr. S. S. Rathvon, Prof. of Entomology. State Hort. Ass. Penn. (Rpt. Agri. Penn.), pp. 8–10, plate.

1890. Mathew Cook. West Am. Sci. Aug. 1890, VIII, pp. 27–29. State Hort. Ass. Penn. (Rpt. Agri. Penn.) pp. 8–10, plate.

1890. Three Friends of New York Agriculture. Trans. N. Y. State Agric. Soc. 50th Ann. Rpt. 1890, pp. 358–366.

Fitch, Asa,	pages 358–361,	ill. facing	p. 358.
Lintner, J. A.,	" 361–363,	" "	" 360.
Comstock, J. H.,	" 363–366,	" "	" 364.

1891. Edwin Wortham Doran (Portrait). W. Am. Sci. 1891, VII, pp. 73–75.

1891. David Starr Jordan (Portrait). W. Am. Sci. 1891, VII, p. 174.

1893. Herbert Osborn. West. Am. Sci., July, 1893, Vol. 8, #65, pp. 39–40.

1904. Ancestry of Lydia Mahitable Chandler, Newcastle, N. S. W. Davies and Carington, 1904, 8.

1906. Genealogy of the Goding Family, with a biographical sketch of the author by Mrs. A. M. Taylor and Stewart Kightly. Richmond, Ind., 175 pp., 21, 17 pl., 8.

1920. A brief history of the American consulate general of Guayaquil, Ecuador, Livermore Falls, Me. The Advertizer Press, 1920, 23 pp., 8.

1933 Synonymical notes on Membracidae, Ent. News, vol 44, July, pp185-187

NOTE ON THE FOOD OF THE BLACK WIDOW SPIDER[1]

By HARRIET EXLINE AND MELVILLE H. HATCH

In western Washington the Black Widow spider (*Latrodectus Mactans* F.) is known only from Whidby Island, Fidalgo Island. and some of the San Juan Islands. In the latter locality one of us (H.E.) in the summer of 1934 collected such an extensive series of the remains of animals, mostly Coleoptera, that had apparently served as the prey of this spider that it was thought worthwhile to publish a list thereof.

The specimens reported on were obtained from a total of seven

[1] Contribution from the Zoological Laboratory of the University of Washington.

or eight nests and the number of individuals of each species collected, when there was more than one, is indicated in parentheses following each name.

Entomologists will recognize in *Coniontis, Eleodes, Dyslobus,* and *Brachyrhinus* very resistant beetles that often endure many hours in the cyanide bottle before being overcome, and the suggestion is probably not without merit that the virulent toxicity of the venom of the Black Widow is correlated with the "tough" nature of its prey.

We are indebted to Mr. M. C. Lane for the name of the *Adelocera* and *Ludius tinctus* and to Mr. W. J. Eyerdam for the identification of the gastropod.

List of Species

ISOPODA: *Porcellio scaber* Latr.

DERMOPTERA: *Forficula auricularia* L.

CICINDELIDAE: *Omus dejeani* Reiche (2)

CARABIDAE: *Scaphinotus angulatus* Harr., *S. angusticollis* Mann., *S. marginatus* Fisch. (4), *Pterostichus algidus* LeC. (*validus* Dej.) (5), *P. adstrictus* Esch., *Amara* probably *californica* Dej., *Harpalus cautus* Dej. (3)

SILPHIDAE: *Necrophilus hydrophiloides* Mann.

ELATERIDAE: *Adelocera profusa* Cand., *Ludius tinctus* LeC., *L. suckleyi* LeC.

BUPRESTIDAE: *Buprestis aurulenta* L. (2)

TENEBRIONIDAE: *Eleodes parvicollis* Esch. var., *Coniontis ovalis* LeC. (26)

SCARABAEIDAE: *Odonteus obesus* Melsh., *Diplotaxis brevicollis* Lec. (16)

CERAMBYCIDAE: *Anoplodera crassipes* LeC.

CURCULIONIDAE: *Dyslobus granicollis* LeC., *Brachyrhinus sulcatus* F., *Phytonomus zoilus* Scop. (*Hypera punctata* F.)

ARANEIDA: Probably *Clubiona pacifica* Banks

GASTROPODA: *Epiphragmophora fidelis* Gray (2 immature)

In addition there were found two specimens of an unidentified *Vespa,* an ant, and the pupal case of a moth.

THE OLD WORLD MEMBRACIDÆ

BY FREDERIC W. GODING

In the following pages are brief descriptions, in the form of keys, of all known Membracidæ which have been found in the Palearctic, Oriental, and Australian regions, those inhabiting the Ethiopian and the African Palearctic regions having been treated elsewhere.[1] A few new forms will be found described within, together with citation of the original description of each species and the various habitats, while in all instances, where the figure of a species has been published, attention is directed to where it may be seen.

A number of heretofore unrecognized species, described by Fairmaire and Walker, have been placed in what is believed to be their correct generic position, examples being *Centrotus magellani* and *Centrotus paria* of Fairmaire, and the genus *Narnia* of Walker which is identical with Stål's genus *Terentius*.

The plan followed is that of the writer's "Classification of the Old World Membracidæ,"[2] wherein are keys to the subfamilies, tribes and genera together with synonyms.

The measurements given represent the extreme length from the head posteriorly, and the width between the tips of the suprahumerals if present, and between the humerals in the unarmed forms.

In the preparation of this work my own collection has been of the greatest use; but the writings of Fabricius, Fairmaire, Walker, Stål, Distant, Funkhouser, and a number of others have been freely consulted when arranging the keys and recording the localities.

ÆTHALIONINÆ

Æthalionini

Darthula

Kirkaldy, Ent. xxxviii, p. 242. (1900); *Urophora* Gray, Griff. ed. Anim. Kingd. Ins. ii, p. 261. (1832), preoccupied.

[1] The Membracidæ of Africa. Jour. N. Y. Ent. Soc. Vol. XL, June, 1932, pp. 205–240.

[2] Jour. N. Y. Ent. Soc. Vol. XXXIX, Sept., 1931, pp. 299–313.

Key to Species

One ferruginous or piceous brown species, median and hind marginal carinæ paler, femora tetaceous, tibiæ and tarsi piceous; tegmina concolorous, venation paler, wings pale brown; 12–17, abd. proc. 13–17 mm. .... **hardwicki**

List of Species

hardwicki Gray, Griff. Anim. Kingd. Ins. ii, p. 261, pl. 90, fig. 3 and pl. 138, fig. 5. (1832); Distant, Faun. Brit. Ind. iv, p. 78, fig. 64. (1908). Khasi Hills, Margherita, Naga Hills, Nepal, Sikhim, India; Ruby Mines, Burma; W. Yunnan, China.

Tolanini

Porcorhinus

Goding, Mon. Aust. Memb. p. 38. (1903).

Key to Species

One ferruginous red species, head mottled with yellow, transverse yellow band on metopidium; tegmina with basal third yellow ferruginous punctate, middle third ferruginous, apical third clearer; abdomen salmon red, femora tawny the tips with tibiæ and tarsi yellowish; ♀ sordid green, tips humerals brown; 9×3.5 mm. .... **mastersi**

List of Species

mastersi Goding, Mon. Aust. Memb. p. 39, pl. 1, figs, 12, 15 and 16. (1903). Sydney, Mt. Victoria, N. S. W., Australia.

Hemicentrus

Melichar, Notes Leyden Mus. xxxvi, p. 114. (1914); *Sarritor* Distant, Faun. Brit. Ind. vi, Append. p. 182. (1916).

Key to Species

1(4). Suprahumerals oblique, two or three times longer than broad at bases; scutellum broader than long, apex rounded, emarginate; legs yellow.

2(3). Eyes not visible from above; pronotum black, abdomen brown, tegmina brown hyaline, scutellum densely pubescent; suprahumerals three times longer than broad at bases, strongly recurved; 10×5 mm. .... **bispinus**

3(2). Eyes visible from above; entirely testaceous, tegmina subhyaline, scutellum with two white basal spots pilose; suprahumerals twice longer than broad at bases, straight, tips lightly recurved; $5\text{–}6 \times 3$ mm. .... **retusus**

4(1). Suprahumerals moderately oblique, slightly longer than broad at bases.

5(8). Scutellum broader than long, suprahumerals recurved from bases; pronotum and abdomen black.

6(7). Apex of scutellum roundly excised, dorsum flat; tegmina hyaline yellow clouded, base of interior discoidal cell stylate, of exterior cell truncate; legs rust brown; 7 mm. .... **bicornis**

7(6). Apex of scutellum distinctly bidentate, dorsum sulcate; tegmina smoky hyaline, base of interior discoidal cell truncate; of interior cell stylate; femora brown, tibiæ and tarsi yellow; 6 × 3 mm. **attenuatus**

8(5). Scutellum longer than broad, densely pubescent, apex roundly notched; tegmina ferruginous hyaline, base of interior discoidal cell stylate, of exterior cell truncate; entirely brown; suprahumerals straight, tips lightly recurved; 7 × 3.6 mm. .... **cornutus**

LIST OF SPECIES

bispinus Stoll, Cig. p. 76, pl. 19, fig. 101. (1783). Ceylon.
aculeatus Oliver, Enc. Meth. vii, p. 669. (1792). Ceylon.

retusus Distant, Faun. Brit. Ind. vi, Append. p. 182, fig. 139. (1916). Farm Caves, Moulmein, Dawna Hills, Burma.

bicornis Melichar, Notes Leyden Mus. xxxvi, p. 115. (1914). Semerang, Java.

attenuatus Funkhouser, Bul. Brook. Ent. Soc. xvi, p. 50, fig. 11. (1921). Kiautschau, China.

cornutus Funkhouser, Ann. Mus. Zool. Acad. Sci. USSR, xxviii, p. 150, pl. 6, fig. 6. (1927). Song Dinh, Annam, French Indo-China.

CENTROTINÆ

Coccosterphini

Coccosterphus

Stal, Hemip. Fabr. ii, p. 51. (1869); *Phærotus* Buckton, Mon. Memb. p. 255. (1903).

KEY TO SPECIES

1(8). Clypeus extended well below margins of genæ, apical margin of head broadly truncate.

2(7). Metopidium unicarinate.

3(6). Apex of posterior process passing apex of clavus, median carina formed of tubercles; pronotum and legs black, tarsi yellow.

4(5). Tegmina piceous sprinkled with cretaceous dots which sometimes almost form a fascia; 2.5–3 mm. .... **obscurus**

5(4). Tegmina tinted with castaneous and cretaceous, a large paler central area, or broad subbasal and subapical black fasciæ the black areas with raised cretaceous dots (variable); 2.5 mm. **decoloratus**

6(3). Apex of posterior process not reaching apex of clavus; pronotum purplish brown, densely pilose, median carina weak, body piceous, margins abdominal segments yellowish, tibiæ and tarsi testaceous; tegmina purplish brown sprinkled with paler spots at subbasal and central fasciæ, apical area pale hyaline; 4–5 × 2 mm. .... **mucronicollis**

7(2). Pronotum castaneous with a strong tubercular basal ridge projecting forward, a broader less elevated convex ridge each side, metopidium centrally and transversely ridged; apical area of posterior process black reaching apex of clavus; tegmina gray, basal fourth, median fascia and apical spots brownish yellow; 3.5–4 × 2–2.5 mm. .... **paludatus**

8(1). Clypeus almost continuous with lateral margins of the genæ, apical margin of head broadly rounded; apex of posterior process extended to apex of clavus.

9(12). Tegmina hyaline, longer than abdomen, with one or two transverse fasciæ.

10(11). Tegmina with basal third and median fascia brown, veins strong and sparingly tuberculate; pronotum and legs rust brown, median carina obsolete anteriorly; 3.5–4 × 2–2.5 mm. .... **tuberculatus**

11(10). Tegmina with more than basal third, and median and subapical fasciæ brown with white dots, veins not prominent with large black granules; pronotum and legs black, fine median carina percurrent; legs granular, tarsi yellow; 3 mm. .... **melichari**

12(9). Tegmina with spots, destitute of fasciæ.

13(14). Pronotum and legs fuscous, tibiæ ferruginous, median carina percurrent; tegmina subhyaline, longer than abdomen, base narrowly, large spot near apex clavus and tip of costa brown, veins with large tubercles; 4 × 2 mm. .... **stipulipennis**

14(13). Pronotum and legs black, median carina obsolete anteriorly; tegmina long as abdomen, semilucid yellow with white dots, basal third and granules on veins black; 3.25 × 2 mm. .... **minutus**

List of Species

obscurus Distant, Faun. Brit. Ind. iv, p. 73, fig. 60. (1908). Calcutta, India; Peradeniya, Ceylon.

decoloratus Distant, Faun. Brit. Ind. iv, p. 71, fig. 58. (1908). Calcutta, India.

mucronicollis Motschulsky, Etud. Ent. viii, p. 109. (1859); Distant, Faun. Brit. Ind. iv, p. 73, fig. 61. (1908). Kesbewa, Peradeniya, Mt. Nura-Ellia, Ceylon.

paludatus Distant, Faun. Brit. Ind. vi, Append. p. 175, fig. 130. (1916). Orissa near Puri, Chikkaballapura, Lake Chilka, Calcutta, Madras, India.

tuberculatus Motschulsky, Etud. Ent. viii, p. 109. (1859); Distant, Faun. Brit. Ind. iv, p. 72, fig. 59. (1908). Peradeniya, Kala-Weisa, Puttalam, Ceylon.

fasciata Melichar, Homop. Ceylon, p. 122. (1903). Ceylon.

melichari nom. nov.

minutus Melichar, Homop. Ceylon, p. 121. (1903), preoccupied. Peradeniya, Kautherly, Puttalan, Trincomalee, Bandarawella, Kandy, Negombe, Matala, Weligama, Anuradhapura, Dambulla, Ceylon.

stipulipennis Buckton, Mon. Memb. p. 255, pl. 59, fig. 3. (1903). Brunei, Borneo.

minutus Fabricius, Ent. Syst. Suppl. p. 514. (1798); Distant, Faun. Brit. Ind. vi, Append. p. 175, fig. 129. (1916). Madras; Tranquebar, India.

Parayasa

Distant, Faun. Brit. Ind. vi, Append. p. 176. (1916).

Key to Species

1(14). Apex of posterior process more or less convexly gibbous, not reaching apex of clavus, dorsum concavely sinuate.
2(13). Base of posterior process not gibbous; ocelli equidistant.
3(12). Head and pronotum brownish ochraceous.
4(11). Pronotum not granulose, apex posterior process black.
5(8). Metopidium and face black.
6(7). Tegmina subhyaline, broad basal and costal areas brownish ochraceous; 2.5–3 mm. .... **atricapilla**
7(6). Tegmina with broad basal area dark brown, median yellowish fascia, apical area black; 4 mm. .... **affixa**
8(5). Metopidium and face concolorous.
9(10). Tegmina brownish ochraceous, costal area and broad median fascia darker with short gray lines, apical area gray and brown mottled; 3.5 mm. .... **affinis**
10(9). Tegmina with basal half brownish ochraceous, median gray virescent fascia, remaining area virescent brown dotted; 4×2 mm. **elegantula**
11(4). Pronotum granulose, brownish ochraceous, apex posterior process concolorous; tegmina grayish white much spotted and suffused with brown, basal area broadly brown; 4×2 mm. .... **maculosa**
12(3). Head, pronotum and body black; tegmina black, claval and subclaval areas, median fascia and row of spots, apical and costal areas and large apical spots grayish white; 4–4.5 mm. .... **typica**
12(2). Base of posterior process depressed then strongly gibbous, again depressed before apical gibba; entirely black; ocelli much nearer to eyes; tegmina black, opaque, veins pilose, four linear white fasciæ at various angles; 3.4×1.7 mm. .... **maculipennis**
14(1). Apex of posterior process acute, not gibbously elevated, shorter than apex of clavus, dorsum straight, rarely lightly concavely depressed; ocelli equidistant.
15(22). Dorsum of posterior process straight, apex not elevated.
16(19). Head and pronotum black, tibiæ and tarsi yellowish.

17(18). Tegmina semihyaline, angular basal area brown, apical cells paler; 4 × 1.5 mm. .... **modesta**

18(17). Tegmina pale ochraceous subhyaline, extreme base indigo black, median whitish fascia, extreme apical margin darker; pronotum indigo black, posterior process robust; 4.5–5.5 mm. **nilgiriensis**

19(16). Pronotum brown, apex of posterior process black, legs brown.

20(21). Pale tawny brown, pilose, not granulose, posterior process slender; tegmina gray and brown mottled especially basal and costal areas and two cellular spots beyond middle; 4 × 1.5 mm. .... **rustica**

21(20). Dark castaneous, pronotum finely granulose, posterior process robust; tegmina brownish ochraceous with virescent suffusions, base and oblique median fascia dark castaneous; 4 mm. **margherita**

22(15). Posterior process distinctly concave, slender, apex curved upward; entirely brown, pronotum granulose, tibiæ and tarsi ochraceous; tegmina greenish, broad basal area, median fascia, large spot near apex of clavus, and dots on apical area brown; 4 × 2 mm. **dissimilis**

List of Species

atricapilla Distant, Faun. Brit. Ind. vi, Append. p. 179. (1916). Nilgiri Hills, India.

affixa Distant, Faun. Brit. Ind. vi, p. 178, fig. 135. (1916). Nilgiri Hills, India.

affinis Distant, Faun. Brit. Ind. vi, Append. p. 179. (1916). Nandidrug, India.

elegantula Distant, Faun. Brit. Ind. vi, Append. p. 178, fig. 134. (1916). Nilgiri Hills, Ootacamund, Somerdale, Kodaikanal, India.

maculosa Distant, Faun. Brit. Ind. vi, Append. p. 177, fig. 133. (1916). Nandidrug, Kodaikanal, India.

typica Distant, Faun. Brit. Ind. vi, Append. p. 177, fig. 132. (1916). Kodaikanal, India.

maculipennis Funkhouser, Jour. Sts. Br. Roy. Asiat. Soc. p. 224. (1920). Sandakan, Borneo.

modesta Distant, Faun. Brit. Ind. vi, Append. p. 181. (1916). Nilgiri Hills, India.

nilgiriensis Distant, Faun. Brit. Ind. vi, Append. p. 180. (1916). Nilgiri Hills, India.

rustica Distant, Faun. Brit. Ind. vi, Append. p. 181, fig. 138. (1916). Lovedale, Nilgiri Hills, India.

margherita Distant, Faun. Brit. Ind. vi, Append. p. 180, fig. 137. (1916). Assam, Margherita, India.

dissimilis Distant, Faun. Brit. Ind. vi, Append. p. 179, fig. 136. (1916). Kodaikanal, India.

Yasa

Distant, Fauna British India, iv, p. 74. (1908).

KEY TO SPECIES

One black species, tibiæ and tarsi ochraceous; posterior process slender, slightly separated from scutellum, straight, tip reaching middle of clavus and decurved; tegmina subhyaline, base black, oblique piceous fascia transversely branching to inner margin beyond apex clavus; 6×2.5 mm. ...... **greeni**

LIST OF SPECIES

greeni Distant, Faun. Brit. Ind. iv, p. 74, fig. 62. (1908). Peradeniya, Kandy, Ceylon.

Kanada

Distant, Fauna British India, iv, p. 74. (1908).

KEY TO SPECIES

One pilose ochraceous species, head, foveate spot above each eye, tip of posterior process and chest black; median carina obsolete anteriorly; tegmina grayish hyaline; 3.5 mm. .... **irvinei**

LIST OF SPECIES

irvinei Distant, Faun. Brit. Ind. iv, p. 75, fig. 63. (1908). Ranchi, Bengal, India.

Insitor

Distant, Fauna British India, vi, Appendix, p. 176. (1916).

KEY TO SPECIES

One brown species with ochraceous legs; tegmina grayish, large brownish yellow basal area, broad median fascia and claval spot black; 3.5–4 mm. **exemplificatus**

LIST OF SPECIES

exemplificatus Distant, Faun. Brit. Ind. vi, Append. p. 176, fig. 131. (1916). Nilgiri Hills, India.

Gargarini

Sipylus

Stal, Analect. Hemipt. p. 387. (1866).

KEY TO SPECIES

1(6). Veins of tegmina not nodulate; pronotum without dorsal tubercles.
2(5). Tips of humerals blunt, posterior process straight, robust.
3(4). Posterior process unicarinate, apex abruptly acute; ferruginous brown, ♂ black anteriorly; tegmina ferruginous semiopaque, with two discoidal cells, subhyaline in ♂; 4.5×3.5–4 mm. .... **crassulus**
4(3). Posterior process tricarinate, apex gradually acute; golden brown, pronotum gibbous between humerals; tegmina smoky hyaline, base black, with three discoidal cells; 7×4.7 mm. .... **rotundatus**

5(2). Humerals acuminate, oblique, lightly inclined forward, tips acute; pronotum black, body and legs brown, pilose, posterior process slender, tip deflexed; tegmina amber hyaline, base black; 6.5 × 4 mm. .... **acuticornis**

6(1). Tegmina subhyaline, veins with prominent brown nodules; ferruginous brown, tips of humerals blunt, a large tubercle behind each humeral, posterior process short, broad, apex abruptly acute; 3–3.5 × 2.75–3.5 mm. .... **dilatatus**

List of Species

crassulus Stal, Eug. Resa Omk. J. Zool. p. 285. (1859); Funkhouser, Phil. Jour. Sci. x, p. 391, pl. 2, fig. 14. (1915). Mt. Banahao, Davao, Mindanao, Philippines; Java; Malacca.

rotundatus Funkhouser, Phil. Jour. Sci. xxxiii, p. 118, pl. 4, fig. 23, 24. (1927). Mt. Banahao, Trinidad, Haight's Place, Sarai, Luzon, Philippines.

acuticornis Funkhouser, Phil. Jour. Sci. xiii, p. 30, pl. 1, figs, 9, 10. (1918). Nueva Viscaya, Imugan, Luzon, Philippines.

dilatatus Walker, List Hom. Brit. Mus. p. 630. (1851). Philippines.

nodipennis Funkhouser, Jour. Ent. Zool. vi, p. 72, fig. 5. (1914); Phil. Jour. Sci. x, p. 392, pl. 2, fig. 15. (1915); Biol. Memb. pl. 35, fig. 17. (1917). Los Baños, Davao, Mindanao, Philippines; Singapore; Sandakan, Borneo.

Centrotoscelus

Funkhouser, Journal Entomology and Zoology, vi, p. 72. (1914).

Key to Species

1(4). Metopidium without a median carina; pronotum dark brown, posterior process short, reaching apex of clavus.

2(3). Posterior process unicarinate tip depressed, dorsum concavely depressed, broad central black stripe on metopidium; ♂ black; tegmina subtranslucent pale yellow, irregular brown median fascia; 5 × 2.3 mm. .... **concavus**

3(2). Posterior process tricarinate, dorsum straight, tip black not depressed; tegmina ferruginous hyaline, narrow subbasal area pale, costal area and tips brown; 5.7 × 2.8 mm. .... **brevispinus**

4(1). Median carina of pronotum percurrent, sometimes obsolete anteriorly; posterior process unicarinate, passing apex of clavus.

5(8). Tegmina with brown markings; pronotum ferruginous brown, median carina obsolete anteriorly, dorsum depressed above scutellum, straight on posterior process.

6(7). Tegmina subhyaline, base, median fascia and part of apical margin brown; tip of posterior process depressed; tarsi yellowish; 4.3–5 × 2.2–2.5 mm. .... **typus**

7(6). Tegmina translucent ferruginous, iridescent, base, one-fourth of apical cells and apical margin brown; legs brown; tip posterior process straight; 4.8 × 2.6 mm. .... **borneensis**

8(5). Tegmina yellow hyaline; head brown; pronotum yellow, median carina percurrent, posterior process straight, tip brown; body black, legs ferruginous yellow; 5 × 2.5 mm. .... **luteus**

List of Species

concavus Funkhouser, Phil. Jour. Sci. xiii, p. 31, pl. 1, figs, 11, 12. (1918). Benguet, Nueva Viscaya, Imugan, Luzon, Philippines; Bettotan, N. Borneo.

brevicornis Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 216, figs. 11, 12. (1920). Sandakan, Borneo.

typus Funkhouser, Jour. Ent. Zool. vi, p. 73, figs, 3, 4. (1914); Phil. Jour. Sci. x, p. 392, pl. 2, fig. 16. (1915). Los Baños, Luzon, Philippines.

borneensis Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 215, figs, 9, 10. (1920). Sandakan, Borneo.

luteus Funkhouser, Phil. Jour. Sci. xiii, p. 30. (1918). Benguet, Bagnio, Luzon, Philippines.

Subrincator

Distant, Ann. Mag. Nat. Hist. xvii, p. 157. (1916).

Key to Species

One black species, median carina, lateral margins and curved fascia each side of pronotal disk, a transverse median fascia and apical area of posterior process, tips of femora and bases and tips of tibiæ sanguineous; tegmina subhyaline, base black with sanguineous spots, spots on central area and on apical margin black; 9–10 mm. .... **tonkinensis**

List of Species

tonkinensis Distant, Ann. Mag. N. H. xvii, p. 157. (1916). Lao Kay near Chapa, Upper Tonkin, French Indo-China.

Gargara

Amyot and Serville, Hemip. p. 537. (1843); *Xanthosticta* Buckton, Mon. Memb. p. 63. (1903), part; *Mœrops* Buckton, Mon. Memb. p. 257. (1903).

Key to Species

1(52). Tegmina back, brown, yellow or hyaline except bases, destitute of fascia or spots.

2(9). Tegmina black, opaque; pronotum black, rarely partly red, tarsi yellowish.

3(6). Veins of tegmina bearing nodules or granules.

4(5). Pronotum finely punctate, no median carina anteriorly, posterior process slender, straight, median carina strong; 5 × 4 mm. **nigra**

5(4). Pronotum rough, median carina strongly percurrent, posterior process moderately sinuate; 3 × 1.5 mm. .... **rugonervosa**

6(3). Veins of tegmina destitute of nodules or granules.

7(8). Pronotum entirely black, median carina percurrent, hind tibiæ and tarsi reddish; 5 mm. .... **minuscula**

8(7). Pronotum black with a ring in front, and apical two-thirds of posterior process red, the two united; legs black; 6 mm. **davidi**

9(2). Tegmina not black.

10(17). Tegmina brown or yellow, opaque or subopaque.

11(16). Tegmina brown, destitute of nodules or granules.

12(15). Median carina of pronotum absent anteriorly; pronotum not black.

13(14). Pronotum entirely brown with long white fasciate pubescence; veins of tegmina very hairy; 3.7 × 2.5 mm. .... **triangulata**

14(13). Pronotum brown, metopidium and dorsum ochraceous; 3 × 2 mm. **trivialis**

15(12). Median carina weakly percurrent; pronotum black, yellow pubescent; veins of tegmina testaceous with testaceous margins; 5 mm. .... **venosa**

16(11). Tegmina yellow or vinaceous, veins bearing thick brown nodules except on the base; pronotum body and legs yellow; pronotum tuberculate, white line from middle of front margin branched above and below each humeral, dark spot above each eye, median carina obsolete, tip of posterior process brown abruptly acuminate; 4–4.5 × 2–2.5 mm. .... **tuberculata**

17(10). Tegmina hyaline or subhyaline, or pale vinaceous.

18(27). Veins of tegmina bearing nodules or granules.

19(26). Median carina of pronotum obsolete anteriorly, acute posteriorly.

20(23). Humerals large, blunt.

21(22). Pronotum pale brown, densely pubescent, smooth black spot above each eye, posterior process sinuate, tip acute; body and legs brown; 4 × 2.2 mm. .... ♀ **granulata**

22(21). Pronotum, body and legs black, tarsi yellow; 4 × 2 mm. ♂ **granulata**

23(20). Humerals not prominent; pubescent.

24(25). Pronotum black, median carina of posterior process at middle and legs yellowish, margins abdominal segments brown; 4 mm. **horishana**

25(24). Pronotum brown, base, vertex and body blackish, legs brownish yellow; 5 mm. .... **tappana**

26(19). Median carina of pronotum strongly percurrent, humerals large auriculate, dorsum arcuate, posterior apex blunt; pale brown, densely white pubescent, margins abdominal segments white above .... **grisea**

27(18). Veins of tegmina destitute of nodules or granules.

20(49). Median carina of pronotum obsolete or absent anteriorly.

29(48). Posterior pronotal process unicarinate.

30(39). Pronotum black or brown.

31(36). Tegmina yellowish or brownish hyaline; posterior process gradually acuminate; head inflexed.

32(35). Pronotum and legs brown or piceous brown, posterior process moderately sinuate median carina weak, tip decurved.

33(34). Apex of posterior process reaching middle of abdomen; hairy; 5 mm. .... **genistæ**

34(33). Apex of posterior process passing inner angle of tegmina; 3.7 × 2 mm. .... **brunnea**

32(32). Pronotum black, median carina posteriorly, tips femora, tibiæ and tarsi yellowish; posterior process narrow, median carina sharp, apex lightly elevated; 4.5 × 2 mm. .... **sumbawæ**

36(31). Tegmina clear hyaline.

37(38). Head inflexed from base; pronotum black, no median carina, posterior process with margins parallel to middle, abruptly acuminate; legs black to whitish; 4 × 2 mm. .... ♂ **varicolor**

38(37). Head projecting forward from base; pronotum brown thickly yellow pubescent; posterior process gradually acuminate from base; median carina distinct; tips tarsi yellow; 5 × 2.3 mm. **projecta**

39(30). Pronotum entirely or partly yellow, or greenish gray.

40(47). Pronotum and legs yellow, apex of posterior process black or brown; scutellum well exposed.

41(44). Pronotum finely granulose, base of posterior process sinuate.

42(43). Body and legs yellow, disk of chest piceous; tegmina brownish yellow; 4.5 mm. .... **citrea**

43(42). Body blackish, femora castaneous except tips; tegmina subhyaline; 4 mm. .... **contraria**

44(41). Pronotum not granulose, posterior process straight.

45(46). Pronotum lemon yellow, finely punctate, slightly pubescent, body black, abdomen and head yellow, apex of posterior process black straight; 5 × 2.4 mm. .... ♀ **nigroapica**

46(45). Pronotum yellow, metopidium brown, coarsely punctate, foveate dark spot above each eye, broad pale stripe above each humeral, apex of posterior process brown, depressed; body and legs brown, head black; tegmina iridescent hyaline; 3.5–5 ×1.5 mm. ♀ **nitidipennis**

47(40). Pronotum greenish gray, not pubescent, posterior process lightly depressed lightly sinuate, nearly covering scutellum; body and legs greenish brown; 4 ×2 mm. .... **fragilla**

48(29). Posterior process tricarinate, high, tectiform, lightly sinuate near base, sides parallel to middle, abruptly acuminate; black, yellow pubescent, tibiæ and tarsi ferruginous; 3.5 × 1.8 mm. **nigrocarinata**

49(28). Median carina of pronotum distinctly percurrent, tip of posterior process reaching apex of clavus.

50(51). Pronotum dark brown, pubescent, white tomentose patch each side, body and abdomen concolorous, legs brownish white (? posterior process unicarinate); 4.8 × 2.1 mm. ....**akonis**

51(50). Pronotum black, pale pilose, central area of posterior process, sometimes median carina, ferruginous, body and abdomen black, tibiæ and tarsi ochraceous; 4–4.5 ×5.2 mm. **flavolineata**

52(1). Tegmina marked with stripes, bands or spots.

53(128). Tegmina with stripes or bands.

54(61). Tegmina with one or more longitudinal stripes.

55(60). Median carina absent or obsolete anteriorly.

56(57). Posterior process straight, tricarinate, reaching apex of clavus, pronotum black, legs brown; tegmina clear hyaline, base and stripe along costal margin brown; 3 mm. ....**sœrœlangœna**

57(56). Posterior process unicarinate; ocelli near eyes; tegmina yellowish opaque or subopaque.

58(59). Robust, head black, pronotum brown with no median carina, metopidium with two spot on base and large spot each side of disk blackish; posterior process bisinuate decurved far passing apex of clavus; tegmina with central longitudinal dark stripe, veins with blackish nodules, base of exterior discoidal cell petiolate; ♂ black, tip of posterior process brown; 3.5 × 2 mm. **parvula**

59(58). Slender, entirely yellow, median carina obsoletely percurrent, dorsum of posterior process lightly arched reaching apex clavus; veins of tegmina smooth and narrowly brown margined; 4 × 2.5 mm. ....**luteipennis**

60(55). Median carina distinctly percurrent, pronotum black, granulose, thickly pilose, legs ochraceous; tegmina subhyaline, costal and apical margins black; 5 × 2.5 mm. ....**extrema**

61(54). Tegmina with transverse bands or fasciæ.

62(75). Veins of tegmina bearing nodules or granules.

63(68). Median carina of pronotum percurrent, pronotum and body black, more or less pubescent.

64(67). Apex of posterior process not passing apex of clavus; tegmina hyaline with one or two median brown bands.

65(66). Median carina weak anteriorly, dorsum of posterior process depressed near base then lightly convex; pronotum dark brown, tibiæ and tarsi yellow, tegmina longer than abdomen, veins slightly nodulate near base, and pilose; 3.6 × 1.7 mm. **pilinervosa**

66(65). Median carina distinctly percurrent, pronotum black, pubescent, posterior process lightly convexly elevated before acute apex; tegmina long as abdomen, veins near base with some large red granules; tibiæ and tarsi reddish; 3.25 mm. **rubrogranulata**

67(64). Apex of posterior process passing apex of clavus, blunt; pronotum black, femora brown, tibiæ and tarsi yellow; tegmina hyaline with two brown fasciæ, veins pubescent with small black nodules; 4 × 1.7 mm. .... **nodipennis**

68(63). Median carina of pronotum obsolete or absent anteriorly; tegmina with one brown or black band.

69(74). Pronotum brown or black, dorsum of posterior process arcuate.

70(73). Tegmina hyaline, veins distinctly nodulate or granulate; apex of posterior process acute; body gray pubescent; band of tegmina brown or black.

71(72). Posterior process not reaching apex of clavus, pronotum black, tips of tibiæ and tarsi brownish yellow; tegmina hyaline, oblique band forked at hind margin, in ♂ black apical third hyaline; 3.5 × 4 mm. .... ♀ **arisana**

72(71). Posterior process passing apex of clavus; pronotum and legs black, tarsi yellow; veins of tegmina pilose; 3.2 × 2 mm. ♂ **nodinervis**

73(70). Tegmina brown, opaque, pilose, transverse band and tips hyaline, veins with brown nodules; pronotum brown, pubescent, two white fasciæ above humerals, apex posterior process blunt, decurved, passing apex of clavus; legs brown; 3.6 × 2 mm. **albolinea**

74(69). Entirely yellow, posterior process lightly sinuate; otherwise as in "72(71)"; 4 × 2 mm. .... ♀ **nodinervis**

75(62). Veins of tegmina destitute of nodules or granules.

76(101). Median carina of pronotum percurrent.

77(92). Posterior process unicarinate.

78(87). Pronotum brown or black.

79(84). Tegmina clear or vinaceous hyaline with one transverse band.

80(83). Tips of tegmina colorless; posterior process acuminate.

81(82). Entirely black, pubescent, posterior process depressed at base and apex; tegmina clear hyaline, base, spot near apex of clavus, and subapical band, with legs, black; 4 × 2 mm. **nigromaculata**

82(81). Pronotum brown, pubescent, black in front, posterior process sinuate; tegmina vinaceous hyaline, iridescent, narrow brown median fascia; 3 × 1.5 mm. .... ♀ **gracila**

83(80). Tegmina hyaline, irregular subapical band and tips fuscous brown; pronotum brown, posterior apex abruptly acute, black, sides of chest piceous, legs pale testaceous; 5 × 2 mm. **myittæ**

84(79). Tegmina subhyaline or opaque with two or more transverse bands, apical margin fuscous.

85(86). Tegmina subhyaline, pale median fascia, a subapical band and apical margin fuscous; pronotum black, pilose, central area of posterior process and legs ochraceous, posterior apex abruptly acute; 5 × 2.3 mm. .... **sikhimensis**

86(85). Tegmina fuscous or blackish, opaque, three transverse bands separated by white more or less confluent and checkered; pronotum ferruginous, tip of posterior process bluntly tectiform just passing apex of clavus; 4 × 2 mm. .... **pulchripennis**

87(78). Pronotum yellowish or greenish.

88(89). Tegmina hyaline, base broadly and median fascia brown; pronotum brownish yellow; slender, spot above each eye and broad stripe above each humeral brown, posterior process slender, sinuate, tip depressed; 3.8 × 1.7 mm. .... **fasceifrontis**

89(88). Tegmina with two or more transverse bands.

90(91). Pronotum yellow, mark each side of median line and one above each eye brown, posterior process sinuate, tip brown; body brown, legs yellow; tegmina opaque with alternating brown and white bands, tips slightly hyaline; ♂ smaller cinnamon yellow, markings darker, tegmina black at base; 3.2 × 1.7 mm. **irrorata**

91(90). Pronotum greenish brown, pubescent, brown line above each eye, posterior process flat, tip black; body and legs brown; tegmina subhyaline, median and subapical bands brown, veins pilose; 4.2 × 2.3 mm. .... **virescens**

92(77). Posterior process tricarinate; black or brown.

93(98). Apex of posterior process not reaching apex of clavus.

94(97). Tegmina subhyaline with one transverse band.

95(96). Pronotum and abdomen below reddish brown, pubescent, head, metopidium, lateral carinæ and apex of posterior process black, legs yellowish; tegmina with base and costal margin reddish, a white subbasal white transverse band; 4 mm. .... **nigriceps**

96(95). Pronotum and body piceous, fine pilose, median carina weak, legs ochraceous; tegmina with base piceous, transverse median band and broad apical margin ochraceous; 5.5–6.6 × 3 mm. **tumida**

97(94). Tegmina long as abdomen, pale smoky, median band from costa, another to central area, and tips brown, hyaline spot beyond base; pronotum reddish brown, pubescent, face, metopidium and posterior apex black, its carina elevated; body black; 4.4 mm. .... **indica**

98(93). Apex of posterior process passing apex of clavus; tegmina hyaline or subhyaline.

99(100). Castaneous brown, pilose, median fascia on metopidium; tegmina with base and broad transverse median band piceous brown; 4 × 2 mm. .... **delimitata**

100(99). Black, body and legs piceous, tarsi yellowish, pronotum granulose; tegmina with base, median fascia obliquely continued and on upper half of apical margin black; 5.5–6 × 3 mm. **rivulata**

101(76). Median carina of pronotum obsolete or absent anteriorly, pronotum brown or black.

102(121). Tegmina with one transverse band.

103(114). Apex of posterior process reaching or just passing apex of clavus.

104(113). Tegmina with tips and apical margin concolorous, not brown.

105(106). Tegmina amber hyaline, base and irregular subapical band brown; pronotum brown, thickly pubescent, posterior process constricted at base, middle strongly swollen and carinate, abruptly narrowed to apex; tips tibiæ and tarsi yellow; 4.5 × 2.1 mm. .... **penangi**

106(105). Tegmina vitreous or hyaline.

107(108). Corium with three discoidal cells, tegmina broadly opaque at base and subapical band brown; pronotum brown, densely pubescent, black spot above each eye, apex of posterior process black, blunt, higher than base, scutellum well exposed; 7 × 3 mm. .... **orientalis**

108(107). Corium with two discoidal cells.

109(110). Posterior process acuminate from base, slender, pronotum brown, pubescent, base, vertex, and apex of posterior process blackish, legs yellowish brown; tegmina dark clouded with broad median band brown; 3.5 mm. .... **zonata**

110(109). Posterior process with sides parallel to middle then acuminate.

111(112). Pronotum dark ferruginous, anteriorly and posterior apex blackish, abdomen piceous margins yellowish; tegmina subhyaline, arcuate brown band on apical third; 4.5 mm. .... **malaya**

112(111). Color variable from black to yellowish ferruginous, the paler forms with spots or bands on posterior process; tegmina with fuscous band behind middle, apical area yellowish; 4.5 × 2 mm. ♀ **varicolor**

113(104). Tegmina hyaline, a subbasal spot, subapical band and tips brown; entirely black; 2.25 mm. .... **semifascia**

114(103). Apex of posterior process distinctly passing apex of clavus.

115(120). Tegmina opaque, brown or blackish.

116(119). Transverse band of tegmina hyaline or white.

117(118). Tegmina piceous, spot on clavus and transverse fascia creamy white, apical area hyaline; pronotum piceous, pilose, posterior process broad, sides parallel to middle then acuminate, legs yellowish; 3 mm. .... **alboapicata**

118(117). Tegmina brown, broad central band and apical margin hyaline; pronotum pale brown, pubescent, posterior process sinuate, decurved; tomentose below; 3.5 × 2 mm. .... **hyalifascia**

119(116). Tegmina dark translucent, median band and spot behind clavus brown; pronotum blackish brown, densely pubescent, legs brown; 4.8 × 2.5 mm. .... **sordida**

120(115). Tegmina vitreous, base and median band black (variable); black, posterior process narrow; 3.3 × 1.5 mm. ..... **nigrofasciata**

121(102). Tegmina with two or more transverse bands.

122(127). Corium with two discoidal cells.

123(126). Apex of posterior process passing apex of clavus.

124(125). Brown, pubescent, darker on metopidium and posterior apex, median carina absent anteriorly, posterior process depressed at base and blunt tip; tegmina hyaline, subbasal and median bands brown; 4.7 × 2.4 mm. .... **nervosa**

125(124). Black, legs sordid yellow; tegmina with two irregular bands and subapical spot black; 2.25 mm. .... **consocia**

126(123). Apex of posterior process reaching apex of clavus, acute; brown, pubescent, metopidium, body and femora blackish, legs yellowish; tegmina white hyaline, two broad median bands and apical third brown; 6 mm. .... **lagustri**

127(122). Corium with three discoidal cells, tegmina brown, basal half coriaceous, apical half hyaline, median and subapical bands brown, the median band touching the basal color at middle; pronotum golden brown, densely pubescent, metopidium darker, posterior process tectiform, tip darker reaching apex of clavus; scutellum slightly exposed; 3.2 × 1.5 mm. .... **semibrunnea**

128(53). Tegmina with spots, destitute of transverse bands.

129(132). Veins of tegmina bearing nodules or granules; apex of posterior process not passing apex of clavus.

130(131). Tegmina subhyaline, brown clouded, whitish at middle and tips; pronotum dark brown, pubescent, ♀ with two pale brown stripes on metopidium; legs yellowish; 3.5 mm. ...**guttulinervis**

131(130). Tegmina brown, large spot near apex of clavus and broad curved subapical spot whitish hyaline; pronotum black, posterior process much shorter than apex of clavus, legs brown; 4 mm. **kawakamii**

(The ♂ *arisana* belongs here, see "71(72)")

132(129). Veins of tegmina destitute of nodules or granules.

133(170). Median carina of pronotum percurrent, sometimes weak.

134(145). Posterior process tricarinate.

135(144). Apex of posterior process distinctly passing apex of clavus.

136(141). Tegmina with more than basal half opaque brown or black; pronotum brown or black.

137(140). Basal opaque area of tegmina black.

138(139). Posterior process sinuate and strongly elevated apical half distant from tegmina apex abruptly acute; costal margin of tegmina ferruginous, apical fourth hyaline; black, tibiæ ferruginous, tarsi yellow; 3 × 1.4 mm. .... **sinuata**

139(138). Posterior process straight impinging upon tegmina, acuminate, metopidium gibbous; entirely black; apical area of tegmina hyaline; 5.2 × 2.3 mm. .... ♂ **bicolor**
140(137). Tegmina opaque brown mottled with black and ferruginous, tips rounded, ferruginous; pronotum blackish brown, posterior process weakly sinuate, scutellum well exposed; body and legs brown, densely pubescent; 6.6 × 3.4 mm. .... **lata**
141(136). Tegmina hyaline or subhyaline, not opaque.
142(143). Tegmina pale bronzy ochraceous, base black; entirely black; 8 × 4 mm. .... **majuscula**
143(142). Tegmina vinaceous translucent, base narrowly opaque brown; reddish brown darker above, legs pale yellow; 5 × 2.2 mm. ♀ **bicolor**
144(135). Apex of posterior process about as long as apex of clavus, pronotum purplish brown or black, legs brown; tegmina subhyaline, spot near apex of clavus and apical margin brown, sometimes fuscous spots on apical half; 3.5–4 × 2 mm. .... **robusta**
145(134). Posterior process unicarinate.
146(161). Apex of posterior process distinctly passing apex of clavus.
147(150). Median carina of pronotum yellow or reddish, posterior process more or less sinuate.
148(149). Black, median carina and tips femora reddish; posterior process broadened at middle, apex acute; tegmina fuscous brown, gray mottled, apical margin gray; 6 × 2.5 mm. .... **cælata**
149(148). Brown, not pubescent, base and central stripe on metopidium black, median carina yellow, posterior process depressed and yellow at base, tip black; tegmina smoky hyaline, brown cloud covering central area, tips hyaline; 4–4.5 × 1.7 mm. **flavocarinata**
150(147). Median carina of pronotum concolorous, not yellow or red.
151(160). Tegmina opaque or semiopaque.
152(157). Apical area of tegmina hyaline; posterior process distinctly passing apex of clavus; legs brown.
153(156). Posterior process sinuate; pronotum black, tarsi paler.
154(155). Tegmina brown, opaque, base and costal area black, veins hairy, tips yellow hyaline; 3 × 1.7 mm. .... **luconica**
155(154). Tegmina with basal two-thirds black, opaque, apical third hyaline; 2.75 × 1.5 mm. .... ♂ **gracila**
156(153). Posterior process straight, tip decurved, apical area paler, pronotum dark brown marked with black; tegmina very dark, subopaque, tips smoky hyaline; 4.2 × 2.1 mm. .... **pinguis**
157(152). Apical area of tegmina black or brown, not hyaline; posterior process not passing apex of clavus.
158(159). Black, slightly pilose, legs yellowish; tegmina opaque gray, apical area, spot near apex clavus and apical margin fuscous brown; 4 × 2 mm. .... **confusa**

159(158). Brown, densely yellow pilose; pronotum with spot above each eye, two central stripes and apical area black; tegmina dark ochraceous black mottled except tips; 5 × 2.5 mm. ....**mixta**

160(151). Tegmina subhyaline, large central fuscous or black spot; dark brown to black, legs paler, posterior process sinuate, sides parallel apex abruptly acute; 4–5 × 1.7–2.5 mm. ....**patruelis**

161(146). Apex of posterior process not passing apex of clavus or shorter.

162(169). Tegmina dark brown and hyaline, or whitish hyaline, not hairy.

163(164). Tegmina black or dark brown, apical fourth hyaline; pronotum blackish, gray pubescent, median carina obscure anteriorly, posterior process acuminate; tarsi tawny; 3 mm. ....**pygmæa**

164(163). Tegmina whitish hyaline or subhyaline.

165(168). Tips of tegmina brown; brown or black, yellow pubescent, sides white tomentose, legs yellowish; brown.

166(167). Posterior process much shorter than clavus; coarsely punctate; tegmina with tips only brown; 5–5.5 mm. ....**garampina**

167(166). Posterior process passing apex of clavus, pronotum dark brown or black, finely punctate, dorsum depressed at middle; tegmina with base, middle of costal margin, apex and spot behind clavus and part of interior margin brown; 4 × 1.8 mm...... **maculipennis**

168(165). Tegmina thickly sprinkled with rust yellow, basal area brown with a row of white dots and sometimes another central row, subapical row of black dots, apical area hyaline; black, legs brown; 3 × 2 mm. ....**apicata**

169(162). Tegmina vinaceous covered with long hairs, veins indistinct, base black, tips hyaline; pronotum dark brown densely pilose, tip of posterior process slightly elevated to apex of clavus; legs yellow; 4 × 2 mm. ....**pilosa**

170(133). Median carina of pronotum obsolete or absent anteriorly.

171(190). Posterior process unicarinate, reaching or passing apex of clavus.

172(183). Tegmina hyaline or vinaceous hyaline.

173(180). Pronotum and body black or brown.

174(177). Tips of tegmina hyaline, legs yellow.

175(176). Tegmina dark yellow hyaline, basal fourth piceous, spot on first apical cell and apical margins abruptly colorless hyaline; pronotum piceous; 2.5 × 1 mm. ....**discrepans**

176(175). Tegmina subhyaline yellow clouded, base black, brown at middle; pronotum black, densely pubescent; 5.5–6 mm. ....**donitzæ**

177(174). Tips of tegmina brown or black; legs black or ferruginous; apex of posterior process distinctly passing apex of clavus.

178(179). Pronotum dark brown, black curved line above each eye, posterior process with slight median carina, apex decurved abruptly acute; legs ferruginous; tegmina subhyaline, base not punctate, ferruginous clouded near middle, tips fuscous, veins hairy; 3.4 × 1.5 mm. ....**attenuata**

179(178). Entirely black; tegmina hyaline, apical third deeply black clouded; 4 × 2 mm. .... ♂ **nigroapica**

180(173). Pronotum not black or brown.

181(182). Head and pronotum pale silky pilose, two central castaneous discal stripes a piceous line each side, tips of humerals, apex of posterior process and body piceous; legs yellow; 4 × 2 mm. **sericea**

182(181). Pronotum yellow, no median carina anteriorly, broad fasciæ on metopidium and tip posterior process brown; head black, legs brown; tegmina iridescent hyaline, brown patch behind middle; 3.5 × 1.4 mm. .... ♂ **nitidipennis**

183(172). Tegmina entirely or one-half or more opaque brown or black.

184(187). Posterior process sinuate; three-fourths or all of tegmina opaque brown.

185(186). Tegmina brown with numerous white spots, veins indistinct; entirely black, pubescent, scutellum well exposed; 2.8 × 1.6 mm. **ornata**

186(185). Basal three-fourths of tegmina opaque brown, apical fourth hyaline with transverse series of black dots, apical margin brown; pronotum brown with three silky discal lines, body black, legs testaceous; 4.5 mm. .... **trinotata**

187(184). Posterior process straight, pronotum black, not pubescent; apical half of tegmina opaque black or brown.

188(189). Apical half of tegmina opaque black, basal half hyaline; apex of posterior process passing apex of clavus; 3 mm. **semivitrea**

189(188). Apical half of tegmina opaque brown, basal half hyaline; median dorsal line of pronotum broadly brown, apex of posterior process reaching apex of clavus, legs brown, tarsi yellowish; 3.6 × 1.8 mm. .... **brunneidorsata**

190(171). Posterior process tricarinate; pronotum shining black.

191(192). Tegmina with basal two-thirds black enclosing large trifoliate white spot, apical third yellow hyaline, tips fuscous; posterior process thick at base, apex far passing apex of clavus; 8 × 4 mm. .... **trifoliata**

192(191). Tegmina reddish subopaque, base black, tips subhyaline; posterior process narrow at base, apex reaching apex of clavus; 2.5–3 × 1.4–1.6 mm. .... **minuta**

LIST OF SPECIES

nigra Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 223. (1920). Sandakan, Banguey, Borneo.

rugonervosa Funkhouser, Phil. Jour. Sci. xiii, p. 34. (1918). Neuva Viscaya, Panay, Imugan, Culasi, Luzon, Philippines; Sandakan, Borneo.

minuscula Walker, Jour. Linn. Soc. x, p. 191. (1868). Mysol; Sula, East Indies.

davidi Fallou, Rev. Ent. ix, p. 354. (1891). Pekin, China; Siberia; Europe.

triangulata Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 12. (1918). Singapore; Penang, East Indies.

trivialis Buckton, Mon. Memb. p. 64, pl. 10, fig. 1. (1903). Luzon, Philippines.

venosa Walker, Jour. Linn. Soc. x, p. 189. (1868). Tondano, Posse See, Samango, Duri, Celebes Is.

tuberculata Funkhouser, Jour. Ent. Zool. vi, p. 70, fig. 6. (1914). (tegmen). Los Baños, Manila, Tayabas, Malinao, Luzon, Davao, Zamboango, Mindanao, Philippines; Penang, Straits Settlements.

granulata Funkhouser, Phil. Jour. Sci. xxxiii, p. 123, pl. 4, fig. 30. (1927). Kolamougan, Mindanao; Imugan, Luzon, Philippines.

horishana Matsumura, Annot. Zool. Jap. viii, p. 25. (1912). Horisha, Is. Formosa.

tappana Matsumura, Annot. Zool. Jap. viii, p. 23. (1912). Tappan, Horisha, Formosa.

grisea Funkhouser, Phil. Jour. Sci. xv, p. 25. (1919). Manila, Luzon, Philippines.

genistæ Fabricius, Spec. Ins. ii, p. 314. (1781). Europe generally; Hokoido, Honshu, Kinshu, Ogasawari, Japan; Osnatschnaja, Jenissej R., Jenissejsk, Vladivostok, Ussuri region, Siberia; New Jersey, Connecticut, U. S. A.

brunnea Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 235, pl. 6, fig. 2. (1914). Mt. Makiling, Luzon, Philippines.

sumbawæ Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 237, pl. 6, fig. 6. (1914) Sambawæ Is., Java.

varicolor Stal, ♂, Hemip. Philip. p. 728. (1870); Funkhouser, Phil. Jour. Sci. xxxiii, p. 124. (1927). Los Baños, Mt. Maquiling, Mt. Banahao, Davao, Mindanao; Manila, Rizal, Montalban, Luzon, Philippines; Sandakan, Borneo.

projecta Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 10. (1918). Penang, Singapore.

citrea Distant, Faun. Brit. Ind. iv, p. 63. (1908). Tenasserim, Myitta, India; Moulmein, Burma; Sandakan, Borneo.

contraria Distant, Faun. Brit. Ind. vi, Append. p. 170. (1916). Punjab, Lahore, India.

nigroapica Funkhouser, (♀), Phil. Jour. Sci. xxxiii, p. 119, pl. 4, fig. 25. (1927). Puerta Princessa, Palawan, Philippines.

nitidipennis Funkhouser, (♀), Jour. Ent. Zool. vi, p. 71. (1914). Los Baños, Davao, Mt. Maquiling, Mt. Banahao, Iligan, Dapitan, Butuan, Paete, Bagnio, Benguet, Panay, Culasi, Philippines; Singapore, Penang; Mujang, Sandakan, Sarawak, Borneo.

fragila Funkhouser, Phil. Jour. Sci. xxxiii, p. 121, pl. 4, fig. 27. (1927). Samar, Philippines.

nigrocarinata, Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 234, pl. 6, fig. 1. (1914). Los Baños, Mt. Makiling, Benguet, Bagnio, Philippines.

akonis Matsumura, Annot. Zool. Jap. viii, p. 20. (1912). Koshun, Ako, Shinsha, Shirin, Hokuto, Hime-Taiwan, Formosa Is.

albomacula Funkhouser, Jour. Fed. Malay Sts. xiii, p. 2, fig. 3. (1927). Lumpur Kuala, Selangor, Malacca.

flavolineata Distant, Faun. Brit. Ind. iv, p. 65, fig. 54. (1908). Ranchi, Bengal, India; Burma; Peradinya, Ceylon.

sœrœlangœna Bierman, Notes Leyden Mus. xxxiii, p. 47. (1911). Sœrœlangœn, Sumatra.

parvula Lindberg, Noct. Ent. vii, p. 27, figs. 5, 10. (1927). Spasskaja, Ussuri region, E. Siberia.

luteipennis Funkhouser, Jour. Ent. Zool. vi, p. 71, fig. 7. (1914). Los Baños, Luzon, Philippines.

extrema Distant, Faun. Brit. Ind. vi, Append. p. 171. (1916). Peradeniya, Ceylon.

pilinervosa Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 222. (1920). Sandakan, Borneo.

rubrogranulata Bierman, Notes Leyden Mus. xxxiii, p. 45. (1911). Singapore, Penang, Malacca; Sandakan, Borneo; Semarang, Java.

nodipennis Funkhouser, Suppl. Ent. xv, p. 9, fig. 14. (1927). Gunung Singgalang, Sumatra.

arisana Matsumura, (♀), Annot. Zool. Jap. viii, p. 24. (1912). Arisan, Is. Formosa.

nodinervis Funkhouser, (♂), Phil. Jour. Sci. xxxiii, p. 122, pl. 4, fig. 29. (1927). Manila, Philippines.

albolinea Funkhouser, Jour. Fed. Malay Sts. xiii, p. 3, fig. 4. (1927). Lampur Kuala, Selangar, Malacca.

nodinervis Funkhouser, (♀), (same as ♂, supra).

nigromaculata Funkhouser, Suppl. Ent. xv, p. 10, fig. 17, (1927). Fort de Kock, Sumatra.

gracila Funkhouser, (♀), Phil. Jour. Sci. xxxiii, p. 120, pl. 4, fig. 26. (1927). Samar, Philippines.

myittæ Distant, Faun. Brit. Ind. iv, p. 64. (1908). Tenasserim, Myitta, India.

sikimensis Distant, Faun. Brit. Ind. iv, p. 64. (1908). Sikhim, Kotagiri, Madras, Nandidrug, India.

pulchripennis Stal, Hemip. Philip. p. 729. (1870); Funkhouser, Biol. Memb. pl. 32, fig. 6. (1917). Butuan, Mindanao; Mt. Maquiling, Los Baños, Davao, Panay, Culasi, Luzon, Philippines; Sandakan, Sarawak, Borneo; Mujang, India.

fasceifrontis Funkhouser, Phil. Jour. Sci. xxxiii, p. 122, pl. 4, fig. 28. (1927). Luzon, Philippines.

irrorata Funkhouser, Phil. Jour. Sci. xiii, p. 35. (1918). Benguet, Bagnio, Philippines.

virescens Funkhouser, Jour. Fed. Malay Sts. Mus. xiii, p. 4, fig. 5. (1927). Lampur Kuala, Selangor, Malacca.

nigriceps Bierman, Notes Leyden Mus. xxxiii, p. 46. (1911). Sœrœlangœn, Sumatra.

tumida Melichar, Hom. Ceylon, p. 123. (1903). Kandy, Peradeniya, Maskeliya, Puttalam, Ceylon; Darjiling, Pashok, India.

indica Bierman, Notes Leyden Mus. xxxiii, p. 46. (1911). Semerang, Batavia, Banjuwangi, Nongkodjar, Nusa Kambangan, Wonosabo, Java.

delimitata Distant, Faun. Brit. Ind. iv, p. 66. (1908). Assam, Magherita, India.

rivulata Distant, Faun. Brit. Ind. iv, p. 64. (1908). Sikhim, Mungphu, India. Wonosabo, Java.

penangi Funkhouser, Jour. Sts, Mr. Roy. Asiat. Soc. p. 11. (1918). Penang, Malacca.

orientalis Funkhouser, Ann. Acad. Sci. Mus. USSR, xxviii, p. 155, pl. 6, fig. 11. (1927). Lake Khanka, USSR, E. Siberia.

zonata Matsumura, Annot. Zool. Jap. viii, p. 24. (1912). Horisha, Is. Formosa.

malaya Stal, Eug. Resa Omk. J. p. 285. (1859). Malacca.

variegatus Matsumura, Annot. Zool. Jap. viii, p. 21. (1912). Arisan, Formosa.

varicolor Stal, (♀), (same as ♂, page 27).

semifascia Walker, Jour. Linn. Soc. i, p. 94. (1857). Malacca; Borneo.

alboapicata Distant, Faun. Brit. Ind. iv, p. 66. (1908). Tenasserim, Myitta, India. Batavia, Wonosabo, Java.

hyalifascia Funkhouser, Suppl. Ent. xv, p. 8, fig. 13. (1927). Fort de Kock, Sumatra.

sordida Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 13. (1918). Singapore.

nigrofasciata Stal, Hemip. Phil. p. 729. (1870). Mt. Maquiling, Mt. Banahao, Luzon; Iligan, Dapitan, Davao, Mindanao; Pæte, Philippines; Sandakan, Borneo.

nervosa Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 13. (1918). Singapore.

consocia Walker, Jour. Linn. Soc. i, p. 164. (1857). Borneo.

lagustri Matsumura, Annot. Zool. Jap. viii, p. 21. (1912). Honshu, Takasago, Tokyo, Japan.

semibrunnea Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. xiv, p. 447, fig. 9. (1929). Bettotan, Borneo.

guttulinervis Matsumura, Annot. Zool. Jap. viii, p. 25. (1912). Horisha, Formosa.

kawakami Matsumura, Annot. Zool. Jap. viii, p. 26. (1912). Koshun, Is. Formosa.

arisana Matsumura, (♂), (same as ♀, see page 28).

sinuata Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 237, pl. 6, fig. 7. (1914). Banguey, Borneo.

bicolor Funkhouser, (♂), Suppl. Ent. xv, p. 9, figs, 15, 16. (1927). Gunung Singalang, Sumatra.
lata Funkhouser, Bull. Brook. Ent. Soc. xvi, p. 51, fig. 12. (1912). Kiautschau, China.
majuscula Distant, Faun. Brit. Ind. iv, p. 61, fig. 53. (1908). Sikhim, Mungphu, Bengal Hills, Rangamati, Chittagong, Pashok, Darjiling, India.
bicolor Funkhouser, (♀), (same as ♂, see supra).
robusta Distant, Faun. Brit. Ind. iv, p. 61. (1908). Banguey, Borneo; Calcutta, Kurseong, India.
affinis Distant, Faun. Brit. Ind. iv, p. 61. (1908). Tenasserim, Myitta, Bombay, India; Sandakan, Banguey, Borneo.
cælata Distant, Faun. Brit. Ind. vi, Append. p. 172. (1916). Nilgiri Hills, India.
flavocarinata Funkhouser, Suppl. Ent. xv, p. 8, fig. 12. (1927). Fort de Kock, Sumatra.
pinguis Funkhouser, Phil. Jour. Sci. xiii, p. 33, pl. 1, figs. 15, 15, (1918). Zamboanga, Davao, Mindanao, Philippines.
gracila Funkhouser, (♂), (same as the ♀, see page 27).
luconica Fairmaire, Rev. Memb. p. 255. (1846). Negros, Cuernos Mts., Mindanao; Dapitan, Mt. Maquiling, Luzon, Philippines; Penang, Malacca; Sandakan, Borneo.
confusa Distant, Faun. Brit. Ind. vi, Append. p. 171. (1916). Calcutta, India.
mixta Buckton, Mon. Memb. p. 257, pl. 59, fig. 8. (1903). Bombay, Calcutta, Tenasserim, Myitta; Bolongoda, Coimbatore, Behar, Perambikulam, Akra, Cochin State, India; Ceylon; Sandakan, Borneo.
variegata Melichar, Hom. Ceylon, p. 123. (1903). Colombo, Malanda, Peradeniya, Kekirawa, Puttalam, Ceylon.
nandidrugana Distant, Faun. Brit. Ind. vi, Append. p. 171. (1916). Nandidrug, India.
patruelis Stal, Eug. Resa Omk. J. p. 285. (1859). Malinao, Tayabas, Mt. Banahao, Luzon, Davao, Mindanao, Philippines; Java.
splendidula Distant, Faun. Brit. Ind. vi, Append. p. 172. (1916). N. India.
pygmæa Walker, List. Hom. Brit. Mus. p. 630. (1851). Palawan, Puerta Princessa, Luzon, Mt. Banahao, Panay, Culasi, Mindanao, Davao, Philippines; Penang, Malacca.
grisea Buckton, Mon. Memb. p. 63, pl. 9, fig. 7. (1903). Philippines.
garampina Matsumura, Annot. Zool. Jap. viii, p. 22. (1912). Hoshun, Is. Formosa.
maculipennis Funkhouser, Phil. Jour. Sci. xiii, p. 32, pl. 1, figs, 13, 14. (1918). Benguet, Bagnio, Luzon, Philippines; Sandakan, Borneo.
apicata Melichar, Hom. Ceylon, p. 124. (1903). Peradeniya, Ceylon.
pilosa Funkhouser, Suppl. Ent. xv, p. 7, fig. 11. (1927). W. Sumatra.
discrepans Goding, Am. Mus. Nov. No. 421, p. 24. (1930). Banguey, Borneo.

donatzæ Matsumura, Annot. Zool. Jap. viii, p. 23. (1912). Honshu, Halone, Tokyo, Japan.

attenuata Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 236, pl. 6, fig. 4. (1914). Penang, Malacca; Banguey, Sandakan, Borneo.

nigroapica Funkhouser, (♂), (same as the ♀, see page 27).

sericea Distant, Faun. Brit. Ind. iv, p. 63. (1908). Kerbuwa, Ceylon.

nitidipennis Funkhouser, (♂), (same as the ♀, see page 27).

ornata Funkhouser, Phil. Jour. Sci. xl, p. 128. (1929). Borneo.

trinotata Distant, Faun. Brit. Ind. iv, p. 63. (1908). Tenasserim, Myitta, India.

semivitrea Walker, Jour. Linn. Soc. i, p. 94. (1857). Singapore.

brunneidorsata Funkhouser, Phil. Jour. Sci. xl, p. 128. (1929). Pekalongan, Java.

trifoliata Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 235, pl. 6, fig. 3. (1914); Phil. Jour. Sci. x, p. 400, pl. 2, fig. 19 (1915). Mt. Maquiling, Luzon, Philippines.

minuta Funkhouser, Jour. N. Y. Ent. Soc. xxii, p. 236, pl. 6, fig. 5. (1914). Banguey, Borneo.

Xanthosticta

Buckton, Mon. Memb. p. 63. (1903); *Tiberianus* Distant, Ann. Mag. N. H. xvi, p. 493. (1915); Goding, Jour. N. Y. Ent. Soc. xxxviii, p. 39. (1930).

KEY TO SPECIES

1(6). Tegmina hyaline without brown markings except base.

2(5). Median carina of pronotum subobsolete anteriorly; veins of tegmina not nodulate.

3(4). Pronotum black, apex of posterior process reaching apex of clavus; tegmina smoky hyaline ferruginous tinged; 4.3 × 2.3 mm. **pseudocornis**

4(3). Pronotum brown, apex of posterior process passing apex of clavus; tegmina yellowish, iridescent; 6 mm. .... **rugosa**

5(2). Median carina distinctly percurrent, pronotum brown, posterior process darker, apex ferruginous far passing apex of clavus; tegmina clear hyaline, veins nodulate; 4.5–5.5 × 2.4 mm. .... **siberica**

6(1). Tegmina with brown or piceous markings.

7(10). Tegmina without transverse bands; posterior process shorter than abdomen.

8(9). Tegmina vinaceous hyaline, apical third piceous; pronotum black, legs tawny; 7 mm. .... **biplaga**

9(8). Tegmina orange yellow, basal third and streaks on apical area brown, tips broadly clear hyaline; entirely brown; 7 mm. **luzonica**

10(7). Tegmina hyaline with two transverse brown bands; pronotum brown, median carina percurrent a tawny stripe each side; posterior process long as abdomen; body and legs tawny; 4 mm. ...... **constipata**

LIST OF SPECIES

pseudocornis Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 217, figs. 13, 14. (1920). Penang, Sumatra.

rugosa Montrozier, Ann. Soc. Lyon, (2), vii, p. 113. (1855). Woodlark Is., west of New Guinea.

siberica Lethierry, Ann. Soc. Ent. Belg. xix, p. 80. (p. 4 in reprint) (1876). Ussuri R., Siberia.

subinermis Lindberg, Not. Ent. vii, p. 24, figs. 3, 8. (1927). Vladivostok, Spasskaja, Ussuri, Siberia.

biplaga Walker, Jour. Linn. Soc. x, p. 191. (1868). Waigiu Is.; Celebes Is.

vulpecula Breddin, Ab. Nat. Ges. Halle, xxiv, p. 125. (1901). Duri, Celebes Is.

luzonica Buckton, Mon. Memb. p. 64, pl. 9, fig. 8. (1903). Luzon, Philippines.

constipata Walker, Jour. Linn. Soc. x, p. 192. (1868). Mysol Is., east of N. Guinea.

Ebhul

Distant, Fauna British India, iv, p. 59. (1908).

KEY TO SPECIES

1(6). Pronotum unicarinate, basal margin projecting forward in a flange.

2(5). Basal area of tegmina brown or black.

3(4). Pronotum black, posterior process tricarinate, ochraceous at middle, body and legs brown; tegmina grayish, broad basal area black, claval area brown and black mottled, white line between the two areas, apical area black mottled; 5 mm. .... **varius**

4(3). Pronotum brown, its summit strongly foveate with margins ridged, base and middle of posterior process ochraceous; tegmina brownish gray tesselate on apical area; 5.5 mm. .... **formicarius**

5(2). Basal half of tegmina yellow, apical half dark brown; pronotum dark brown, posterior process yellow at middle, tibiæ and tarsi yellow; 6×2.7 mm. .... **maculipennis**

6(1). Pronotum brown, tricarinate, basal margin not projecting forward, middle of posterior process white apex black; tegmina brown followed by triangular black fascia, then a triangular white fascia and a subapical black fascia, tips subhyaline; 5×2 mm. **carinatus**

LIST OF SPECIES

varius Walker, List Hom. B. M. Suppl. p. 162. (1858); Distant, Faun. Brit. Ind. iv, p. 59, fig. 51. (1908). Maymyo, Burma; Singapore, Penang; Fort de Kock, Sumatra; Sarawak, Borneo.

formicarius Distant, Faun. Brit. Ind. vi, Append. p. 169, fig. 125. (1916). Maymyo, Burma.

maculipennis Funkhouser, Rec. Ind. Mus. xxiv, p. 326, pl. 10, fig. 3. (1922). Pashok, Darjiling, E. Himalayas, India.

carinatus Funkhouser, Phil. Jour. Sci. x, p. 393, pl. 2, fig. 17. (1915). Butuan, Mindanao, Philippines.

Ebhuloidesini

Ebhuloides

Goding, Jour. N. Y. Ent. Soc.

KEY TO SPECIES

1(4). Median carina of pronotum moderately elevated, base of posterior process distinctly elevated above scutellum then straight.

2(3). Base of head bituberculate; pronotum black, not pubescent, posterior process pale brown, legs yellow brown; sides of chest bidentate; tegmina with basal third black, opaque, remaining area hyaline with black spots; 5.5 × 2 mm. .... **notatus**

3(2). Base of head nontuberculate; entirely brown, pubescent; sides of chest unidentate; tegmina flavous, opaque, fine brown lines on apical area; 4.5 × 1.8 mm. .... **uniformis**

4(1). Median carina of pronotum elevated in a crest at summit; entirely brown, posterior process slightly elevated above scutellum then sinuate; sides of chest bidentate, head bituberculate; tegmina brown, opaque, broad hyaline subapical spot; 6 × 2.5 mm. ...... **elegans**

LIST OF SPECIES

notatus Funkhouser, Suppl. Ent. xv, p. 17, fig. 27. (1927). Gunnung Singgalang, Sumatra.

uniformis Funkhouser, Suppl. Ent. xv, p. 18, fig. 28. (1927). Fort de Kock, Gunnung Singgalang, Sumatra.

elegans Funkhouser, Phil. Jour. Sci. xl, p. 117, pl. 1, fig. 9. (1929). Manorg, Borneo.

Centrotini

Antialcides

Distant, Ann. Mag. N. H. xvii, p. 326. (1916); *Pantaleon* Distant, Ann. Mag. N. H. xvii, p. 327. (1916).

KEY TO SPECIES

1(6). Suprahumerals gradually acuminate, tips acute.

2(5). Tegmina opaque brown; tip of posterior process straight.

3(4). Corium with two vitreous spots on exterior margin, and basal and central testaceous spot; pronotum black, carinæ tawny, crest of posterior process convex; 6.5 mm. .... **trifoliaceus**

4(3). Corium ferruginous without spots; pronotum ferruginous, crest of posterior process triangular; 6.5 × 4.7 mm. .... **erectus**

5(2). Tegmina hyaline, base broadly opaque, spot near apex of clavus and tips brown, veins to apical cells inwardly curved; pronotum slender, brown, pubescent, suprahumerals shorter than intermediate space, oblique, crest of posterior process high as suprahumerals, twice longer than high, apical area behind crest curved upward; 4.6 × 2.2 mm. .... **attenuatus**

6(1). Suprahumerals broad, tips bifid, oblique; tegmina opaque brown.

7(10). Tegmina without spots; legs brownish.

8(9). Piceous, pronotum much depressed in front, angular each side before humerals, suprahumerals twice as long as intermediate space, crest of posterior process conical lightly inclined forward, disk each side concave; 7 mm. .... **montifer**

9(8). Entirely brown, suprahumerals oblique, much longer than intermediate space, crest of posterior process slightly longer than high front margin vertical, rounded behind, with ferruginous lines; 7 × 3.5 mm. .... **brunneus**

10(7). Tegmina with central area, apical cells except the first, and middle of apical margin hyaline; brown, disk of posterior process crescentiform, the punctures and legs yellow; 6 × 3 mm. .... **dorsalis**

LIST OF SPECIES

trifoliaceus Walker, List Hom. B. M. Suppl. p. 163. (1858). North China.

erectus Funkhouser, Bull. Brook. Ent. Soc. xvi, p. 47, figs. 7, 8. (1921); Lingn. Sci. Jour. vii, p. 478, pl. 14, fig. 3. (1929). Kiautschau, China.

attenuatus Funkhouser, Rec. Ind. Mus. xxiv, p. 327, pl. 10, fig. 4. (1922). Sureil, E. Himalayas, India.

montifer Walker, List Hom. B. M. p. 620 (1851). Hong Kong, China.

brunneus Bull. Brook. Ent. Soc. xvi, p. 45, figs. 5, 6. (1921. Hiautschau, China.

dorsalis Matsumura, Annot. Zool. Jap. viii, p. 18. (1912). Kammutsu, Horisho, Formosa Is.

Machærotypus

Uhler, Proc. U. S., Nat. Mus. xix, p. 284. (1896); *Maurya* Distant, Ann. Mag. N. H. xvii, p. 326. (1916); Goding, Jour. N. Y. Ent. Soc. xxxviii, p. 39. (1930).

KEY TO SPECIES

1(6). Posterior process laterally broad to just before apex, pronotum and legs brown.

2(5). Tegmina brownish hyaline or subhyaline, veins not nodulate; median carina of pronotum strong, dorsum of posterior process nearly straight.

3(4). Ocelli nearer to eyes; pronotum castaneous brown base darker, suprahumerals much shorter than intermediate space, extended outward; tegmina hyaline without spots; 5–6 × 2.9 mm. .... **sellatus**

4(3). Ocelli equidistant; pronotum brown mottled with black, suprahumerals long as intermediate space extended outward and forward; tegmina translucent brown darker mottled, tips ferruginous tinged; 6.2 × 3 mm. .... **angulatus**

5(2). Tegmina yellowish brown, subopaque, two darker spots on apical margin, veins nodulose; pronotum rust brown with black basal dots, suprahumerals horizontal, much shorter than intermediate space, median carina weak, base of posterior process lightly gibbous, dorsum sinuate; body black, legs brown; 6 × 2.6 mm. .... **vitulus**

6(1). Posterior process pale yellow, middle band and tip piceous, laterally broad on basal half dorsum convex, then abruptly attenuate to apex, pronotum pale luteus, base with head and chest piceous; suprahumerals subhorizontal, long as intermediate space, front margin rounded and piceous; tegmina with two tawny bands, base piceous; legs and abdomen reddish; 4 mm. .... **gibbosulus**

LIST OF SPECIES

sellatus Uhler, Proc. U. S., Nat. Mus. xix, p. 284. (1896); Goding, Jour. N. Y. Ent. Soc. xxxviii, p. 40. (1930). Japan.

brevicornis Funkhouser, Bul. Brook. Ent. Soc. xvi, p. 49. (1921). Harima, Japan.

angulatus Funkhouser, Bul. Brook. Ent. Soc. xvi, p. 48, fig. 9, 10. (1921). Kiautschau, China.

vitulus Lindberg, Noc. Ent. iv, p. 23, figs. 2, 7. (1927). Spasskaja, Ussuri R., Vladivostok, Evgenievka, Siberia; Atani, Japan.

gibbulosus Walker, Jour. Linn. Soc. x, p. 187. (1868). Macassar, Celebes Is.

Otaris

Buckton, Mon. Memb. p. 249. (1903).

KEY TO SPECIES

1(6). Suprahumerals projecting forward.

2(5). Posterior process unicarinate, suprahumerals moderately diverging, pronotum brown, pubescent, legs yellowish; tegmina hyaline or subhyaline, veins nodulate.

3(4). Tegmina with base brown, opaque, apical margin brown; suprahumerals double longer than intermediate space, subparallel, tips rounded, apex of posterior process passing apex of clavus; body black; 1.7 × 1.7 mm. .... **porrectus**

4(3). Tegmina pale yellow clouded; suprahumerals long as intermediate space, subdiverging, tips truncate, apex of posterior process not passing apex of clavus; body brown; 7 mm. .... **mojiensis**

5(2). Posterior process tricarinate, tip slightly passing apex of clavus, pronotum ferruginous or black, weakly carinate, suprahumerals subparallel, more than twice longer than intermediate space, tips rounded and flattened; body brown, legs ferruginous; 6 × 2.3 mm. .... **convergens**

6(1). Suprahumerals horizontal or oblique, not projecting forward.

7(14). Suprahumerals horizontal or subhorizontal.

8(11). Tegmina hyaline without bands or spots, sometimes clouded, veins nodulose; entirely reddish brown, suprahumerals short, posterior process unicarinate.

9(10). Ocelli nearer to eyes; tegmina clear hyaline, apical area brown clouded: 3.5 × 3 mm. .... **minor**

10(9). Ocelli equidistant; tegmina brown clouded; 5 × 4 mm. **intermedius**

11(8). Tegmina bronze hyaline with spot or transverse band, veins without nodules; posterior process tricarinate.

12(13). Apex of posterior process elevated not touching margins of tegmina, suprahumerals very short, tips roundly subtruncate; black, legs ochraceous; tegmina with a distinct paler transverse band; 5.5 × 3 mm. .... **subangulatus**

13(12). Apex of posterior process straight touching margins of tegmina; suprahumerals long, broad, tips obliquely truncate; dark brown; tegmina with large white subbasal spot; 5.5 × 4 mm. **horizontalis**

14(7). Suprahumerals more or less oblique, sometimes nearly erect.

15(20). Posterior process unicarinate, apex concolorous with pronotum.

16(19). Median carina of pronotum absent anteriorly, suprahumerals equally broad to squarely truncate tips.

17(18). Black; suprahumerals long, broad; posterior process broad, apex abruptly acute not passing apex of clavus; tegmina ferruginous hyaline, veins nodulose; ocelli equidistant; 6 × 6 mm. **truncaticornis**

18(17). Brown; suprahumerals shorter, posterior process broad to middle, apical half moderately slender passing apex of clavus; tegmina dense brown; 8 × 4 mm. .... **auritus**

19(16). Median carina of pronotum percurrent, reddish; pronotum reddish brown mottled with black, two vertical black stripes on metopidium, suprahumerals broad, tips black, anteriorly rounded, truncate; posterior process broad, tip black, abruptly acute passing apex of clavus; tegmina smoky hyaline, base black, veins pilose; 5 × 4 mm. .... **lata**

20(15). Posterior process tricarinate.

21(26). Pronotum brown or ochraceous, gray pilose, legs yellowish.

22(23). Suprahumerals weakly oblique, upper surface rugose, posterior process moderately attenuated, darker on basal half passing apex of clavus .... **kamaonensis**

23(22). Suprahumerals distinctly oblique, posterior process robust, gradually narrowed to subacute apex not passing apex of clavus.

24(25). Pronotum bronze brown, tips suprahumerals darker; tegmina pale bronze brown, base darker; 5 × 3.5 mm. ....**æneus**

25(24). Pronotum ochraceous, suprahumerals rounded and slightly ampliate anteriorly with central carina on upper surface, tips rounded, posterior process tectiform apical third black; tegmina pale ochraceous subhyaline; 5 × 3.5 mm. ....**selenus**

26(21). Pronotum and legs black, yellow pilose, suprahumerals moderately broad, distinctly oblique, weak carina behind middle of upper surface; posterior process robust, median carina obscure on the front, gradually acuminate to apex of clavus; tegmina pale bronze, base darker more opaque, frequently with several extra cross veins; 4.5–5 × 3 mm. ....**congestus**

LIST OF SPECIES

porrectus Funkhouser, Phil. Jour. Sci. xl, p. 118, pl. 1, fig. 10. (1929). Davao, Luzon, Philippines.

mojiensis Matsumura, Annot. Zool. Jap. viii, p. 17. (1912). Hokkaido, Morioka, Otaru, Monshu, Hakone, Moji, Japan.

convergens Walker, List Hom. B. M. p. 623. (1851); Funkhouser, Phil. Jour. Sci. x, p. 385, pl. 1, fig. 9. (1915). Los Baños, Manila, Panay, Culasi, Luzon, Philippines.

minor Schmidt, Zool. Anz. xxxviii, p. 243. (1911). Sœkaranda, Sumatra.

intermedius Schmidt, Zool. Anz. xxxviii, p. 242. (1911). Mt. Marapok, Dent, Borneo.

subangulatus Distant, Faun. Brit. Ind. iv, p. 55. (1908). Nilgiri Hills, Chikkaballapura, India; Rajmahal, Bolund, Goalbathan, Bengal; Moulmein, Burma.

horizontalis Distant, Faun. Brit. Ind. vi. Append. p. 164. (1916). Moulmein, Burma.

truncaticornis Funkhouser, Jour. Str. Br. Roy. Asiat. Soc. p. 8. (1918). Singapore; Sandakan, Borneo.

auritus Buckton, Mon. Memb. p. 249, pl. 59, fig. 1. (1903). Sœkaranda, Pangherang-Pisang, Ager Mantcior, Sumatra.

latus Funkhouser, Suppl. Ent. xv, p. 5, figs, 8, 10. (1927). Mt. Guning, Singgalang, Sumatra.

kamaonensis Distant, Faun. Brit. Ind. vi, Append. p. 163. (1916). Kumaon, Bhimtal, Ceylon; Bombay, India.

æneus Distant, Faun. Brit. Ind. vi, Append. p. 167. (1916). E. Himalayas, Peshoke, Kurseong, Darjiling, Kallimpong, Ghumti, Pussingbing, Myitta, Assam, Margherita, Kumaon, Almore, Tenasserim, Bengal, India.

selenus Buckton, Mon. Memb. p. 247, pl. 60, fig. 6. (1903). Tenasserim, Myitta, India.

congestus Walker, Ins. Saund. Hom. p. 79. (1858). Sulu Is., Philippines.

(To be continued)

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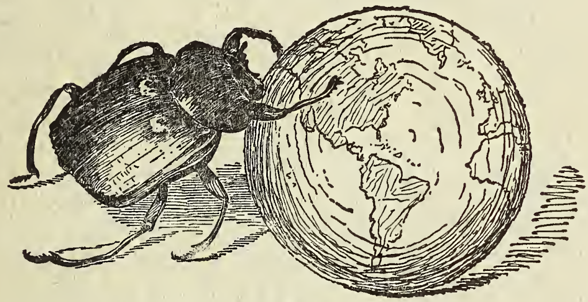

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THE ANATOMY OF PYROTA MYLABRINA (CHEV.)*

By Rozella Blood
Department of Zoology
The University of Wichita
Wichita, Kansas

INTRODUCTION

The purpose of this paper is to contribute to the knowledge of insect anatomy:—to coleopterous anatomy in general with specific reference to Meloidæ.

The wing venation of Coleoptera is a comparatively new study, its importance lying chiefly in its relation to taxonomic characters. For example in *Pyrota mylabrina* (Chev.) a variation in the number of thoracic spots appears. If this variation could be correlated with a difference in wing venation, the species could be divided.

The most outstanding point in the material, relative to internal anatomy, is the study of the circulatory system. According to the foremost workers in insect anatomy, very little has been done upon coleopterous hearts. The study in this paper endeavors to contribute to the general knowledge of beetle heart structure, and to add observations upon the microscopic structure of insect alary muscle.

COLLECTION, PRESERVATION, AND PREPARATION OF MATERIAL

Material for this paper was collected near Wellington in Sumner County, Kansas, in August, 1932. The beetles appear

* A Dissertation Submitted to the Graduate Faculty in Candidacy for the Degree of Master of Science.

near the middle of July, and reach their maximum number late in August. They are pollen feeders, and were found feeding upon Helianthus (sp?), with their bodies partly buried in the disc of the flowers. The mating season is in the latter part of August, and in 1932 these beetles occurred in such numbers that it was possible to collect several hundred within half an hour in one patch of weed.

The insects were killed with chloroform vapor and immediately placed into one of two solutions: 1, 1 per cent glycerine in 10 per cent formalin; and 2, Bouin's fixative (4). Later it was observed that those preserved in formalin were not fixed so well for gross internal dissection as those fixed in Bouin's. The organs were firm but not brittle in the case of the latter.

For the study of external anatomy, the chitin of the insect was softened and decolorized by soaking the specimen in an aqueous solution of 10 per cent potassium hydroxide. This may be done within an hour if the potassium hydroxide be warmed almost to the boiling-point. Boiling insects in potassium hydroxide should be avoided because it tends to distort the specimens.

Mouth parts were dissected out and mounted in glycerine jelly. Dry mounts were made of the wings in the following manner: The wings (by pairs) were laid flat upon a slide and moistened in order that they might be stretched out. The cover slip was fixed to the slide with narrow strips of adhesive paper, and the wings then allowed to dry. After the wings were removed, the beetles were preserved in bottles numbered to correspond with those of the wing slides, in order that any variation might be checked back to the original specimen.

GENERAL DESCRIPTION OF THE SPECIES

Pyrota mylabrina (Chev.) 1834 is a synonym for *P. concinna* (Casey). It is placed in the subfamily Cantharinæ, separated from the one other subfamily in Meloidæ, Meloinæ, by the facts that the side pieces of the meso- and metathorax are visible in ventral aspect; that the inflexed portion of the elytra is narrow; that wings are present; and that the elytra almost, or entirely, cover the abdomen and do not overlap at the median line (1), (Plate II, Fig. 6).

It belongs to the tribe Cantharina, members of which are described (1) as subcylindrical beetles having the front distinctly marked by a transverse suture prolonged beyond the insertion of the antennæ (Plate I, Fig. 1), and the tarsal claws cleft to the base (Plate II, Fig. 6).

The genus Pyrota is separated from the other genera of Cantharina (1) by the form of the antennal joints which are slender and cylindrical, the second joint being about one fourth that of the third. The males have the last joint of the maxillary palpus transversely oval, with the under side concave (Plate I, Fig. 2); in the female it is elongate and truncate at the tip. In the female, the last abdominal segment is notched upon the venter (Plate II, Fig. 5).

Pyrota mylabrina (Chev.) is an elongate cylindrical beetle varying in length from 2.2 cm. to 3.2 cm., and in width, from 0.4 cm. to 1.0 cm. It is a dull yellow with black antennæ and black markings on the thorax, abdomen and elytra. There are two to four small spots on the prothorax, and six to eight are found on the elytra extending to the mid-dorsal line producing a banded appearance. The variation in number occurs in the most anterior pair of spots. In ventral aspect, the sternum, episternum and epimerum of the metathorax, have black spots and each abdominal segment is banded with black. The entire body is pitted and slightly pubescent. The mouth parts bear dense brushes, characteristic of pollen feeding beetles.

THE HEAD AND MOUTH PARTS

A. The Fixed Sclerites of the Head

The sclerites of the head are fused to form the box-like structure characteristic of Coleoptera. The occipital region is about one half the width of the head proper, and is distinctly collar-like (Plate I, Fig. 1). On the dorsal aspect the heart is rounded. There is no epicranial suture. There is a slight depression on the frons at the level of the antennæ. The clypeo-frontal suture is definite, separating the frontal region from the broad clypeus. Although the labrum is considered an immovable part of the head, it is described with the mouth parts. The compound eyes are situated anteriorly.

In ventral aspect, very definite gular sutures separate the post genal region from the gular region (Plate I, Fig. 2). Two deep gular pits are located in the posterior half of the gular suture. The head is slightly pubescent.

B. The Movable Parts of the Head

1. The antennæ.—The antennæ are eleven jointed and filiform. The most proximal joint is larger than the others and strongly curved. The second joint is about one fourth the length of the following distal joints. The antennæ are strongly pubescent.

2. The mouth parts.—The mouth parts of *P. mylabrina* are not modified to a great extent. The labrum is about one fourth the width of the head and, when in place, covers the inner surface of the mandibles (Plate I, Fig. 1). The inverted Y-shaped epipharynx lies on the ental surface of the labrum (Plate I, Fig. 3). It bears heavy spinulæ. The entire ental aspect of the labrum presents a bushy appearance.

The mandibles (Plate I, Fig. 3, 2A and 2B) are of the blunt, herbivorous type. They are for the most part smooth on the ectal surface, but the inner surface of the dentary edge is provided with a strong brush.

The brush-like character of the mouth parts is emphasized to the greatest extent in the *maxillæ* (Plate I, Fig. 3, 3A and 3B). The cardo is a strong triangular sclerite whose apex has been flattened to form the point of articulation with the head. The stipes is also triangular shaped but narrower than the cardo, with the apex tapering distally. The palpifer, lying laterad to the stipes, bears the maxillary, five jointed palpus.

The elements of the labium (Plate I, Fig. 3, 4A and 4B) cannot be distinguished as separate units. There is a four jointed labial palpus. The ental surface of the labium presents the usual brush-like appearance.

Attached to the floor of the labium is the hypopharynx (Plate I, Fig. 3, 3A). It is barely more than a slight elevation and densely haired.

THE WINGS

A comparative study of the wing venation in Coleoptera by Forbes (3), shows that although quite modified, coleopterous wing venation conforms to the common plan.

In *Pyrota mylabrina* (Plate II, Fig. 7), the costa, sub-costa, and radius are fused along the costal margin, and distinguishable as separate veins only for a short distance along the humeral margin.

Radial sector is present, quite distinctly dropping from radius. Forbes, in his "Wing Venation of Coleoptera" (3), describes the venation of *Pomphopie sayi* (Lec.), (a species of the Meloidæ very closely related generically with *Pyrota mylabrina,* the two genera being separated only on the basis of a slight antennal difference). In *Pomphopie sayi* (Lec.) (3), the radial sector seems to have dropped out.

The unstable media is almost gone in *P. mylabrina.* There is a strong radio-medial cross vein (r-m). On the proximal side of the caudal end of this cross vein, media (M) appears as a short spur. From this junction media-1 plus media-2 (M_{1+2}) proceeds to the margin of the wing, and media-3 plus media-4 (M_{3+4}) drops to fuse with cubitus (Cu), which is a strong vein extending the length of the wing.

Arculus is very definitely present between radial sector (Rs) and cubitus (Cu).

In the anal region, the first anal (A_1) has apparently begun to drop out as its proximal portion lies almost in the medial part of the wing. It is a simple vein with no branches. The second anal (A_2), branches (2nd A_2)* downward to meet an upward branch of the third anal (1st A_3), forming a short vein which Forbes describes as "chevron-like" (3). The fourth anal (A_4) is in two parts.

In some forms, there is evidence of an atrophied cross vein between the first anal (A_1) and the first branch of the second anal (1st A_2), (Plate II, Figs. 2, 3, and 9). This is the only variation in the wing venation and not sufficiently substantial to be of taxonomic value. In some specimens it is absent in both wings; present in both wings; or again it may be present in one wing and not in the other, on the same beetle. In no case, in the 100 wings observed, was this cross vein found to be completely bridged between the first anal (A_1) and the first branch of the second anal (1st A_2). However there appear thickenings on the first anal (A_1) and the first branch of the second anal (1st A_2),

* These references are in accordance with the lettering on Plate II, Fig. 7, and are not the usual notations for these veins.

at the level of this cross vein, even when it is not present in rudimentary form (Plate II, Figs. 7 and 8).

There is a definite pterostigma in the apical portion of the wing.

The folding pattern is shown on Plate II, Figure 10, in which, after the custom of Forbes (3), the reversed portions are shaded. Fig. 11 shows a folded wing.

THE DIGESTIVE SYSTEM

Plate I, Figure 4

The digestive tract of *P. mylabrina* is simple. The mouth opens into the œsophagus, a simple tube extending caudad to the mid-region of the prothorax, and becomes the proventriculus at this point. The crop is wanting. This feature is characteristic of pollen feeding insects (6). The ventriculus follows the œsophageal valve and lies in the first five abdominal segments. The caudal third of the ventriculus is covered on the dorsal aspect by small tubular gastric coeca. These lie entirely on the dorsal side of the ventriculus, and from the ventral aspect are not apparent.

The Malpighian tubules lie at the junction of the ventriculus and the small intestine, and are six in number. The small intestine is short and loops dorsally to form the large intestine which constricts slightly before passing into the pouch shaped rectum.

THE REPRODUCTIVE SYSTEM

A. The Female Reproductive System

Plate III, Figure 1

As the specimens observed for this study were collected near the end of the mating season, the females were all gravid. Large sacs, containing ovarioles filled with eggs, lie in either side of the abdominal cavity and fill it. There is a relatively small chitinized bursa copulatrix, and a short vagina.

On the ventral side of the bursa copulatrix is the opening to the spermathecal duct, which leads to the pouch-like spermatheca. Here the spermatozoa are stored, after being received into the bursa copulatrix.

A great many eggs are produced by a single female. This is necessary because of the hazardous development of the hypermetabolous type, which is described by Imms (6) as follows: "The females lay a very large number of eggs, (often 2,000 to 10,000), which is explainable on the grounds that the subsequent life-history is extremely precarious, and very large numbers of larvæ perish in the first instar. Oviposition takes place in the soil or on the surface of the ground, and the resulting larvæ prey upon the eggs of Orthoptera and aculeate Hymenoptera. In the first instar they are minute, active, hard-skinned, campodeiform larvæ known as triungulins. At this stage they are principally engaged in seeking out their hosts; having discovered the latter, they subsequently undergo ecdysis and change into soft-bodied, short limbed, eruciform larvæ; or more rarely, into a modification of the campodeiform type known as the caraboid stage. The next succeeding instars differ from the preceding, and the second, or later larva, passes into a resting period when the insect assumes the pseudopupal or 'coarstate' condition. The latter is followed by a further larval instar which is succeeded by the pupa."

B. The Male Reproductive System
Plate III, Figure 2

The male reproductive system is made up of testes, vasa deferentia, seminal vesicles, accessory glands, a median ejaculatory duct and an ædeagus. The testes are flat bodies with several suspensory ligaments, which are attached to the apodeme of the metathorax. The vasa efferentia are tubes leading from the testes. Between each vas efferens and vas deferens appears a thickening which investigation has shown to be tubular in form and filled with spermatozoa, therefore it is permissible to term it a seminal vesicle. After receiving small glands, the vasa deferentia empty into the median ejaculatory duct.

At the junction of the vasa deferentia with the ejaculatory duct are three pairs of accessory glands. Very little information is available concerning the function of the accessory glands (6). Usually there are only two pairs. According to Beauregard (6) the secretion of the third pair is extremely rich in cantharadin. The secretion of all three pairs evidently mix with the spermatozoa. The ejaculatory duct is a heavy muscular tube (6), which opens into the ædeagus.

THE CIRCULATORY SYSTEM

Plate III, Figure 3

According to Imms (6) very little is known concerning the structure of the aorta and the accompanying tubular heart and alary muscles of beetles. The heart is divided into eight chambers. There are seven, corresponding to the abdominal segments, and a long thoracic chamber, the aorta proper, which enters the head and opens dorsad of the supra-œsophageal ganglion. This tube is held in the pericardial chamber by seven pairs of alary muscles. These are triangular groups of muscle fibers, the bases lying along the tubular heart and the apices attached to the intersegmental region of the dorsal body wall. The anterior and posterior points of the bases overlap. The most caudal pair of the abdominal alary muscles is small, made up of a group of only a few fibers.

Study of the insect heart is difficult because of the extremely delicate nature of the aorta, the heart and the alary muscles. Accurate observation is made possible by the nature of the pericardial cells. These are groups of cells, excretory in function, which are clumped along the fibers of the alary muscle. They have the power of collecting and retaining nitrogenous waste material. Therefore if the living insect be injected with an aqueous solution of ammonia-carmine (2) and allowed to live for a few hours, the pericardial cells pick up and retain the dye, and stand out in gross dissection as a brilliant red. Their close association with the alary muscles and the heart make it possible to observe the structure of the latter.

For small insects capillary pipettes may be used for the purpose of injecting the stain, and for larger insects small hypodermic syringes may be used.

The histological structure of the alary muscles is a point upon which there has been some controversy. Imms states definitely that they are made up of striated muscle fibers (6), and Packard (9) states that they are mere suspensory filaments. Observations made upon living material with the use of a water immersion objective show them to be striated muscle.

THE NERVOUS SYSTEM

Plate III, Figure 4

The points which will be discussed in connection with the nervous system in this chapter are as follows: a supra-œsophageal ganglion, with connective commissures; three thoracic ganglia; and three abdominal ganglia, with double commissures.

The supra-œsophageal ganglion is large, occupying about one fifth the length of the head, and about one half the width. It gives off definite optic, antennary and clypeal nerves, and is somewhat bilobed. In front of the supra-œsophageal ganglion is the small frontal ganglion which is associated with the sympathetic nervous system (6). The sub-œsophageal ganglion lies ventrad to the œsophagus, and gives off branches to the mandibles, maxillæ and the labium.

Concerning the thoracic and the abdominal ganglia, only the position and the comparative size have been noted. There has been no attempt made to trace out the nerves leading from these ganglia to the various endings. There are three thoracic, and three abdominal ganglia. Imms (6) states, in regard to the number of ganglia, "The most generalized type of nervous system is found in the Cantharidæ where in addition to the supra- and infra-œsophageal centers, there are three thoracic ganglia and seven or eight abdominal ganglia . . . reduction of the number of abdominal ganglia, unaccompanied by a similar specialization of the thoracic centers, may be traced through a number of genera." *P. mylabrina* (Chev.) is an example of the latter statement. The prothoracic ganglion is the largest of the three thoracic ganglia, and lies beneath the muscles of the prothorax between the two prothoracic apodemes. The meso- and meta-thoracic ganglia are smaller and lie on the floor of the meso- and meta-thorax.

The three abdominal ganglia lie along the floor of the abdomen, in segments two, four, and six respectively, the most caudal of the abdominal ganglia being the largest.

LITERATURE CITED

1. BLATCHLEY, W. S. *The Coleoptera or Beetles Known to Occur in Indiana.* Nature Publishing Company.
2. COMSTOCK, JOHN HENRY. *An Introduction to Entomology.* The Comstock Publishers, 1924.
3. FORBES, W. T. M. *The Wing-venation of the Coleopetera,* Annals of the Entomological Society of America, Vol. XV, No. 4, December, 1922.
4. GUYER, M. F. *Animal Micrology.* University of Chicago Press, 1930.
5. HENNEGUY, L. FELIX, *Les Insects.* Mason et Cie Editeurs — Paris, 1904.
6. IMMS, A. D. *A General Text Book of Entomology.* E. P. Dutton and and Company, 1924.
7. LENG, C. W. *A Catalogue of the Coleopetera of America, North of Mexico.* Daw, Illston, and Co., Publishers, 1930.
8. MAC GILLIVRAY, ALEX D. *External Insect Anatomy.* Scarab Publishers, 1923.
9. PACKARD, ALPHEUS S. *Text-Book of Entomology.* The Macmillan Company, 1898.

PLATE I

Head, Mouth Parts and Dorsal Aspect of the Digestive System

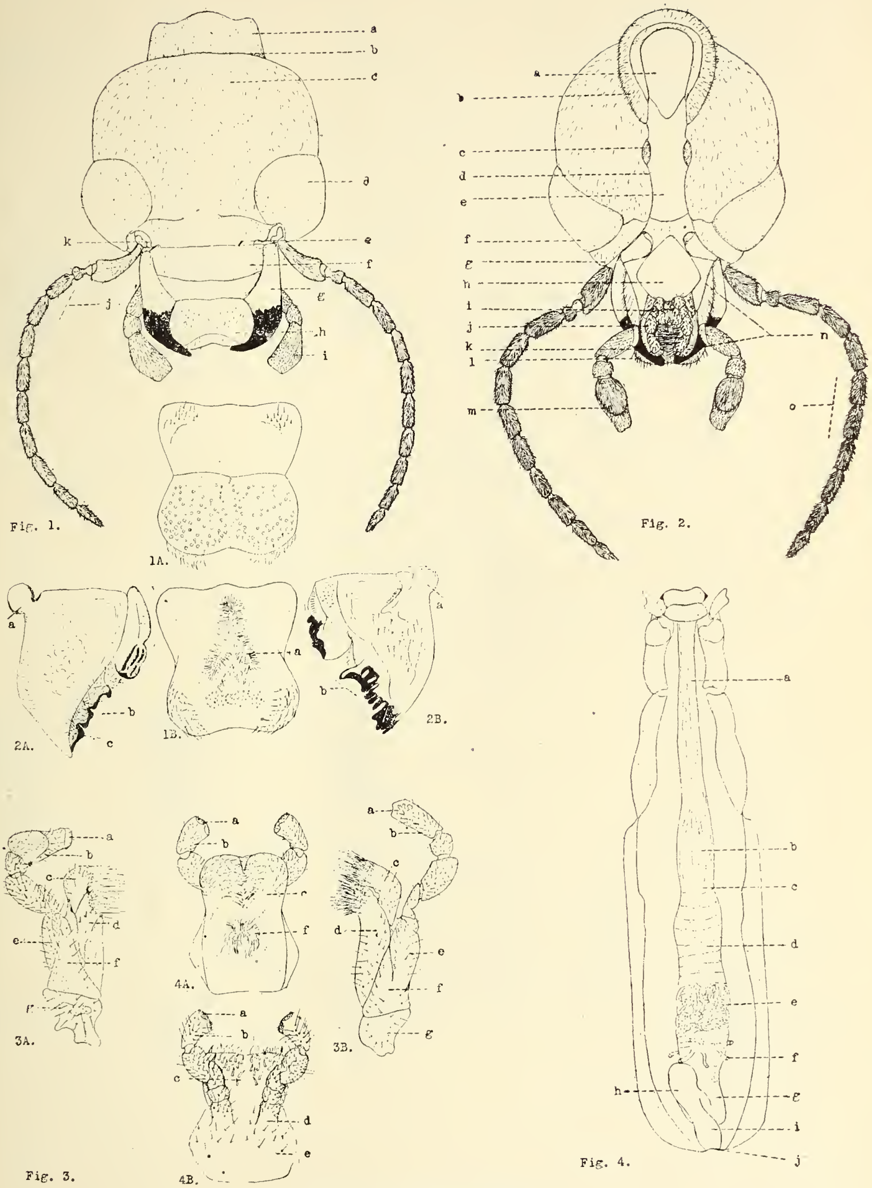
Fig. 1. Dorsal Aspect of Head.
- a. occiput.
- b. occipital region.
- c. region of vertex.
- d. compound eye.
- e. clypeal suture.
- f. clypeus.
- g. mandible.
- h. labrum.
- i. maxillary palpus.
- j. antenna.
- k. antennary sclerite.

Fig. 2. Ventral Aspect of Head.
- a. foramen.
- b. occiput.
- c. gular pit.
- d. gular suture.
- e. gular region.
- f. eye.
- g. post genal region.
- h. submentum.
- i. ligula mentum.
- j. labial palpus.
- k. mandible.
- l. maxillary brush.
- m. maxillary palpus.
- n. maxilla.
- o. antenna.

Fig. 3. Mouth Parts.
1. Labrum.
   - 1A. Ectal aspect.
   - 1B. Ental aspect.
     - a. Epipharynx.
2. Mandible.
   - 2A. Ental aspect.
   - 2B. Ental aspect.
     - a. articular process.
     - b. mandibular teeth.
     - c. mandibular brush.
3. Maxilla.
   - 3A. Ental aspect.
   - 3B. Ectal aspect.
     - a. sensory tip.
     - b. palpus.
     - c. galea.
     - d. lacini a.
     - e. palpifer.
     - f. stipes.
     - g. cardo.
     - h. maxillary brush.
     - i. oval sensory spot of male.
4. Labium.
   - 4A. Ental aspect.
   - 4B. Ectal aspect.
     - a. sensory tip.
     - b. four jointed labial palpus.
     - c. mentum.
     - d. palpiger.
     - e. submentum.
     - f. hypopharynx.

Fig. 4. Dorsal Aspect of Digestive Tract of Female.
- a. oesophagus.
- b. proventriculus.
- c. region of eo. valve.
- d. ventriculus.
- e. enteric coeca.
- f. Malpighian tubules.
- g. small intestine.
- h. large intestine.
- i. rectum.
- j. anus.

PLATE I.



PYROTA MYLABRINA

PLATE II

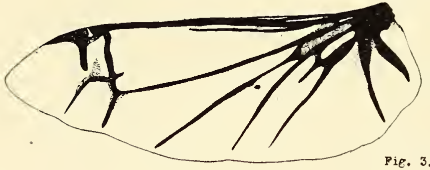
External Anatomy and Wings.

Fig. 1. Wing 1. (Left).
Fig. 2. Wing 2. (Left).
Fig. 3. Wing 3. (Left).
Fig. 4. Genitalia of Male.
    a. cercus.
    b. aedeagus.
Fig. 5. Genitalia of Female.
    a. ovipositor.
    b. genital hood.
Fig. 6. Ventral Aspect of Beetle.
    a. cervical apodeme.
    b. epipleurum of prothorax.
    c. sternum + episternum of prothorax.
    d. epimerum of prothorax.
    e. first thoracic spiracle.
    f. epimerum of mesothorax.
    g. episternum of mesothorax.
    h. sternum of mesothorax.
    i. epimerum of metathorax.
    j. episternum of metathorax.
    k. sternum of metathorax.
    l. coxa.
    m. trochanter.
    n. femur.
    o. tibia.
    p. tarsi.
    q. tarsal claw.
Fig. 7. Wing 1. (Right).
Fig. 8. Wing 2. (Right).
Fig. 9. Wing 3. (Right).
Fig. 10. Folding Pattern of Wing.
Fig. 11. Wing Folded.

PLATE II.


Fig. 1.


Fig. 2.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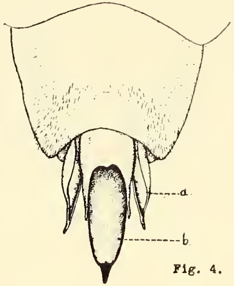

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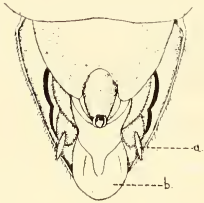

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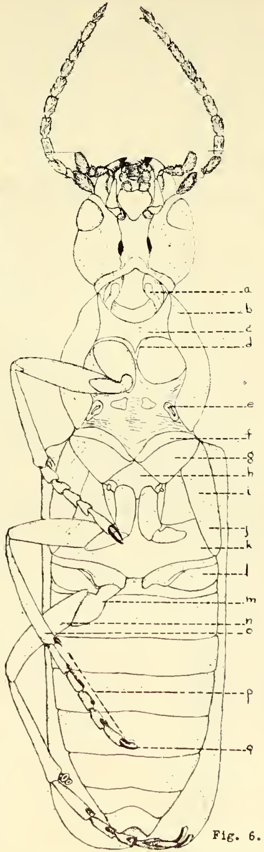

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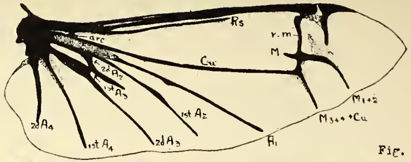
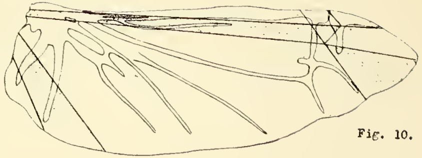


Fig. 7.


Fig. 8.


Fig. 9.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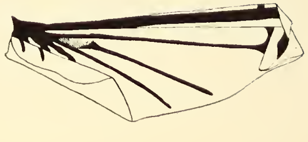


Fig. 11.

PYROTA MYLABRINA

Plate III

Internal Anatomy.

Fig. 1. Female Reproductive System.
- a. terminal ligament.
- b. ovary.
- c. vagina.
- d. spermatheca.
- e. spermathecal duct.
- f. bursa copulatrix.

Fig. 2. Male Reproductive System.
- a. accessory glands.
- b. terminal ligament.
- c. testis.
- d. vas efferens.
- e. seminal vesicle.
- f. vas deferens.
- g. ejaculatory duct.
- h. gland.
- i. aedeagus.

Fig. 3. Circulatory System.
- a. aorta.
- b. metathoracic pair of alary muscles.
- c. first abdominal chamber.
- d. vestigal pair of alary muscles.

Fig. 4. Nervous System (greater ganglia and nerves).
- a. clypeal nerve.
- b. frontal ganglion.
- c. optic nerve.
- d. circumoesophageal commissure.
- e. suboesophageal ganglion.
- f. double connective commissures.
- g. prothoracic ganglion.
- h. mesothoracic ganglion.
- i. metathoracic ganglion.
- j. first abdominal ganglion.
- k. second abdominal ganglion.
- l. third abdominal ganglion.
- m. antennary nerve.

Plate III

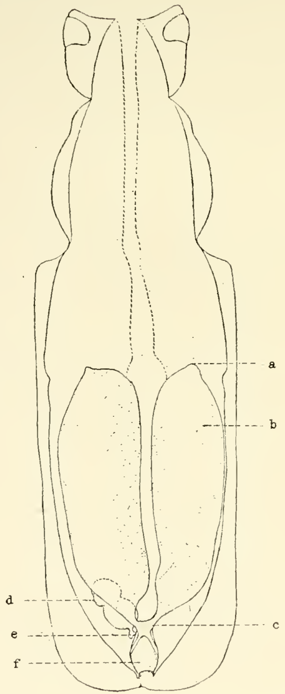
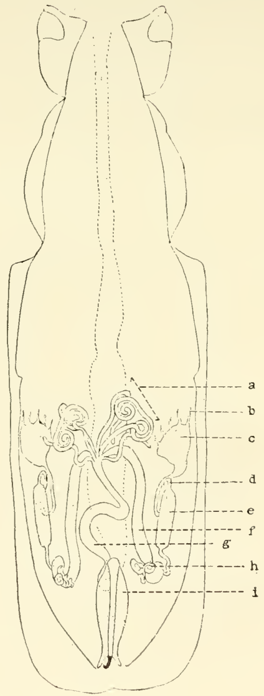


Fig. 1.



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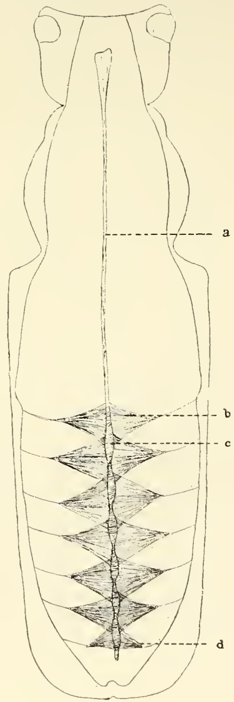


Fig. 3.

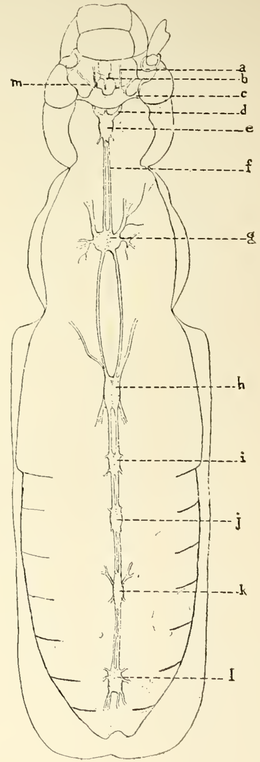


Fig. 4.

PYROTA MYLABRINA

NOTES ON THE HABITS OF CERTAIN AUSTRALIAN THYNNIDÆ

By R. W. Burrell

Division of Japanese and Asiatic Beetle Investigations,
Bureau of Entomology and Plant Quarantine,
United States Department of Agriculture

ABSTRACT

This paper gives observations made on the flight, mating and feeding habits of certain Australian Thynnidæ, and discusses these habits in relation to a few typical habitats. Brief descriptions are given of the egg, larva and larval feeding habits.

During the period from 1930 to 1932, the writer was stationed in Australia, and engaged in research on the parasites of the Scarabæidæ for two seasons of field work, during the course of which two species of Ortalidæ and four or five species of Tachinidæ were found as parasites of adult beetles. The larval parasites encountered were one species of Tachinidæ and members of the families Scoliidæ and Thynnidæ. The Thynnidæ are a most interesting group because of their very peculiar habits about which little has been published. (Plate IV).[1]

The digger wasps of the family Thynnidæ are now placed in the superfamily Mutilloidea. The observations treated in this paper were made on members of the subfamily Rhagigasterinæ and Thynninæ, which occur chiefly in Australia. They are represented by many genera and over 400 described species. Some earlier writers suggested that thynnids, like the mutillids, were parasites of other aculeate Hymenoptera, but Froggatt (1),[2] Bridwell (3), and Tillyard (4) consider that they parasitize soil inhabiting Coleoptera of the family Scarabæidæ. To the writer's knowledge, however, there are no host records in the literature and only one instance on record of an egg being deposited on a scarabæid larva by a thynid (5). During the studies recorded

[1] This illustration was very kindly prepared by Mr. R. J. Sim of the Moorestown laboratory of the Bureau of Entomology.

[2] Figures in parenthesis refer to Literature Cited.

in this paper approximately 24 species representing some sixteen genera were observed, and many of them tested in the laboratory with scarabæid larvæ. The species on which fairly complete observations on some phase of their habits were made are listed herewith.[3]

Subfamily	*Genus and Species*
Rhagigasterinae	*Dimorphothynnus morio* Westw.
"	*Eirone ichneumoniformis* Smith
"	*Rhagigaster aculeatus* Sauss.
"	*Rhagigaster unicolor* Guer.
"	*Rhagigaster unicolor* var. *mandibularis* Westw.
Thynninae	*Epactiothynnus pavidus* Smith
"	*Glaphyrothynnus zanthorrhoei* Smith
"	*Hemithynnus apterus* Oliv.
"	*Lophocheilus obscurus* Klug.
"	*Neozeleboria proximus* Turner
"	*Thynnoides fulvipes* Guer.
"	*Thynnoides fumipennis* Westw.
"	*Thynnoides sensilis* Erich.
"	*Tmesothynnus zelebori* Sauss.
"	*Zaspilothynnus leachiellus* Westw.
"	*Zeleboria monticollis* Turner
"	*Zeleboria nitidulus* Turner
"	*Zeleboria sexmaculata* Smith
"	*Zeleboria trivialis* Smith

These observations were made in three different types of habitats. The first of these was the coastal plain type. This habitat is usually close to the actual coast line. Generally it has a very light sandy soil, and the ground cover is bunch grass. There is an abundance of large and small flowering shrubbery, at least some of which is in blossom during the greater part of the season. The most common of these are the species of the "tea-tree" (*Leptospermum* spp. and *Melaleuca* spp.). Large trees are relatively few. These areas have an abundance of rainfall. A second type of habitat is the tableland sections of New South Wales. These are extensive plateaus paralleling the coast and varying in altitude from approximately 1,000 to 3,000 feet.

[3] These determinations were made by Mr. K. E. W. Salter, who at the time was a graduate student at Sydney University, and was specializing in the Thynnidæ.

They have about half the amount of rainfall that the coastal sections receive, and are devoted chiefly to grazing. The soil is usually hard and packed and the ground cover is grass. There are scattered wooded tracts which have not as yet been cleared to enlarge grazing areas. Most of the blossoms in this habitat are the flowers of the various species of *Eucalyptus* trees. A third type of habitat is the farming country, areas of rich soil and abundant rainfall. The farming practiced is chiefly truck gardening, deciduous fruit raising, and dairying. The ground cover of the uncultivated land is varied and commonly consists of either wooded areas or of extensive pastures. Some species of flowering shrubs are fairly common. General observations on Thynnidæ were made in representative areas of these three types of habitats. Most of the detailed observations were made in the farming country habitat.

In the coastal plain type, thynnids may be taken in small numbers at almost any time from early spring to late autumn, with the exception of the driest part of the summer. During collecting trips a number of species were usually taken, but *Rhagigaster aculeatus* Sauss. was the only one found in great numerical abundance. The majority of the species found in these areas were blossom feeders, a few examples being *Dimorphothynnus morio, Rhagigaster aculeatus, R. unicolor, Hemithynnus apterus,* and *Lophocheilus obscurus.*

In the tablelands habitat, somewhat similar to the coastal strip, there is a fair abundance of species without any great numerical abundance, although the species are not as numerous here as in the coastal habitat. In the tablelands a majority of the thynnids were found feeding on the blossoms of *Eucalyptus,* but many were also seen feeding on exudations from scale insects which were more noticeably abundant in this habitat than in the coastal areas.

Rhagigaster unicolor variety *mandibularis* and *Zeleboria trivialis* were found as scale feeders in this area while *Aeolothynnus umbripennis* Smith and *Agriomyia luctuosus* Smith were taken on blossoms. The farming country habitat differs from either of the others. The number of species found here seems to be less than in the other areas. Fewer species were found in any given area which could be covered in any one day of collecting. However, the numerical abundance of individuals of most of the species found in the farming country was markedly greater than in either of the other habitats and several hundred individuals per day could be collected with ease at the concentration points. Nearly all of the species found so abundant in these areas feed on the exudations of scale insects, especially in the dairy country where relatively few blossom feeders were found.

Some of the more numerous species found feeding on scale exudations in this habitat were *Thynnoides fulvipes, T. senilis, Zeleboria nitidulus, Z. sexmaculata, Eirone ichneumoniformis* and *Neozeleboria proximus.*

A few species, such as *Hemithynnus apterus, Rhagigaster unicolor,* and others not identified, were found in all these habitats, but not in abundance.

All of the female Thynnidæ are wingless. The males are winged and are much larger than the females, ranging in size from 6 mm. to 35 mm., and are very strong fliers. On sunny days they begin flight about 8 in the morning and from then until midday their flying is fairly close to the ground and seems concentrated on finding the females. The females first appear in the morning about half past 8 or 9. On cultivated areas males of *Thynnoides fulvipes* were observed on several occasions digging at small cracks in the ground. Sometimes they would be so engaged for several minutes before the female emerged from the crack and coupling occurred. In the tall grass and shrub regions the males usually do not locate the females until the latter are well out of the ground. Females of *Zeleboria nitidulus* and *Z. sexmaculata* were watched emerging from this type of habitat and their usual procedure on leaving the ground was to climb the nearest twig or grass blade. After climbing a foot or so they would turn around, face the ground, and move their abdomen back and forth a few times. A male would soon swoop down and couple with the female, sometimes without alighting, and then fly off to the feeding grounds with the female hanging from the end of his abdomen. In observations made on those species feeding on flowers such as *Dimorphothynnus morio* and *Rhagigaster aculeatus*, the male usually alighted on the edge of the petals and then turned facing away from the center of the flower. The female crawled into the center of the flower without disengaging and fed on the nectar. After half a minute or so the male would fly off to another flower and the procedure would be repeated. During this process the males make no attempt to feed. The habits are somewhat similar when the thynnids are feeding on scale insect exudations. The males of *Neozeleboria proximus, Zeleboria nitidulus* and *Z. sexmaculata* fly onto the scale-infested leaves and crawl slowly about on them, allowing the females to feed. Often when a particularly good feeding spot is encountered the female tries to remain there longer, but she is seldom able to get a good foothold and is dragged off by the male. Coupling is a daily event in favorable weather.

There are three functions served by this coupling of the thynnids. The first is transportation of the females to the feeding places and subsequent feeding, which has already been described. The second function is mating. The third function is the transportation and dissemination of the species.

It is logical to assume that mating takes place at least once during the time the female is being carried about by a male of the same species. The writer is of the opinion, however, that mating occurs more than once, and perhaps each time a pair are coupled, though Turner (2) notes that males have been taken paired with females of another species. Females spend most of their time in the ground. They are only rarely observed walking about on the ground. The males, so far as observed, do not reenter the ground once they have emerged from the cocoon. Thus it seems that the time spent by the pairs flying about is the only time that the males have access to the females.

As stated, the third function of the coupling process is the dissemination of the species, which has been noted by Turner (2) and according to this observer it may be carried to such a point that females of several species may occasionally be transported by males of other species. Females are wingless and their legs are adapted for burrowing and not for extensive walking. The usual habit of the females is to disengage from the males, drop to the ground, and proceed to burrow in. A few cases were observed where the female dropped off while the male was in full flight and more than 10 feet in the air, but it is not known whether or not this is the usual practice. Little is known about the efficiency of such a method of dissemination; however, in spite of the typically spotty distribution of host grubs in nature, the method certainly seems to be successful as evidenced by the abundance of individuals of some species.

On sunny days males begin flying about 8 o'clock in the morning and spend most of the morning flying close to the ground seeking the females. They were never seen to hover about one spot in numbers, as is frequent with some species of *Tiphia,* but generally fly about alone. They were seen at this time of day in all manner of places and in bushy and wooded country as well as in the open pastures and over cultivated ground. During the afternoon their flight is higher, and it is at this time of day that they are most frequently seen feeding. About 4 or 5 in the afternoon their flights become less frequent and they soon alight on tall grass blades or small twigs of bushy shrubs, fold their wings and remain motionless for the night. Most of them seem to choose a place within 4 feet above the ground, though where a species is abundant some rest at higher levels. From laboratory rearings it seems that the males emerge a few days ahead of the females. The males persist in abundance throughout the entire period of adult activity. This is in direct contrast to male *Tiphia,* which have a peak of abundance that is reached several days before the peak of the females. In *Tiphia* the males soon die off after reaching this peak, and during the latter part of the season they are scarce while the females are still abundant. It is assumed that the extent of the male life in the Thynnidæ is due to the fact that they also have the function of transportation to fulfill. It was thought at first that the continued abundance of males might be due to a condition where males normally outnumber the females in abundance and are present at all times by virtue of part of them being delayed in emergence, but several large lots of field dug cocoons were held for emergence in the laboratory and the sex ratio of males and females in the emergence was approximately equal.

When the females detach from the males they immediately dig into the ground and begin their search for a suitable host. On finding a host they attack and sting it. The sting causes permanent paralysis; it is often severe and occasionally kills the host. The paralyzed hosts are left in their feeding cell and are not moved by the thynnid. Under laboratory conditions females frequently sting several grubs a day without apparent regard for the species of grub, but deposit no eggs. Representatives of five different genera, *Thynnoides fulvipes, Tmesothynnus zelebori, Zaspilothynnus leachiellus, Neozeleboria proximus* and *Glaphyrothynnus zanthorrhoei* deposited eggs in the laboratory. The grubs used as hosts by *Glaphyrothynnus* and *Zaspilothynnus* were not identified, and only two eggs were obtained from each. *Thynnoides* laid on several hosts, but the grubs of *Scitala* sp. were apparently preferred. All except one or two of the eggs of *Zeozeleboria* were placed on grubs identified as *Heteronyx aphodioides* Blch.

Only two of these, *Tmesothynnus zelebori* Sauss. and *Neozeleboria proximus* Turner, were reared as far as the cocoon stage. The cocoons of *Neozeleboria* had to be abandoned because of the termination of the Australian project. An adult of *Tmesothynnus zelebori* Sauss. was reared from an egg deposited in the laboratory on a grub of *Phyllotocus* sp.

After stinging the grub the next step is egg deposition. In all the instances of egg deposition under laboratory conditions by the various species of Thynnidæ the egg was deposited on the ventral surface of the host, on or near the median line of the second, third or fourth abdominal segment. The egg is very loosely attached to the host and is frequently brushed off despite care in handling. The females do not malaxate or prepare any particular point on the host grub before depositing their egg as do female *Tiphia*. There is apparently no adhesive substance used to attach the egg to the host. The egg itself is slightly sticky and will adhere to a brush or the tip of a forceps as readily as to the host grub. The egg is elliptical in shape and most of those secured were fairly uniform in size, measuring about 3 mm. by 0.8 mm. When first laid the egg is pure white, but it soon obtains a faint yellowish tinge. The chorion is faintly reticulated, is very flexible, and readily depresses when a forceps or blunt needle point is rested against it. The approximate incubation period is two or three days. Eggs can be transferred from one paralyzed host to another without injury and when they are so transferred they hatch normally; the larvæ begin feeding, and seem normal in every respect.

The young thynnid larva is very active upon hatching and is frequently found attached to its host at a spot several segments away from the place where the egg was deposited. All feeding larvæ lie along the long axis of the host, their heads directed toward the cephalic end of the host. When larvæ move away from the segment where the egg was laid and begin feeding at some other point the place selected is near the median ventral line. No cases of dorsal oviposition or feeding were observed in the species worked with. The young thynnid larva is possessed of strong prominent mandibles, but after the feeding puncture is torn in the host derm the feeding seems to be by suctorial action, at least for the first few days. The larva is not a "clean" feeder as are the larvæ of *Tiphia*. After the young thynnid larva has hatched and is ready to begin feeding it tears an irregular hole in the host derm with its mandibles. This hole is invariably much larger than the head of the larva can fill and consequently the host fluids exude from around the feeding puncture and bathe the head of the feeding larva, and frequently its entire ventral surface. This feeding habit is apparently responsible for the bacterial infection of the host which often set in and caused the host to turn black in less than a day and subsequently killed the parasite. This tendency to infection was the main cause of the death of many of the larvæ that were kept in the laboratory and the few that were successfully reared through to the cocoon stage were kept in small tubes between plugs of moist cotton. In the specimens reared in the laboratory the extremes of the larval feeding period were 5 and 13 days. This was apparently governed somewhat by the amount of food available. The thynnid larva is of the usual elliptical shape characteristic of the Scoliidæ and Tiphiidæ and it is faintly yellowish in color. The head is well demarked from the rest of the body by a fairly strong constriction. The segmentation of the abdomen is very faint. Thynnid larvæ could easily be distinguished from any of the scoliid larvæ that were encountered in Australia. A number of scoliid larvæ were taken in the field and reared and, without exception, they had each segment of the abdomen marked by a constriction, as well as the separation between the head and the rest of the body.

After the completion of feeding the larvæ spin their cocoons within the cell of the host. The cocoons are of the usual elliptical shape common to cocoons of Scoliidæ and Tiphiidæ. They are made up of numerous closely appressed layers of silk. There is also some loosely woven silk partially filling the host cell. Cocoons were found in the field at depths varying from 1 to 8 inches. Thynnid cocoons could be readily distinguished from scoliid cocoons because all of the latter observed in Australia had a double cocoon which consisted of the usual strong inner cocoon and outside of that another flexible outer envelope.

While no special studies were made to determine the economic value of Thynnidæ in the Australian fauna, that this group is of some value is clear from the fact that some of the species tested by the writer were found to be definitely parasitic on scarabæid larvæ. In addition to the evidence already presented, abundant proof of the nature of their parasitism was found in the field. During the course of these observations many thynnid cocoons were dug in the field. Some of them were dug so that only a part of the host cell was broken away exposing the cocoon, and in most of the cells so found there was the head capsule of the host entangled in the outer layers of the cocoon. These were saved and examined under the microscope and found to be scarabæid head capsules. Evidence of the number of scarabæids destroyed by thynnids was obtained from some of the diggings in addition to the evidence presented by the abundance of thynnids in the field as adults. In some diggings in restricted areas, cocoons of the same species were found as many as ten to the square foot, averaged over a number of diggings.

From these observations it seems that the Thynnidæ would be of use if they could find suitable host material when introduced into new habitats, and provided that they were free of retarding factors such as secondary parasitism. During these studies thynnids were found to be parasitized by bombyliids and mutillids. Several bombyliids were reared, but the most abundant parasites were the mutillids. In three fairly large collections of thynnid cocoons from the field the mutillid parasitization ranged from 8 to 20 percent.

Literature Cited

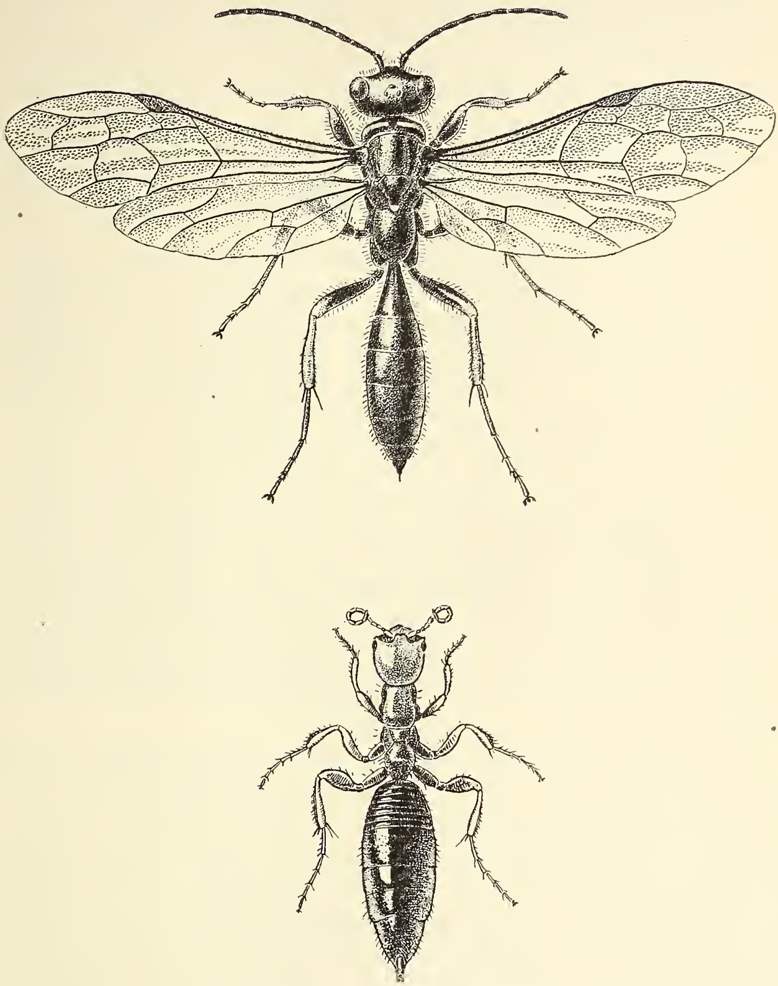
1. 1907. Froggat, W. W., Australian insects. William Brooks & Co., Ltd., Sydney.

2. 1910. Turner, Rowland E., Additions to our knowledge of the fossorial wasps of Australia. Proc. Zool. Soc. Lond., June, p. 259.

3. 1917. Bridwell, G. C., Notes on the Thynnidæ. Proc. Hawaiian Ent. Soc., vol. 3, no. 4, pp. 263-265.

4. 1926. Tillyard, R. J., The insects of Australia and New Zealand. Angus and Robertson, Sydney.

5. 1919. Williams, F. X., A note on the habit of *Epactiothynnus opaciventris* Turner, an Australian Thynnid Wasp. Psyche, vol. 26, p. 160.



ADULTS OF *NEOZELEBORIA PROXIMUS* TURNER

Field Book of Insects. By Frank E. Lutz. G. P. Putnam's Sons, New York. 1935. 510 pages. 100 plates. $3.50.

This is the third edition of Doctor Lutz's authentic, well-written and popular "Field Book of Insects," and it is not usual to find these three attributes in a single book on entomology. Always having had a high regard for Doctor Lutz's entomological work and for his ability to express his ideas clearly and interestingly, I knew, without opening this third edition, that it would continue to be good so long as Doctor Lutz had anything to do with it.

But being, in some respects, a conscientious person, I opened it. I did more. I read parts of it. I even did more than this. I put my pipe down, got up out of an easy chair and rummaged through my books until I found the first edition, that was published in 1918. I found that during the sixteen years it had not grown perceptibly fatter, that its weight was still sufficient to pull an entomologist's pocket out of shape, but they are always out of shape anyhow, that its colored plates were all holding a meeting together next to the index, and that numerous typographic and textual changes had taken place. And I found, too, that the third edition, like the first, was still packed with facts, facts about collecting, about preservation, about control, about habits, food preferences, injury, identification, characteristics, and with many keys for the separation of certain common species, all presented orderly.

Although intended for non-specialists, many specialists who make a practice of being ill informed on groups outside their immediate interest, could consult Doctor Lutz's book to their advantage. But I wonder if they ever will. There are no superfluous words in this "Field Book." Practically every sentence is informative, and budding entomologists in particular could do no better than to obtain from it their early knowledge. It answers all the questions that would naturally occur to most of them. And it is "up-to-date" with respect to new facts, changes in names, and newly discovered important species.

I hope that rising generations will continue to appreciate and demand Doctor Lutz's book and that he is "all wrong" in his supposition that he will probably never again revise his "Field Book of Insects."—H. B. WEISS.

AMERICAN ERIGONEÆ: THE SPIDER GENERA PELECOPSIDIS AND FLORICOMUS

BY SHERMAN C. BISHOP
UNIVERSITY OF ROCHESTER
AND
C. R. CROSBY
CORNELL UNIVERSITY

In earlier papers we have revised part of the Erigoneæ having hardened dorsal abdominal sclerites. (Ceratinella and Ceraticelus in N. Y. State Museum Bul. 264, 1925, and Pelecopsis in Jour. N. Y. Ent. Soc. 39: 381–388, 1931). In this paper we revise the remainder.

PELECOPSIDIS new genus

Type, *Lophocarenum frontalis* Banks.

This genus is related to Pelecopsis in having hardened sclerites on the abdomen and in having the embolic division of the spiral type with a long tail-piece. It differs in having all the eyes borne on the cephalic lobe. The cavity between the two lobes and lying below the anterior lateral eyes is not homologous with the postocular pits of Pelecopsis.

Pelecopsidis frontalis Banks

Figs. 1–6

Lophocarenum frontalis Banks. Jour. N. Y. Ent. Soc. 12: 111, pl. 5, fig. 1–3, 1904.

MALE. Length, 1.5 mm. Cephalothorax brownish yellow, lighter on the head and clypeus; viewed from above, evenly rounded on the sides and somewhat narrowed and pointed in front because of the protuberant clypeus; viewed from the side, evenly arched behind with the head strongly and abruptly elevated into a large cephalic lobe bearing all the eyes. Clypeus very strongly protuberant. The cephalic and clypeal lobes come together below the eyes leaving a pit just below the anterior lateral eyes.

Posterior eyes in a greatly recurved line, the median separated by a little more than the diameter and from the lateral by two-thirds the diameter. Anterior eyes in a slightly procurved line, the median much smaller than the lateral, subcontiguous, separated from the lateral by the diameter. Sternum grayish brown, smooth and shining. Hind coxæ separated by a little less than the diameter. Endites grayish yellow, lighter at tip. Legs light brownish yellow, palpi yellow. Abdomen light gray.

Patella of palpus very long and thicker distally. Tibia short and broad, armed on the dorso-lateral angle with a long, broad round-pointed apophysis bearing on its mesal side an obtuse tooth. On the mesodorsal angle of the tibia there is a shorter process bearing two points. Paracymbium very small and strongly curved. The tail-piece of the embolic division consists of a foot-shaped enlargement that lies over the edge of the tegulum; at the base of the tail-piece there is a branch directed ventrally. Just beyond the base of this process the embolus arises, broad at base but soon narrowing to a black style which is arched over the end of the bulb. This becomes more slender and curves down behind the bezel and under the tail-piece, passes around back of the bulb and emerges on the lateral side; it then makes a loop and returns under the cymbium where it turns a wide loop emerging again at the base. It then turns distally and the tip lies under the first big turn of the embolus.

FEMALE. Length, 1.8 mm. Similar to male in color but the legs have more brown on the femora and tibiæ. Cephalothorax without lobes; viewed from the side, evenly arched over the back to the eyes. Clypeus straight, nearly vertical. Posterior eyes gently procurved, nearly equidistant, separated by the diameter. Anterior eyes in a gently recurved line, the median smaller than the lateral, nearly touching but separated from the lateral by a little less than the diameter. The epigynum is a convex plate; the receptacles show through the integument, well separated.

Type locality: Falls Church, Va.

Described from the types, 1♂ 4♀.

FLORICOMUS Crosby and Bishop

Florida Ent. 9: 33, 1925.

Type *F. floricomus* Crosby and Bishop, which equals *Phlocomma rostratum* Emerton.

We here place a group of species which have a hardened sclerite on the abdomen and in which the males do not have cephalic pits. They may be separated from Ceratinella and Ceraticelus by the lack of a spiral tail-piece in the embolic division of the bulb and from Pelecopsidis by the much shorter embolus and the form of the tibial apophysis. The species placed here agree in having the clypeus protuberant and clothed with hairs; the tibia of the male palpus has a thin projection that overlies the base of the paracymbium. The embolus arises from a bulb-like base—sometimes in the interior of the bulb.

Floricomus nasuta Emerton

Figs. 7–11

Histagonia nasuta Emerton. Conn. Acad. Sci. Trans. 16: 390, pl. 1, fig. 9, 1911.

MALE. Length, 1.5 mm. Thorax grayish yellow, head dusky. Cephalothorax viewed from above elongate, pointed in front, rounded on the sides to the cervical groove where there is a slight constriction, from this point the outline of the head has the sides slightly convex but strongly converging to the tip of the clypeal lobe, narrowly rounded at tip. Cephalothorax viewed from the side low and gently arched over the back to the cervical groove, then rounded over the moderately elevated head to the anterior median eyes. The clypeal lobe very strongly developed, clothed above and at tip with stiff hairs directed upward and backward; viewed from the side extending forward on a level with the base of the anterior median eyes, then convex and very strongly retreating.

Posterior eyes in a gently procurved line, the median separated by the radius and from the lateral by nearly the diameter. Anterior median eyes on the cephalic aspect of the head. When viewed from above the anterior eyes are in a recurved line, the median smaller than the lateral, narrowly separated from each other and from the lateral by more than the diameter.

Sternum broad and short, smooth and shining, yellow suffused with gray, much darker towards the edge. Hind coxæ separated by a little more than the diameter. Labium dark gray. Endites light yellow sprinkled with gray. Cheliceræ grayish yellow, rather weak. Legs yellow orange, coxæ, trochanters and base of femora lighter. Palpi same color as legs but lighter. Abdomen provided with a brownish orange strongly chitinized dorsal sclerite which is clothed with numerous recumbent stiff hairs. Epigastric sclerite not well developed. Inframammillary sclerite distinct but weakly chitinized, confined to the ventral side of the spinnerets. Soft parts of abdomen gray.

Femur of palpus nearly straight, slender; patella gently curved. Ratio of length of femur to that of patella as 15 to 6. Tibia as long as patella, armed dorsally with a very high quadrate ridge as in *plumalis;* the claw-like tooth is lacking but its position is marked by a minute black denticle. Laterally from this ridge the edge of the tibia is thin and smooth, the edge is nearly straight, not produced into an apophysis lying over the base of the cymbium as in *plumalis.* There are two strong spines on the edge as in *plumalis.* Paracymbium slender, strongly hooked at tip. Cymbium short, deeply excavated at base on the lateral side. Bezel has the edge produced into a long, sharp point directed ventrally. The embolus is like that of *plumalis* in structure and follows the same course.

FEMALE. Length, 1.6 mm. Similar to the male in form and color; the cephalothorax is broader and the head normal. Posterior eyes in a slightly procurved line, the median separated by two-thirds the diameter and from the lateral by one-half as much. Anterior eyes in a nearly straight line, the median smaller than the lateral, separated by less than the radius and from the lateral by the radius. Clypeus gently convex and slightly protruding. In both sexes the dorsal abdominal sclerite is relatively smaller than in *plumalis.*

Epigynum has the middle lobe narrower than in *plumalis.*

Type locality: Three Mile Island, Lake Winnipesaukee, N. H.

New York: Great Pond, Riverhead, May 23, 1924, 1 ♂; Riverhead, June 20, 1934, 1 ♂ 2 ♀.

New Jersey: Millville, June, 1925, 1 ♀ (Fletcher).

District of Columbia, Washington, March 25, 1925, 1 ♂ 2 ♀. H. C. Barber. In sphagnum moss.

Floricomus nigriceps Banks

Figs. 12–16

Exechophysis nigriceps Banks. Ent. Soc. Wash. Proc. 7: 97, pl. 2, fig. 10, 11, 1905. (Author's extras published Jan. 11, 1906.)

MALE. Length, 1.3 mm. Cephalothorax brownish yellow, much darker on the head, rather broad, rounded on the sides, slightly constricted back of the head; head rounded on the sides and in front. Cephalothorax viewed from the side gradually ascending to the cervical groove; head strongly elevated, rounded over the top. Clypeus extremely wide, very convex, strongly protruding in front of the eyes, the lower part strongly retreating. Cheliceræ small and retreating. Upper half of clypeus clothed with short hairs directed upward.

Posterior eyes in a straight line, the median a little nearer each other than to the lateral. Anterior eyes in a straight line, the median much smaller than the lateral, subcontiguous but well separated from the lateral.

Sternum grayish brown, broad and short. Hind coxæ separated by their width but not by their length. Labium same color as sternum, very wide; endites lighter. Legs brownish yellow, coxæ and patellæ lighter.

Abdomen covered by a large brownish sclerite. Ventral sclerites not developed. Soft parts gray.

Palpus not in good condition, somewhat expanded. Tibia armed with a high longitudinal dorsal ridge the edge of which is armed with minute setigerous tubercles. Laterally from this ridge the margin is depressed, thin and semitransparent, a strong spine on tibia on the ridge back of this depressed area opposite the paracymbium. The slender process figured by Banks over the base of the tarsus is not present in the right palpus. (Banks figured the left.) Paracymbium short, flat and provided with a large hook. The tail-piece of the embolic division is a short, rounded process which is attached to the enlarged base of the embolus. The embolus curves over the top of the bulb down on the lateral side and the tip lies near the pointed tip of the bezel which is black and spine-like.

Type locality: A swamp near Ithaca, N. Y.

Described from the type, 1 ♂.

Floricomus plumalis Crosby

Figs. 17–21

Exechophysis plumalis Crosby. Phila. Acad Nat. Sci. Proc. 1905, p. 323, pl. 28, fig. 8, 13; pl. 29, fig. 1.

Exechophysis palustris Banks. Ent. Soc. Wash. Proc. 7: 97, pl. 2, fig. 4, 8, 9, 1905. (Author's extras published Jan. 11, 1906.)

Histagonia palustris Emerton. Conn. Acad. Sci. Trans. 14: 188, pl. 2, fig. 4, 1909.

MALE. Length, 1.4 mm. Cephalothorax dull orange-yellow suffused with gray, darker in the middle, on the edge and along the radiating furrows; viewed from above rather broad, the sides evenly rounded to opposite the first coxæ and then converging towards the front, rather narrowly rounded across the front; viewed from the side the thorax is rather low, gradually ascending and gently arched to the cervical groove where there is a broad but distinct depression, head elevated, rounded behind to the posterior eyes. Cephalic lobe broad and rounded, separated from the protuberant clypeal lobe by a distinct transverse groove, armed above with a median row of 3 or 4 stiff hairs. All the eyes borne on the cephalic lobe. Clypeus very wide and strongly convex, produced forward into a blunt rounded point which is densely clothed with stiff hairs directed upward.

Posterior eyes in a straight line, equal and equidistant, separated by a little less than the diameter. Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

Sternum brownish gray over orange, broad and short, produced between the hind coxæ into a broad inflexed point. Hind coxæ separated by less than the diameter. Labium same color as sternum. Endites orange-yellow suffused with gray. Legs and palpi yellow orange, patella lighter, posterior tibiæ darker.

Abdomen rather flattened, oval, a little pointed in front, provided with a brownish yellow orange dorsal sclerite covering the front three-fourths. The sclerite is shallowly punctate and clothed with short stiff hairs. Epigastric sclerite not well developed, a small area at the side and back of the epigastric plates weakly chitinized and yellowish orange. Inframammillary sclerite more distinct, confined to the ventral side.

Femur of palpus rather short, strongly compressed. Patella rather large, stout, viewed from the side nearly triangular. Ratio of length of femur to that of patella as 12 to 8. Tibia large, stout and of complicated form, the mesal aspect is roughly rectangular. On the dorsal surface there is a very high longitudinal, nearly quadrate ridge armed on the lateral face with a small black incurved claw-like tooth and with the dorsal edge bearing a closely packed series of four small setigerous tubercles. Laterally from this ridge the tibia is hollowed out, thin and smooth and produced forward to fit into the excavation in the base of the cymbium, the tip of the process is slender, sinuate and bent upward along the edge of the excavation; near the lateral edge there are two long, stiff spines. Cymbium short and broad, deeply excavated at base on the lateral side. Paracymbium small, hooked at tip and hidden except at tip under the edge of the tibial process. Bezel strongly convex, moderately wide. The embolus long, slender, whip-like, arising from a bulb-like base which lies just under the edge of the cymbium. The embolus is curved in a complete circle on the end of the palpal organ, about half the way following the edge of the obliquely truncate cymbium.

FEMALE. Length, 1.5 mm. Similar to the male but the head is normal and the dorsal abdominal sclerite does not extend so far back. The cephalothorax is rather broad, evenly rounded on the sides to the cervical groove where there is a slight constriction, broadly rounded across the front.

Posterior eyes in a straight line, equal, the median separated by a little less than the diameter, a little closer to the lateral. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by a little more. Clypeus gently convex and slightly protruding. Epigynum consists of a convex plate, the middle lobe short and broad, sides slightly convergent posteriorly, square behind; on each side there is a semicircular opening on the hind margin.

Type locality: Ithaca, N. Y.

New Hampshire: Three Mile Island, Lake Winnipesaukee, May 25, 1905 (Emerton); May 20, 1905, 1♂ 1♀ (Bryant).

New York: Newfane, Oct., 1915, 1♀; Lake Keuka, April, 1904, 1♀; Enfield Glen, Tompkins Co., June 4, 1922, 1♂; Ithaca, 1♀ recorded by Banks as *Ceratinella brunnea;* July, 1♂; Nov., 3♀; May 19, 1♂; McLean, May 16, 1925, 1♂; Sylvan Beach, Aug., 1904, several ♀; Juanita Island, Lake George, Aug. 5, 1920, 2♂ 10♀; July 22, 1920, 1♂; Whetstone Gulf, Lewis Co., Sept. 2, 1926, 1♂; Chapel Pond, July 19, 1925, 1♂.

Missouri: Columbia, Feb., 1905, 2♂; Oct., 2♂; Nov., 5♂ 7♀; Dec., 1904, 3♂ 3♀.

Louisiana: Shreveport, 3♀ (Banks).

Illinois: Salts, May 24, 1926, 1♂ (Smith).

This species is not closely related to Exechophysis. *E. bucephalus* Cambr., the type of that genus, has cephalic pits in the male and the tail-piece of the embolic division is long as in Ceraticelus. The abdomen has the dorsal sclerite strongly developed. It is evidently closely related to Lophocarenum. The present species, *plumalis,* lacks the cephalic pits and the base of the embolic division is bulb-like, without a tail-piece.

Floricomus praedesignatus new species

Figs. 22-24

MALE: Length, 1.2 mm. Cephalothorax dull yellow strongly suffused with dusky, darker at the margin, viewed from above evenly rounded on the sides with a slight depression at the cervical groove, narrowed and gently convex towards the bluntly pointed snout; viewed from the side, low posteriorly, gently arched to the base of the cephalic lobe, steeply ascending and rounded over the head. Clypeus developed into a strongly protuberant lobe which is separated from the cephalic lobe by a deep transverse fissure. Clypeus thickly clothed with a group of stiff, plumose, erect hairs curved upward. Sternum dull yellow, strongly suffused with dusky, darker at the margin, broad, moderately convex, smooth and shining, broadly produced between the hind coxæ, which are separated by a little more than the diameter. Endites dull yellow. Legs orange yellow. Abdomen armed with a small, irregular, poorly chitinized dorsal sclerite. General color gray. Femur of palpus moderately long, nearly straight, gradually widened distally. Patella short. Ration of length of femur to that of patella as 15 to 8. Tibia very similar to that of *plumalis* except that the lateral margin is not produced into a black sinuous tooth. The edge is almost straight, thin, semi-transparent. The bulb is almost exactly as in *plumalis.*

Holotype, male, Penn Yan, N. Y., July 5, 1926.
New York: McLean, May 16, 1925, 1♂.

Floricomus pythonicus Crosby and Bishop

Figs. 25–28

Floricomus pythonicus Crosby and Bishop. Florida Ent. 9: 35, fig. 5–7, 1925.

MALE. Length, 1.2 mm. Cephalothorax evidently orange suffused with dusky; viewed from above, evenly and broadly rounded on the sides with only a slight constriction at the cervical groove, then gently converging and a little convex to the broadly rounded clypeus. The cephalic lobe rather narrow, rounded behind and in front. Cephalothorax viewed from the side abruptly rounded up behind to the cervical groove, more gradually ascending to the base of the cephalic lobe, which is abruptly elevated and rounded over the back to the posterior median eyes. Median ocular area slanting steeply forward. Clypeus produced above into a pointed lobe below which it is concave and slightly protruding. Clypeal lobe clothed above with erect, curved hairs, parted in the middle. Sternum broad, somewhat convex, bluntly rounded between the posterior coxæ. Endites dull yellowish suffused with dusky. Abdomen covered by a heavy scutum and clothed with stout depressed hairs.

Posterior eyes in a straight line, equal and equidistant, separated by the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter.

Femur of palpus nearly straight, cylindrical. Patella short, wider distally. Ratio of length of femur to that of patella as 11 to 7. Tibia short ventrally, dorsally produced into a very high, longitudinal ridge, rounded over in front, the ventral angle acute and bearing a small, stiff hair, a row of similar hairs on the rounded dorsal and anterior margin. On the lateral side the margin of the tibia covers all but the tip of the paracymbium with a quadrate lobe at the distal corner of which there is a stiff hair, and another just back of it. On the lateral side of the dorsal process there is a rectangular, thin, semitransparent tooth which is separated from the lateral lobe by a very deep notch.

Just inside there is a curved band which ends in a sharp point ventrally. The fine style-like embolus arises in the interior of the bulb, makes a turn along the edge of the tip of the cymbium, the tip lies close to the bezel.

Type locality: Palm Beach, Fla., 1♂, March, 1919, (Thomas Barbour) from the stomach of *Bufo quercicus* Holbrook.

Redescribed from the type.

Floricomus rostratus Emerton

Figs. 29–34

Pholcomma rostratum Emerton. Conn. Acad. Sci. Trans. 6: 30, pl. 6, fig. 5, 1882.

Histagonia nasuta Simon. Hist. Nat. Ar. 1: 585, 1894.

Floricomus floricomus Crosby and Bishop, Florida Ent. 9: 33, fig. 1–4, 1925.

MALE. Length, 1.6 mm. Cephalothorax orange with darker radiating lines, cephalic lobe lighter; viewed from above broadly and evenly rounded without a constriction at the cervical groove, then converging to the truncated front; viewed from the side gently ascending behind to the cervical groove where there is a shallow depression, then broadly and evenly rounded over the cephalic lobe to the frontal horn. Clypeus produced just below the eyes in a stout horn which projects forward and slightly upward. It is armed in front and on the dorsal surface with a cluster of long, slender, capitate hairs. The tip of each hair is flattened, bent back sharply and divided into three narrow lobes (Fig. 33). The clypeus below the horn slightly concave and nearly vertical. Sternum reddish orange lightly suffused with dusky, darker at the margin, strongly convex, smooth and shining, rather broadly produced between the hind coxæ which are separated by the diameter. Labium, endites and coxæ the same color. Legs bright orange. Abdomen covered with a large orange sclerite clothed with large appressed hairs.

Posterior eyes in a straight line, equal, the median separated by the diameter and from the lateral by a little less. Anterior eyes in a procurved line, the median slightly smaller than the lateral, separated by a little less than the diameter and from the lateral by a little more.

Femur of palpus moderately long and stout, nearly straight, slightly widened distally. Patella proportionally long and rather stout, straight, armed laterally with six stiff hairs and on the mesal side with seven hairs. Ratio of length of femur to that of patella as 20 to 13. Tibia short, dorsally compressed to form a thick ridge which ends in a blunt rounded point. On the lateral side of this process there are six or seven stiff spines and dorsally in the median line there are three similar spines. The lateral margin of the tibia thin and depressed; the edge is smooth but next to the base of the dorsal ridge there is a thin, spatulate process which arises on the inner surface of the hollowed-out tibia, only the rounded tip being visible except as it shows through the thin, semitransparent, depressed margin. Near the lateral margin there are two long, stiff, stout spines. The paracymbium is entirely under the edge of the tibia except at the tip, which is very strongly hooked. The bezel is produced ventrally into a sharp, spine-like, tooth. The embolus arises in the interior of the bulb, is hooked over the end of the bulb, then follows the truncate edge of the cymbium, the tip lying behind the edge of the bezel.

FEMALE. Length, 1.8 mm. Similar to the male but the head is normal. Dorsal abdominal scutum does not extend back so far as in male. Posterior eyes in a very slightly procurved line, equal, the median separated by the diameter and from the lateral by two-thirds the diameter. Anterior eyes in a slightly procurved line, the median only slightly smaller than the lateral, equidistant, separated by the radius. The epigynum is a transverse oval plate, slightly convex, with a very small middle lobe.

The specimen that we described as *floricomus* is much smaller than northern examples but agrees with them in all the essential characters of the palpus. The clypeal process is longer, more slender, and directed upward so that the tip is higher than the head. The modified hairs on this process are longer and directed upward instead of being curved downward. This is evidently a southern variety of the species.

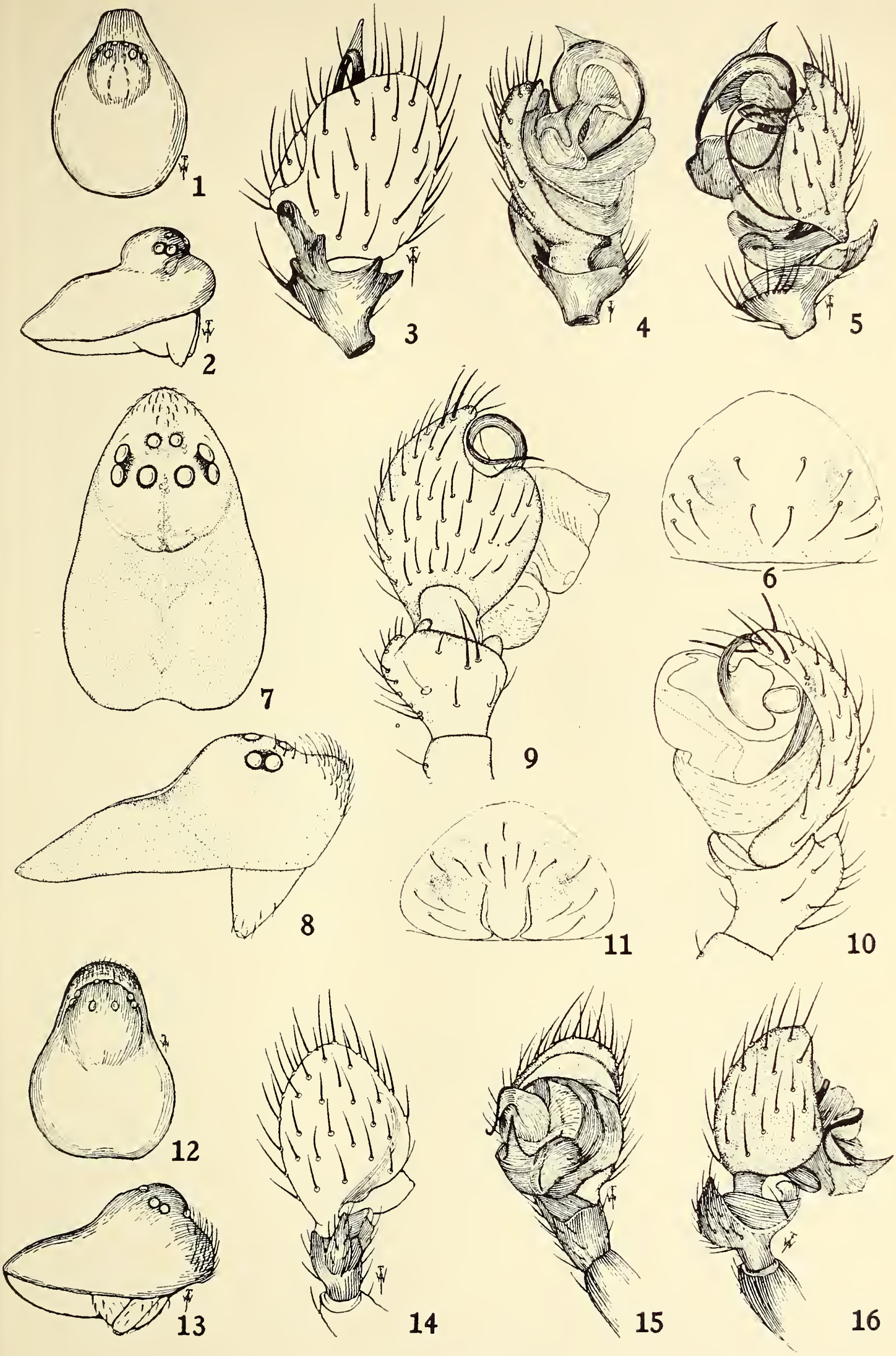
Type localities: Waltham and Watertown, Mass.

Connecticut: Lyme, Oct. 5, 1913, 2 ♂♂, in straw on salt marsh (Emerton).

Georgia: Okefinokee Swamp, May 28, 1922, 1 ♂, in stomach of *Bufo quercicus* Holbrook (A. H. Wright).

PLATE V

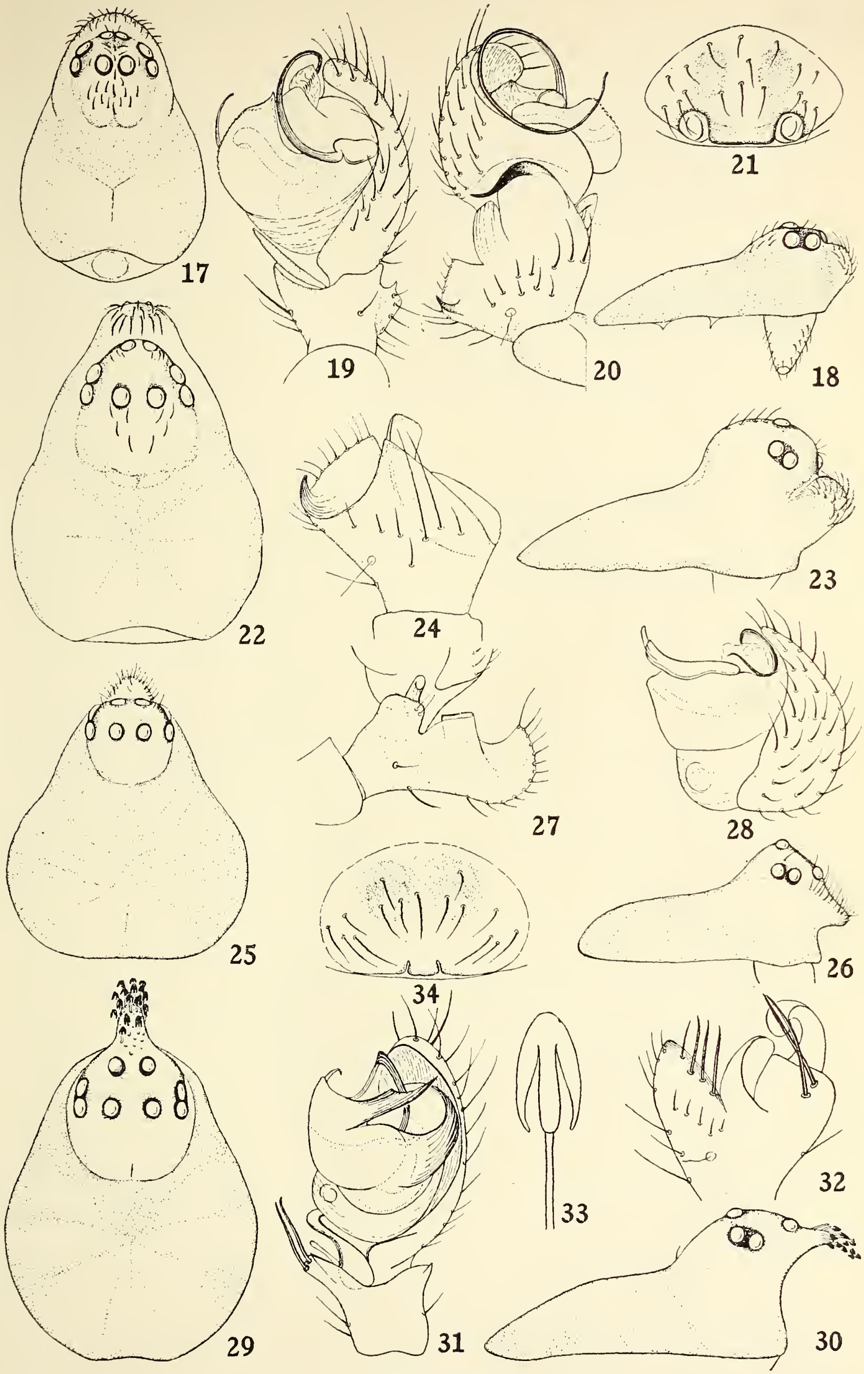
1. *Pelecopsidis frontalis* ♂ cephalothorax, dorsal view.
2. *Pelecopsidis frontalis* ♂ cephalothorax, lateral view.
3. *Pelecopsidis frontalis* ♂ left palpus, dorsal view.
4. *Pelecopsidis frontalis* ♂ left palpus, mesal view.
5. *Pelecopsidis frontalis* ♂ left palpus, lateral view.
6. *Pelecopsidis frontalis* ♀ epigynum.
7. *Floricomus nasuta* ♂ cephalothorax, dorsal view.
8. *Floricomus nasuta* ♂ cephalothorax, lateral view.
9. *Floricomus nasuta* ♂ right palpus, dorsal view.
10. *Floricomus nasuta* ♂ right palpus, mesal view.
11. *Floricomus nasuta* ♀ epigynum.
12. *Floricomus nigriceps* ♂ cephalothorax, dorsal view.
13. *Floricomus nigriceps* ♂ cephalothorax, lateral view.
14. *Floricomus nigriceps* ♂ right palpus, dorsal view.
15. *Floricomus nigriceps* ♂ right palpus, ventral view.
16. *Floricomus nigriceps* ♂ right palpus, dorso-lateral view.



ERIGONEÆ

PLATE VI

17. *Floricomus plumalis* ♂ cephalothorax, dorsal view.
18. *Floricomus plumalis* ♂ cephalothorax, lateral view.
19. *Floricomus plumalis* ♂ right palpus, mesal view.
20. *Floricomus plumalis* ♂ right palpus, lateral view.
21. *Floricomus plumalis* ♀ epigunum.
22. *Floricomus praedesignatus* ♂ cephalothorax, dorsal view.
23. *Floricomus praedesignatus* ♂ cephalothorax, lateral view.
24. *Floricomus praedesignatus* ♂ right tibia, dorsal view.
25. *Floricomus pythonicus* ♂ cephalothorax, dorsal view.
26. *Floricomus pythonicus* ♂ cephalothorax, lateral view.
27. *Floricomus pythonicus* ♂ left tibia, lateral view.
28. *Floricomus pythonicus* ♂ end of bulb.
29. *Floricomus rostratus* ♂ cephalothorax, dorsal view.
30. *Floricomus rostratus* ♂ cephalothorax, lateral view.
31. *Floricomus rostratus* ♂ right palpus, meso-ventral view.
32. *Floricomus rostratus* ♂ tibia, dorsal view.
33. *Floricomus rostratus* ♂ capitate hair from horn.
34. *Floricomus rostratus* ♀ epigynum.



ERIGONEÆ

A NEW GALL MIDGE

By E. P. Felt, Stamford, Conn.

There are a considerable series of gall midges which do not produce deformities in plants, but which live in dead or decaying organic matter of one kind or another. A long series of small flies were reared from cow dung February 25, 1932, by Mr. Carl Mohr of Urbana, Ill., and submitted for identification.

Monardia illinoiensis new species

MALE: Length 1.5 mm. Antennae three-fourths the length of the body, pale straw; 14 segments, the fifth with a stem nearly as long as the basal enlargement, the latter with a length a little greater than its diamenter; terminal segment reduced and narrowly separated from the preceding. Palpi; first segment short, stout, second broadly dilated, the third with a length nearly three times its diameter, the fourth a little longer than the third. Mesonotum fuscous. Scutellum, postscutellum and abdomen fuscous yellowish. Halteres and legs pale straw.

FEMALE: Length 1.75 mm. Antennae extending to the base of the abdomen, fuscous yellowish; 12 subsessile segments, the fifth with a length one-fourth greater than its diameter; the terminal segment reduced and broadly fused with the preceding segment. The third and fourth palpal segments about equally long, the distal more slender. Mesonotum fuscous. Scutellum, postscutellum and abdomen fuscous yellowish. The ovipositor stout, with a length nearly half that of the abdomen; terminal lobes tri-articulate, the distal segment narrowly oval. Halteres and legs pale straw.

The male approaches in its general characters *M. barlowi* Felt, it being readily distinguished therefrom by the marked difference in the color of the abdomen and the relatively shorter fourth palpal segment. The female approaches in character *M. toxicodendri* Felt, from which it may be separated by the somewhat shorter fifth antennal segment and the shorter fourth palpal segment.

Types deposited in the collections of the Illinois State Natural History Survey.

A GALL MIDGE ON PINE CONES

By E. P. Felt

Bartlett Tree Research Laboratories, Stamford, Conn.

The species described below was reared together with a number of other specimens by Dr. A. D. Hopkins, Bureau of Entomology, U. S. Department of Agriculture. There were several lots of these rearings, and there is possibly more than one species of Asynapta, though the poor condition of much of the material and our present fragmentary knowledge in regard to this genus does not permit a positive statement in this respect. Several of the lots numbered 17172 produced species of Lestodiplosis, predacious and possibly inquiline forms, which occur somewhat generally and have little direct relation to the food plant. The microscopic mount of the type bears the label: "Lake City, Fla. 18 IX 34, Hopkins 17172A, from pine cones."

Asynapta hopkinsi new species

Male: Length 2mm. Antennae about as long as the body, probably thickly haired, light brown; 23 segments, the fifth with a stem one-half the length of the subcylindrical basal enlargement, which latter has a length one-half greater than its diameter; terminal segment variably produced and tapered to a narrowly rounded apex or a short, cylindrical tip. Palpi quadriarticulate, the first and second segments each with a length about three times the width, the third twice as long as the second, slender, the fourth one-fourth longer than the third and more slender. Mesonotum dark brown. Scutellum and postscutellum yellowish. Abdomen sparsely haired, fuscous yellowish. Halteres yellowish. Legs a nearly uniform pale straw, claws moderately stout, unidentate, the pulvilli longer than the claws.

The male approaches in characters *A. americana* Felt, from which it is easily distinguished by its larger size, the greater number of antennal segments and the shorter stems of these segments. This sex is the type of the species.

Female: Length 1.5 mm. Antennae a little shorter than the body, sparsely haired, pale yellowish; 18 segments, the fifth with a stem about one-fourth the length of the cylindrical basal enlargement, which latter has a length twice its diameter. Palpi, the first and second segments short, stout, the third twice the length of the second, more slender, and the fourth one-fourth longer than the third, more slender. Mesonotum dark brown. Scutellum and postscutellum yellowish. Abdomen fuscous yellowish. Halteres pale yellowish. Legs light straw, claws moderately stout, unidentate, the pulvilli longer than the claws. Ovipositor moderately long, the lobes rather broad, biarticulate, and obtuse apically.

This female is provisionally associated with the male, since they were reared in the same lot and in spite of the fact that the female is decidedly smaller and has fewer antennal segments than the male.

The types are deposited in the U. S. National Museum.

A Manual of Entomological Equipment and Methods. Part One. By Alvah Peterson. Edwards Brothers, Inc. Ann Arbor, Michigan. April, 1934. 22 p. + 138 plates + 10 p. + i–xiv. $3.75.

Sometimes I marvel at the length of time entomologists in general have to wait for adequate summaries and analyses of different phases of their work. They scatter their findings everywhere, frequently in inaccessible places, and there it remains for years and years until someone with energy and ability collects it, evaluates it and presents it in an orderly manner so that it becomes available and useful.

Doctor Peterson's volume, which is the outgrowth of his graduate course on "Research Methods with Living Insects" at the Ohio State University, presents in 138 plates with explanatory text, numerous pieces of equipment and methods used by entomologists under field, laboratory, and insectary conditions. It is the first text in English upon this subject, and its topics include field insectaries, cages, museum methods and equipment, collecting, killing, sampling and sorting equipment, traps, tree bands, behavior equipment, weather, temperature, wind, light, and humidity recording instruments, temperature and humidity controlled cabinets, refrigeration outfits, dusting and spraying equipment, field worktables and desks, in fact everything which an entomologist is likely to use. At the end of the book are some very useful temperature, humidity, pressure and other tables, followed by author and subject indexes. Each outline illustration is fully lettered and explained.

The entire book is full of suggestions for amateur and professional entomologists, and any one contemplating the use or building of a piece of equipment to meet particular entomological needs cannot afford to neglect Doctor Peterson's "Manual." It should be on the reference shelf of every entomologist who is working with living insects. In addition, other workers in the field of zoology are likely to find therein much that will be helpful to them. It is a long needed volume for which entomologists should be grateful.

Doctor Peterson has in preparation a second volume that will deal with insect rearing methods, laboratory and other technique, etc., to which we may look forward.—H. B. WEISS.

THE SPECIES OF ZETES (ORIBATOIDEA–ACARINA) OF THE NORTHEASTERN UNITED STATES.

BY ARTHUR PAUL JACOT

This is the largest genus of the subfamily of large-winged mites (Galumninæ), being found throughout the world except the northernmost regions. The species are common under old boards, bark, stones, in leaf mould and on vegetation. The primitive species of the Galumninæ of this region have already been treated (7) as also the most specialized genus Galumna (8). A key to the genera will be found in the former work. Zetes differs from Galumna by the presence of the anterior edge of the notogaster (midthoracic suture) as a distinct, external rim, and by the slenderly clavate pseudostigmatic organs.

The European material recorded below was secured through a grant of the Elizabeth Thompson Science Fund.

Genus ZETES (10, p. 99)

Characters: Galumninæ having lamellæ reduced to closely appressed bands or straps curving down to anterior end of ventral plate wings; tectopedia I chiefly ental; pteromorphæ with transverse groove and deep, well formed notch in ventral edge; midthoracic suture distinct; tectopedia without bristles; bristles of parasterna I gular in position; genital covers each with at least two marginal bristles; preanal bristles paranal in position; color usually deep horsechestnut (mahogany).

Type: Zetes elimatus (10, pl. 11, fig. 55).

"Die Gattungsbezeichnungen beschäftigen sich nur mit den äusserlich sichtbaren Merkmalen, auch geben die, solchen beigefügten Figuren, als **Typus** dienend, bloss ein getreues Bild irgend einer Art der betreffenden Gattungen und der mit einfachem Microscop zu erkennenden Charaktere." Karl Ludwig Koch.

(Ubersicht des Arachnidensystems, Drittes Heft, *Vorwort*, p. 6)

Zetes elimatus (9, fasc. 31: 5 text only; 10, pl. 11, fig. 55) As already pointed out (6, p. 4) Carl Ludwig Koch's description is based on two species. For instance (1) the pseudostigmatic organs are described (in Latin) as long, slender, hardly fusiform, subclavate, (in German) as: "zu kaum ein venig verdickt." This fits *Z. obvius* exactly and not the *Z. elimatus* of European authors. (2) It is one of the largest of the genus. *Z. obvius* is 830 microns (13, p. 178), *Z. elimatus* of authors is 650, *G. longipluma* is 700. (3) There is no midthoracic suture (which would make it *G. longipluma.* (4) The cephalothorax has two short and two long bristles. This is a total of four and therefore is *Z. obvius,* certainly not *Z. elimatus* (of authors) which has six distinct ones. Thus according to the description, it fits *Z. obvius* closest. The only discrepancy is the lack of midthoracic suture.

The figure which accompanies the text shows the interlamellar bristles and is therefore another species. Now turning to Koch's second figure of *Z. elimatus* which he gives as "type" of his genus Zetes, one finds the midthoracic suture clearly indicated, and no interlamellar bristles (only the pseudostigmatic organs). Thus there is overwhelming evidence that *Oribates obvius* of Berlese is a synonym of *Oribates climatus* of Koch. This condition was clearly recognized by Oudemans in 1913 (pub. 1914), page 27, last paragraph and overpage. Later, unfortunately, Oudemans followed Berlese, not Koch!

Of twenty-two moss lots from Regensburg six contained this species, most of them from sides of drainage ditches in the meadows and marshy places. On the other hand, out of a total of forty lots secured from Regensburg city and its environs, to and including the Schwaighausen woodlands, no *Z. elimatus* of of authors were found. Therefore if *Z. elimatus* of authors occurs in and about Regensburg it is so rare that Koch, with his slow and crude collecting methods, did not come across it, at least not to recognize it, while *Z. elimatus* **Koch** is common "in etwas feuchten Wiesen." The other species he got mixed with this one evidently came from "in Waldungen unter Moos," but it is not the species figured as genotype of Zetes. At any rate the one found "in Waldungen unter Moos" is not *Z. elimatus* of authors as I did not find it, out of ten lots of moss from woods, both evergreen and deciduous (or forty lots from Regensburg).

The pseudostigmatic organs in this species are flattened with the barbs arranged sparingly along both edges. When it is seen on edge it is equally thick throughout its length and appears quite smooth; when turned so that it is seen in all its breadth, it appears lanceolate, with the barbs distinct. It may also be seen with the distal half turned over so that it looks more suddenly clavate.

Material examined: from Bavaria, Regensburg and vicinity: Seventy-six specimens from moss, sides of drainage ditch along side of Pürkelgut farm, draining Pürkelgut meadows (barely a mile beyond the Kasern of Regensburg); taken July 25, slides 3115o1, 3115n4, 3117o3. One specimen from moss from stump in Dechbetten woods (the tract nearest Ziegetsdorf); taken July 27, slide 3119o2. A female from stick on ground in fairly heavy woods at Walhalla; taken August 6, slide 3131o5. Two specimens from moss, side of three foot ditch, meadows between Unter-Isling and Bergweinting; taken August 12, slide 3135o1. Two specimens from moss from bottom of shallow ditch, north and west of alder row, meadows of preceding locality; taken August 15, slide 3136o4. Eight specimens from moss from meadow and brookside in midst of woodland near Ziegelhütte; taken August 30, slide 3151o6. Four specimens from moss from meadow below dam of pond near auto road near Ziegelhütte, dried September 2, slide 3152o3.

***Zetes elimatus ithacensis** (6, p. 28)

Figures 1–5

Diagnostic characters: Lamellar bristles peripherofrontal (figures 1 and 5), not reaching insertion of rostral (as seen in dorsal aspect); interlamellar bristles very short, inconspicuous, curved; pseudostigmatic organs fairly long, slender, without distinct head, pencil-like to slightly flattened, pointed, typically smooth (figure 2, right of numeral) occasionally with a few barbs (below numeral); pteromorphæ with pivot considerably anterior to angle; anterior porose areas rather slender, usually broadest at mesal end, barely overlapping shadow of tectopedia I; adalar porose areas elongate, rather stout, ventral end somewhat widened, occasionally extended posteriorly (figures 1 and

5); mesonotal fairly large, angularly circular, the lateral one smaller; ventral edge of leg cupboards joined to ventral plate by a broad suture; bristles of genital covers aligned along longitudinal center of covers, bristles 1 distant from anterior edge, bristles 2 more mesad than 1 and 3, bristles 4 very close to posterior edge; paranal bristles posteriad of pseudofissura; anterior pair of anal cover bristles close to anterior edge, more remote than posterior pair.

Description: Size fairly large (0.7×0.5 mm.); shape broadly ovate, somewhat depressed; cephaloprothorax relatively long, broad, conical, outline interrupted only by slight protrusion of lamellæ; rostrum narrow but not prominent, (figure 1), rim projecting (figure 3) though not visible from above; lamellæ not usually reaching up onto vertex; insertion of interlamellar bristles small, as distant from shadow of tectopedia I as from edge of notogaster; rostral bristles inserted beneath overhang of rostrum (figure 3, in which the line above the bristle demarks a differentiated band); pseudostigmatic organs dipping down under pteromorphal pivot; pseudostigmata and pivot insertion bulging out from sides of body; midthoracic suture distinct.

Notogaster broad, dense; mandible retractor muscle scars distinct, elongate; pteromorphæ rather smooth in outline, groove very slender at mesal end, the ribs broad but short, rather close to groove, veining very sparse, not anastomosing or branching. I have seen one individual with adalar porose areas divided to form one at each end (two). Two insertions posterior to adalar porose areas (figure 5). There is a pair of elongate posterior porose areas (not figured).

Ventral plate (figure 1) with wings quite broad but the posterior corners cut off to broadly expose tectopedia II; tectopedia III very short and broad; tectopedia IV as usual; sides of abdomen quite vertical, not rounded onto ventral face as in many species; apodemata I and II–III quite long, slender, with long ceriphs, apodemata IV very close to II–III but strongly bent so that the ceriph, which is longer than the body (as seen in ventral aspect) forms a wide angle with it; bristles inserted as in figure 1. In some individuals the insertion of sternal bristles 1 is present; parasternal lacunæ small; genital aperture with corners well rounded, sides somewhat converging, anterior edge quite straight, posterior edge somewhat undulate; paramesal bristles as distant from genital aperture as diameter of a genital cover, more remote than diameter of aperture; subanal muscle plate oval; anal aperture with sides strongly converging, anterior end narrow, posterior angle marked; pseudofissuræ short, well separated from aperture, the anterior end much more prominent; paranal bristles distant from pseudofissuræ. I have one specimen in which the anterior *pair* of cover bristles are supplanted by two, distant from each other as the anterior one is from anterior edge of cover, which seems to signify that it is the posterior half of the cover which is the most stable; the four postanal bristles subequally spaced; mesal postanal bristles as approximate as posterior cover bristles.

I have included a figure of the mouth parts in position to show more particularly a thin membrane extending from the labium dorsad, covering the angle of the mouth opening. The distal edge of this membrane is indicated by means of a shaded line in figure 3. I know of no earlier mention of this structure. It seems to be braced by sclerotized stays with stout proximal ends for articulation near angle of opening. In figure 3 two bristles spring from its dorsal portion.

Figure 4 illustrates tarsi I in dorsal aspect, showing the extent and position of the mesal bristle of the tibia. These bristles nearly meet over the cephaloprothorax. Similarly the dorsal bristle extends to distal edge of the pteromorphæ. Note the small size of one of the bristles of the dorsoproximal quartette of the tarsi, and the minute size of the insertion of the lost bristle.

This subspecies differs from the species in its relatively smoother, pencil-like or strap-like pseudostigmatic organs (the European species has them usually burred and the distal end is slightly club-shaped); the shorter, smooth (not burred) rostral and lamellar bristles, and the more posterior paranal bristles (in the species the paranal bristles are usually on transverse plane of the pseudofissuræ.

Dimensions: The smallest male, average of six males, average of five females, largest female, all from Ithaca, are given, respectively:

Total length of body	720	735	770	800
L. of notogastral plate	580	588	592	620
Breadth of same	530	550	578	595
Length of pteromorphæ	390	400	405	425
Interlamellar bristle span	140	144	145	152
Median l. of ventral plate	535	556	575	604
Camerostome to genit. apert.	103	117	115	123
Length of genital aperture	102	102	107	117
Breadth of same	115	116	125	127
Genit. apert. to anal apert.	131	139	150	156
Length of anal aperture	143	152	160	172
Breadth of same	164	168	175	176

Material examined: New York: Fifteen specimens from twigs and/or under surface of stones, Cayuga Heights, Ithaca; taken April 1, 1917, slide 173o1 (*cotypes*). Five specimens from among fallen leaves, more especially twigs among them, brush pile, Cayuga Heights, Ithaca; taken March 31, 1917, slide 172o1. One specimen from under face of stone, bark of twig or board, Six Mile valley, south of Ithaca; taken April 14, 1917, slide 176o4. Four specimens from twigs, bark and stones, between Danby and West Danby; taken May 19, 1917, slide 1710o3. An ovigerous female, Fall Creek, Ithaca; taken May 18, by N. Banks, slide 26B94. A female (4 eggs), Buttermilk Creek, Ithaca; taken May 21 by Banks, slide 26B81. An ovigerous female from upper layer of beech, rock maple and red-oak leaves, from pocket in northwest slope of Arnot Forest, up Jackson Hollow, Cayuta; taken November 29, 1927, by Robert Harwood, slide 41A1 (Cornell Univ. lot 845). Two specimens from lower half of five inch layer of wet chestnut oak, basswood, mountain maple leaf mould from steep, southern, rocky slope of glen two miles north of Ithaca; taken June 8, 1928, by Harwood, slide 87B1 (Cor. Univ. lot 845). Forty-seven specimens from upper half of preceeding layer; slide 87B3. Three specimens from leaf mould, small gully along road up from lake between Myers and Norton (near Ithaca); taken December 5, 1932, by C. R. Crosby, slide 32111o1. Two specimens from Sea Cliff, Long Id.; taken by Banks, slide 26B39b. *Connecticut:* One specimen from moss on rocks along trickle (probably also rotten roots), Calhoun Pines, Cornwall; taken August 26, 1932, slide 3253o4. Two specimens from deep layer of old leaves, Plummer's Id., *Maryland;* taken by H. S. Barber, slides 307o1 and -o2. An eggless female from Great Falls, *Virginia;* taken October 21 by Banks, slide 26B92. One specimen from under walnut bark on ground, Chillicothe, *Ohio;* taken September 24, 1923, by A. E. Miller, slide 374 (Miller coll.). One specimen from Putnam Co., *Indiana;* taken March 22, by Blatchley, slide 26B102. Two specimens from under loose, moist bark on fallen tree, Brownfield's woods, Urbana, *Illinois;* taken May day, 1926, by A. E. Miller, slide 0–20–26 (Miller coll.).

Distribution is therefore eastern transitional.

Habitat: Decaying wood and especially leaves of forest floor. Absent from most moss lots and swamp tussocks.

Eggs: The maximum number of eggs was eight.

Zetes arboreus (6, p. 26)

Figures 6–8

Diagnostic characters: Size rather large (0.8 × 0.6 mm.); cephaloprothorax fairly long, conical; lamellæ prominent, rostral bristles the longest, closely appressed, lamellar and interlamellar bristles very fine, rather short, about as long as the very slender anterior porose areas, lamellar peripheral (figure 8); pseudostigmatic organs (figure 7) fairly long, slightly curved at proximal end of head, head clavate, slender, much shorter than pedicel, bluntly pointed to rounded, minutely burred to barbed, these barbules appearing in concentric lines, the figures are taken from four specimens, showing amount of variation and different aspects; pteromorphæ smooth, veining sparse, coarse, groove very narrow, anterior rib thinly chitinized, pivot distant from angle; anterior porose areas unusually long and slender, adalar elongate triangular, often unsymmetrical (in one specimen broken to form a short triangular and a small oval one at mesal end), mesonotal small; posterior edge of notogaster with a median groove.

Ventral plate (figure 6) joined to sides of cupboards by a fine line only, wings as in *Z. elimatus* but slightly narrower distally (figure 6); posterior corner of tectopedia II exposed; tectopedia III not extending as far laterad as tectopedia II; apodemata distinct, apodemata IV sharply bent (see figure) quite close to apodemata II–III; gular bristles fairly long, rather approximate; genital aperture fairly large, anterior edge nearly straight, bristles nearer median than lateral edge, bristles 1 distant from anterior edge, bristles 4 very close to posterior edge, the bristles progressively spaced; paramesal bristles nearer aperture than narrowest diameter of a genital cover; subanal muscle plate elongate oval; anal aperture distant from posterior edge of plate, sides strongly converging, anterior corners rounded; pseudofissuræ anteriad of center of aperture; paranal bristles posteriad of pseudofissuræ, distant from them by length of fissuræ; mesal pair of postanal bristles as approximate as posterior cover bristles; anterior pair of cover bristles more remote than posterior pair, near anterior edge.

Thus closely related to *Z. elimatus* but with longer interlamellar bristles; less extremely modified pseudostigmatic organs; more projecting lamellæ; and triangular adalar porose areas.

Material examined: Connecticut: Nine specimens from under the bark-scales of branches of apple tree, East Village, Monroe; taken June 16, 1926, slide 265o2 (*cotypes*). Ten specimens from moss on and scrapings from fallen and well rotted tree trunk in hemlock gorge, Sandy Hook; taken June 25, 1926, slide 2614o3.

Zetes niger (5, p. 119)

Figures 10–17

Diagnostic characters: Cephaloprothorax well marked off, with very steep front (figure 13); rostrum small, prominently set off, midthoracic suture distinct; bristles well developed; pseudostigmatic organs (figure 12) relatively small, head slender, gradually merging into pedicel, finely, sparsely barbed, pointed; adalar porose area elongate, grub-like, lateral end turned posteriad (figures 10 and 13); mesal mesonotal porose areas large, roundish, the lateral elongate; surface of pteromorphæ strongly angled by an outfolding posteriad of notch (figure 10); genital aperture fairly large, sides only slightly converging, cover bristles nearly equidistant between lateral and median edges; ventral edge of leg cupboards heavily chitinized; anal aperture with sides strongly converging, bristles subequally distant from mesal edge; paranal bristles distant from pseudofissuræ; mesal pair of postanal bristles more remote than cover bristles, lateral pair more approximate than diameter of aperture.

Description: Size fairly large (0.8 × 0.6 mm.); shape broadly pyriform, high, with bulging vertex (figure 10); dark; cephaloprothorax broad and short; rostrum prominently protruding when seen from sides or from above, though less so when seen somewhat from in front and above (figure 13); lamellæ broad, forming a fairly distinct ridge along cephaloprothorax (figures 10, 11, 13), not retuse (figure 13), the bristles peripheral, rather appressed; rostral bristles inserted on ventral surface close to edge of camerostome, closely appressed; edge of camerostome projecting as a rim beyond face of rostrum (figure 13); interlamellar bristles about length of lamellar, inserted close to shadow of tectopedia I, caducous, insertion minute; anterior porose areas very slender, elongate, as seen from above broadly overlapping shadow of tectopedia I; pseudostigmatic organs as above described (figures 10 and 12), not extending across pteromorphæ when these are fairly well outspread.

Notogaster extending well down onto ventral plate behind (figure 13); porose areas as above described, toe of adalar touching posterior insertion; pteromorphæ with pivot below angle (dorsal aspect of figure 10), veining sparse, groove deep, clean cut, with strongly developed ribs, insertion distinct, pseudofissura short.

Ventral plate deep, giving the animal considerable height (figure 13), sternal area convex, channeled anterior to aperture, truncately infolded midway between anterior edge and genital aperture then bulging to fit about base of labium (figures 10, 13 and 14, edge of fold represented by a solid line), lateral edge heavily sclerotized (figure 10 and 14 which shows how closely it fits edge of pteromorphæ (upper line), heavy line is edge of ventral plate), wings broad, covering tectopedia II more than in *Z. elimatus;* tectopedia II long (figure 10), posterior end only exposed, tectopedia III slender, short, truncate; tectopedia IV elongate triangular, the apex well marked; camerostome broad; apodemata with long ceriphs (figure 10), apodemata IV quite short, almost all ceriph; the three sternal bristles as in figure 10, bristle of parasterna III inserted on thickened rim of cupboard, the bristle quite long; anterior edge of genital cover almost at right angles to median plane; marginal bristles inserted closer together than to median plane; bristles 1 distant from anterior edge, bristles 2 and 3 unusually near each other, bristles 4 very near posterior edge of cover; paramesal bristles distinct, inserted less than diameter of a genital cover from aperture; subanal muscle plate oval; anal aperture close to posterior edge; details above described.

Legs 1 (figure 16) with rather widely differentiated bristles. Tarsi quite slender, with triheterohamate ungues; dorsal face with a cluster of five proximal bristles: three dorsal, one lateral and a mesal; of the three dorsal, the proximal is inserted greatest diameter of the segment from proximal end, not extending to distal end of segment when appressed, smooth, second bristle minute, only a little longer than the thickness of the wall from which it springs, inserted close to third which is longer than proximal, smooth, with distal half more bent; mesal bristle as long as third dorsal, very fine, distal end curved, inserted on transverse plane of second; lateral bristle shorter than proximal, barbed, inserted slightly more distad than transverse plane of third dorsal; fourth dorsal removed from third by an interspace as great as between dorsoproximal and proximal end of segment, nearly as long as dorsoproximal, slightly burred on dorsoproximal edge; fifth dorsal as long as dorsoproximal, separated from fourth by an interspace slightly less than between third and fourth; a dorsolateral bristle inserted on transverse plane just proximad of fifth dorsal, burred (figure 19) or barbed (figure 20), nearly as long as fifth, these last two constituting a pair (the dorsoproximal pair); sixth dorsal bristle much shorter, reaching outer edge of extended hooks, inserted halfway between fifth and distal end of segment, a similar dorsolateral inserted on transverse plane slightly proximad of sixth dorsal, the two comprising the dorsodistal pair; the four distal bristles as usual, that is the two ventrodistal with broad spoon-like base (rather drawn out in this species), the dorsodistal straight and fine; ventral face with four, subequally spaced, strongly ciliate (figure 18) bristles on proximal half of segment, of these, the second (from proximal end) is the major and inserted on ventral face, the proximal and fourth are ventromesal, the third is ventrolateral; distal half of segment with a pair of rather long, barbed (figure 20) bristles inserted on transverse plane slightly proximad of dorsoproximal pair which are slightly longer than this ventroproximal pair; slightly more than half way to distal end is inserted another bristle corresponding to the sixth dorsal. I find no mesal one at this node, so that there are but three about this plane. Tibiæ stoutly clavate; major bristle inserted rather far from distal end, not on a boss-like outgrowth of the segment, reaching to distal end of ungues; dorsodistal bristle inserted halfway between major and distal end of segment, about half length of major bristle, smooth; dorsomesal bristle inserted more proximad than major, considerably longer than dorsodistal; ventral bristle inserted on transverse plane of dorsomesal, reaching to beyond base of second ventral of tarsus, pauciciliate; ventrolateral bristle inserted on transverse plane of major bristle, pauciciliate, the shortest of its segment; ventromesal bristle inserted on transverse plane of major bristle, as long as ventral, strongly ciliate. Genuals slightly sinuous; dorsal bristle inserted at distal third, extending slightly more than half its length beyond its segment, strongly depressed, tetragonal, burred (figure 19); mesal bristle inserted close to distal edge, rather short, stout, straight, multiserially coarsely burred; lateral bristle inserted close to distal edge, very long, extending to base of tarsus, smooth. Femora elongate ovate, slightly keeled; a dorsoproximal bristle inserted at center of segment; a dorsodistal pair of bristles inserted close together, the mesal inserted a short distance from distal end of segment, rather short, depressed, seven barbed, the lateral twice as long, extending to base of lateral bristle of genuals, with a few, fine cilia; ventral bristle inserted proximad of transverse plane of dorsoproximal.

Legs II similar, shorter. Tarsi with dorsal bristles relatively shorter, proximal cluster comprising two, smooth, subequal bristles inserted on dorsal face, and two similar, barbed bristles: a lateral inserted on transverse plane closely proximad of second dorsal, a mesal inserted on transverse plane closely distad of dorsoproximal, both longer than the two dorsal bristles; dorsoproximal pair barbed, as long as lateral of proximal quartette, reaching nearly to end of extended hooks, not inserted on same transverse plane; dorsodistal pair, smooth, finely drawn out, not reaching ends of hooks, distal quartette longer than in tarsi I; ventral face bristles longer, the proximal three more elegantly ten-ciliate, proximal inserted on transverse plane distad of dorsoproximal; fourth ventral bristle inserted close to third, short ciliate, with finely drawn out tip; fifth bristle similar, inserted on transverse plane midway between fourth bristle and dorsodistal pair. Tibiæ shorter, less stout (high); major bristle inserted quite close to distal edge; dorsomesal bristle inserted nearly diameter of tarsus from distal end of segment, as long as tarsus, short ciliate; ventral bristle very similar to that of tarsus I; ventromesal bristle inserted almost as distad as major bristle, long ciliate; ventrolateral bristle short ciliate. Genuals shorter than genuals I; lateral bristle inserted at center, smooth, reaching distal end of segment; dorsal bristle inserted close to distal edge of segment, very long, reaching middle of tarsus, smooth; lateral bristle inserted proximad of center of segment, reaching to beyond center of tibia, strongly barbed, stiff. Femora longer than femora I, strongly curved (figure 15) to extend laterad and parallel to femora I; dorsoproximal bristle inserted proximad of center of segment, decurved, not reaching insertion or dorsodistal, strongly barbed; dorsodistal pair inserted more proximad than in femora I, separated by width of segment, the lateral one reaching to insertion of lateral bristle of genual, the mesal one shorter, both weakly barbed; ventral bristle inserted more proximad than dorsoproximal, long and slender, reaching genual if depressed, sparsely barbed; pedicel with a short, fine bristle on ventral face (which makes me suspect it is a fused trochanter).

Legs IV (figure 17) quite slender. Tarsi with dorsoproximal bristle barely reaching base of claws, slightly barbed on dorsoproximal edge; a pair of dorsodistal bristles inserted at distal fourth of segment, reaching nearly as far as extended hooks, finely burred on two sides; the four distal bristles not extending as far as dorsodistal, subequal except the dorsomesal which is somewhat longer; the ventral bristles long, ciliate (about seven cilia), the distal pair inserted on transverse plane of the dorsodistal pair, each bristle of the same side not on the same transverse plane; a ventrolateral bristle inserted slightly proximad of dorsoproximal, extending nearly to end of tarsus, long ciliate. Tibiæ slightly shorter, dorsal face somewhat wrinkled; major bristle inserted greatest diameter of segment from distal end, almost as long as its segment, smooth; ventral bristle inserted slightly more proximad than major, ciliate in at least three ranks, not extending to insertion of ventroproximal of tarsus; distoventral inserted on extreme distal edge of segment, closely appressed (not so figured), extending to slightly distad of insertion of dorsoproximal, long ciliate; a ventrolateral bristle inserted slightly distad of ventral, extending to insertion of ventrolateral of tarsus, long ciliate. Genuals straight, long, longer than tarsus distad of dorsoproximal bristle; with two dorsal bristles, the proximal inserted at distal third, extending more than half its length beyond its segment, barbed; the distal one inserted close to distal end, strongly decurved, reaching to angle of pedicel and body of tibia, strongly nine- to ten-ciliate. Femora broad, with a very slight ventral keel; dorsal bristle inserted slightly distad of center, strongly decurved, reaching well beyond proximal end of genual, stout, apparently tetragonal, burred in two to three ranks; ventral bristle inserted on transverse plane distad of dorsal bristle, slightly shorter than genual, straight, with two to three rows of fine barbs. Trochanters somewhat oblique.

Legs III similar. Tarsi shorter and stouter, with all bristles relatively longer; dorsoproximal bristle inserted more proximally, loosely ciliate on dorsoproximal edge; the dorsodistal pair more proximally inserted than at distal fourth, an extra pair half way between the last pair and distal end; these last two and the distal four have the distal end slightly thickened as a very minute knob! This extra dorsal pair thus throws the proximal ones more proximad while the bristles of the ventral surface keep the same relative positions as in legs IV. Finally there is also a lateral bristle inserted more proximad than the ventroproximal, as long as dorsoproximal and similarly ciliate. Tibiæ shorter, bowed; major bristle not erect, more distally inserted, thus the ventral bristle is more proximally inserted than the major, the distal bristle less distally inserted, the ventrolateral bristle inserted on same plane as ventral; ventrodistal bristle somewhat longer. Genuals very much shorter, strongly curved; dorsodistal bristle smooth, nearly straight, shorter; proximal bristle on lateral side, inserted in center, short, ciliate on two sides. Femora elongate triangular; dorsal bristle inserted at proximal fourth, extending to distal end of genual when pressed down, thus much longer than that of legs IV. Trochanters more oblique; ventral bristle inserted near distal end, extending to insertion of ventral bristle of femur, barely burred, drawn out to an unusually long point.

Dimensions: The smallest male, average of three males, average of six females, largest female of Illinois material are given respectively:

Total length of body	782	822	871	900
L. of notogastral plate	595	663	685	715
Breadth of same	638	651	697	714
Length of pteromorphæ	433	454	470	485
Interlamellar bristle span	196	201	214	230
Median l. of ventral plate	578	616	652	682
Camerostome to genital apert.	102	120	124	132
L. of genital aperture	111	117	117	131
Breadth of same	127	133	143	145
Gen. apert. to anal apert.	153	163	180	196
Length of anal aperture	161	170	180	182
Breadth of same	170	185	199	203

Material examined: Nine specimens from Ottawa, *Canada;* Banks, slide 26B43. Two specimens from rootlets and well rotted material on sides of *Carex stricta* clump, in old, uncut, meadow with much fern, Monroe, *Connecticut;* taken September 5, 1925, slide 2537o1. *New York:* Two specimens from Buttermilk Creek, Ithaca; taken May 21, by N. Banks, slide 26B81b.

Eleven specimens from under old boards, possibly under face of stones and bark, Enfield Gorge; taken April 5, 1917, slide 174o1. Three specimens from Putnam Co., *Indiana;* taken by Blatchley, March 22, slide 26B102. Six specimens from under stone, Batavia, *Illinois;* taken by H. E. Ewing, April 27, 1907, slides 26EwB98a and -b.

Geographical Distribution: As far as known, eastern transitional.

Habitat: Also a species of decayed vegetation though its scant numbers may indicate that its true habitat has not yet been determined. It may well be arboreal, sheltering under wood and stones when estranged from its normal habitat. The two specimens in the sedge tussock, compared to all the sedge tussock material examined, look accidental.

Eggs: The maximum number of eggs found was six.

Zetes graminetum *sp. nov.*

Figures 21–23

Diagnostic characters: Fairly large (0.8 x 0.6 mm.), high and broad for its length; cephaloprothorax very short with very steep front (figures 21 and 23); rostrum projecting prominently as a small nubbin (figures 21 and 23); lamellæ with lateral edge developed laterad to form a prominent, rounded rim at each side of cephaloprothorax (shaded lines in figure 23), the bristle inserted on mesal edge, longer than rostral (figure 23) though appearing shorter in dorso/ventral aspect; interlamellar bristles rather short, quite fine, inserted close to shadow of tectopedia I; anterior porose areas very slender; midthoracic suture distinct, strong; pseudostigmatic organs (figures 22) rather long, slender, with short, slender, distinct, burred, pointed head, pedicel bent at juncture with head, in some aspects there seem to be two distal points; adalar porose areas elongate, lateral end bent posteriad (figure 23); mesonotal oval and elongate; ventral plate wings short and broad, truncate behind; apodemata IV nearly at right angles to apodemata II–III and nearly touching them; genital aperture with sides only slightly converging, anterior edge simply curved; bristles 4 of genital covers represented by a channel at the angle, other bristles nearer median than lateral edge, separated from median edge by a ridge; pseudofissuræ of anal aperture short, very oblique, with a pseudoforamen; paranal bristles on transverse plane posteriad of pseudofissuræ; posterior pair of cover bristles more approximate than mesal pair of postanal bristles.

Dimensions: Smallest male, average of three males, average of six females and largest female from Ohio are given respectively.

Total length of body	752	759	815	832
Breadth of notogaster	587	587	631	658

Material examined: Ohio: Four specimens from beneath and among dead leaves of Kentucky bluegrass, Chillicothe; taken August 27, 1922, by A. E. Miller, slide 32 (Miller coll.), (*cotypes*). Five specimens from under side of railroad tie in timothy meadow, Chillicothe; taken April 11, 1924, by Miller, slide 18 (Miller coll.). Three, twenty-two, six, three and eleven specimens from bluegrass sod, Mt. Logan, Chillicothe; taken April 20, 27, July 13, August 3, 1925, by Miller, slides 30M9o1 and -2, 30M7o1, 30M15o and 30M18o1, respectively. Four specimens from under walnut bark on ground, Chillicothe; taken September 24, 1923, by Miller, slide 374 (Miller coll.). *Illinois:* One specimen from dying roots of Benen roses, Shelbyville; taken July 1, 1923, by C. L. Metcalf, slide 32M16o. Ten specimens from Urbana; taken July 21, 1924, by Miller, slides 32M99o1 and -o2.

Habitat: From the above it seems evident that *Z. graminetum* is a sod dweller and, judging from the amount of earth piled up about its snout or rostrum, in many balsam mounts, it must be a great rooter about in the soil. A further adaptation or result is the depressed lamellar bristles and smaller interlamellar bristles. This habit, accompanied by the broad, strong front and stubby snout makes it the pig among the Galumninæ.

Eggs: The largest number of eggs found per individual was eight.

Zetes graminetum, Z. niger, Z. arboreus and *Z. elimatus* form a closely related group by their large size, bulging pseudostigmatic area, and posteriorly exposed tectopedia II. They show three steps in reduction of their interlamellar bristles, and three steps in development of lamellar rim. They are the four largest species of the northeastern States. *Z. graminetum* and *Z. niger* are the most specialized and both have steep, vertical fronts. *Z. graminetum* may at once be recognized by its large, prominent lamellar rim which makes the animal look like an invalid perambulator, as seen from above, the lamellar rim representing the rubber tired wheels and the rostrum the invalid's toes. *Z. niger* is easily recognized by the peculiar angle in the sides of the pteromorphæ and the dark band at the juncture of the ventral plate with the leg cupboards. *Z. elimatus* and *Z.*

arborea have conically sloping cephaloprothorax but reduced interlamellar bristles.

As to habitat, *Z. graminetum* is strictly a prairie-sod species. The other three species seem to prefer woodland.

Zetes minutus (5, p. 121)

Diagnostic characters: The smallest known North American *Zetes* (0.32×0.2 mm.); pale amber yellow; all bristles relatively short, rostral quite distinct; lamellar bristles lateral; pseudostigmatic organs with a broad, decurrent, round-ended head fringed on anterior edge and distal end by long, fine, somewhat crowded cilia; adalar porose areas short; genital covers each with but two bristles on the disc; anal aperture without pseudofissuræ; paranal bristles slightly posterior to center of sides; postanal bristles grouped in two pairs.

Description: Shape elongate-oval, rather slender; cephaloprothorax rather broad, lamellæ not forming a sharp ridge but a gentle swelling on sides; rostrum not conspicuously set off; rostral bristles inserted well down on sides, short, fine; lamellar bristles inserted well back from edge of lamellæ, short, fine; interlamellar bristles inserted as far from shadow of tectopedia I as from notogaster; anterior porose areas slender, rather short; pseudostigmatic organs stiff, with rather stout pedicel directed forward, bent at juncture with head which crosses over anterior end of pteromorphæ, compressed, blade-like; midthoracic suture distinct, faint, often undulate.

Notogaster without median pseudoforamen, adalar porose areas short, fusiform (long axis parallel to edge of pteromorphæ); mesonotal porose areas small, angularly round-oval; pteromorphæ smooth, practically no veining, groove open anteriorly, that is, without the anterior rib well developed, pivot well below angle, pseudofissura fine, insertion small.

Ventral plate wings broad, exposing tectopedia as a narrow edge beyond posterior angle, tectopedia III semicrescentic, easily confounded with what appears to be a suture between trochanter and femur on legs II; apodemata I quite bent, with stout distal end and short cerifs; apodemata II–III with long ceriphs; apodemata IV short, strongly curved posteriad; a well defined lacuna between anterior two apodemata, the anterior one developed chiefly on posterior edge; gular bristles unusually approximate; other bristles as usual; genital aperture with a broad frame, anterior edge slightly undulate, posterior edge strongly undulate; cover bristles 1 and 4 represented by channels, bristles 3 more remote than bristles 2, fairly close to lateral edge of covers; paramesal bristles more remote than diameter of aperture, as distant from aperture as smallest diameter of a cover; anal aperture with strongly converging sides and rather sharp posterior angles, with fairly broad frame on anterior and lateral sides; paranal bristles distant from aperture; lateral postanal bristles near corner of aperture; mesal postanals more remote than cover bristles; anterior cover bristles more approximate than posterior.

Tarsi with very slender lateral and mesal hooks. Tarsi I with all bristles rather short, the four dorsoproximal bristles reduced to two, inserted close to each other; ciliate bristles of ventral face with only three to four stout, long, widely spaced, cilia; femora I with the ciliate, ventral face bristle similar to the tarsal, otherwise normal.

The reductions that have taken place in this smallest species are not specializations but harmonic changes that take place in dwarfing. Dwarfism has affected not only total size but length of bristles. It also mechanically brings about concentration. For example, by the shortening of the genital covers their twelve bristles are brought closer together, making it less necessary to have so many in so small a space. Outstanding are the lateral lamellar bristles. The pseudostigmatic organs are the most distinctive and highly developed of the now recognized American species of this genus.

Dimensions: The smallest male, average of nine females (the males seem to be quite rare) and the largest female, all from Florida are given:

Total length of body	311	320	328
Length of notogastral plate	246	256	263
Breadth of same	209	215	217
Length of pteromorphæ	168	171	178
Interlamellar bristle span	54.5	57	60

Median l. of ventral plate	230	238	246
Camerostome to genital apert.	59	63	65
Length of genital aperture	41	43.6	46.8
Breadth of same	49.5	50	51
Genital apert. to anal apert.	66	67.7	70
Length of anal aperture	64	65	68
Breadth of same	75	76	78

Eggs: The largest number of eggs found is two, each one quite filling up its own half of the abdomen.

Material examined: Twelve specimens from shore bay debris, Vero Beach, *Florida;* taken April 6, 1928, by Erdman West, slides G67G1, -G2, -G6, -G9, -G15, -G16. A female from under board, garden of Mrs. Allison, Arcola, *Illinois;* taken June 20, 1906, by H. E. Ewing, slide EwB138 (Banks coll.).

Zetes corrugis (6, p. 28)

Figures 37–45

Diagnostic characters: No median pseudoforamen; cephaloprothorax bristles long, lamellar bristles frontal; ventral edge of pteromorphæ sculptured by conchoidal corrugations posterior to notch; pseudostigmatic organs slenderly clavate with few, short barbs (figures 37 and 38); adalar porose areas long, L-shaped; bristles 4 of genital covers visible as channels; anterior bristle of anal covers much more remote than posterior pair; paranal bristles posterior to reduced pseudofissuræ.

Description: Size medium large (0.8×0.53 mm.); shape (figure 37) broad-ovate; cephaloprothorax conical, the lateral outline only slightly interrupted by lamellæ and insertion of rostral bristles; rostrum somewhat prominent, rounded; rostral bristles well developed, touching or nearly so; lamellar bristles quite long, as seen from above crossing rostral, undulate, insertion not far from lamellæ; interlamellar bristles fairly long (figure 38, foreshortened in figure 37), inserted as far from shadow of tectopedia I as from notogaster; anterior porose areas cuneate, the broad end mesad of interlamellar bristles; pseudostigmatic organs of medium length, bluntly pointed, with few barbs (figures 37 and 38).

Notogaster with anterior edge quite distinct; adalar porose areas quite long, extending to within their own diameter from mesal adalar pseudoforamen (figure 37) ventral end bent posteriad; mesonotal porose areas angularly roundish, fairly large, the lateral one more elongate; pteromorphæ (figure 40) with pivot near angle, groove distinct, slender (figure 37), insertion distinct, close to edge, veining distinct, broad, simple, sculpturing extending well up towards posterior angle, fine and close.

Ventral plate (figure 37) with wings narrow at anterior end, posterior corner broadly cut off considerably exposing tectopedia II; tectopedia III well developed, without posterior angle; apodemata I curved, with a fairly long posterior ceriph; apodemata II–III straight with a long anterior ceriph and a short posterior one; apodemata IV curved, almost touching II–III!; sternal bristles 1 represented by a small pseudoforamen; insertions of sternal bristles also present; genital aperture with anterior and posterior edges only slightly sinuous, surrounded on anterior and lateral sides by a slender frame; covers with bristles much as usual, inserted subequally distant from lateral and median edges; bristles 4 represented by a curved channel, paramesal bristles more remote than diameter of genital aperture, distant from aperture the diameter of a cover; subanal muscle plate triangular, the point directed posteriad; anal aperture with prominent anterior and posterior angles, cover and paranal bristles as above mentioned, lateral postanal bristles some distance from corners of aperture, the four subequally spaced.

Trochanters III (figure 41) and IV (figure 43) are figured to show the two articulation pivots. Femora II (figure 42) are illustrated to show the bow-like curve needed to get around femora I (note the trochanteral end).

Figures 38 and 39 have been included to show the shape and position of tectopedia I. In figure 38 they are shown by means of broken lines, their edges are thickened and therefore shown by double lines. In some species they project from surface of cephaloprothorax at about the height of the lamellar bristles and pass down sides of cephaloprothorax to the ventral plate as a slight ridge. Above the lamellæ they do not project, but curve posteriad then ventrad at a more posterior plane. Their ental position seems to be due to pull by the mandible retractors and adductors which are in part attached to these tectopedia (figure 39). The object between the short triangular muscle and the right coxa is a hyaline plate. The tracheal tube on the left side is quite distinct. There seem to be other fine tracheal (?) tubes between and above the mandibles, one of them running along the proximolateral edge of one of the mandibles.

Figures 44 and 45 are included to show the structures within the acetabulæ, the coxa of legs II, the membranes about the edges of the insertions, and the attachments of the tracheæ. In figure 44 the lobe at the upper angle of the gular collar, often seen projecting under edge of camerostome at its posterior angles, is here shown to be a plate-like lobe of the collar (shown by double broken lines). Tectopedium IV is shown as a dark rim circling up to tectopedium II and enclosing the lighter tectopedium III. Note: (1) that femur II is separated from the trochanter (broad line), and (2) the trochanter is joined to the coxa, while (3) its upper edge is held by a socket membrane. A similar membrane encircles base of trochanter IV. The thickened rims (enclosed by shaded lines) on ventral plate wing, are seen to fade out on its surface. Acetabulum III lies open and vacant. In figure 45 between the trochanters (upper lobes in figure) stands out tectopedium III while the hump on its left side is tectopedium IV very much foreshortened. The ventral plate is broken across and shown in section enclosed by shaded line. To the right of numeral III is the trachea. The black figure above the same numeral is the toe or ridge which probably acts as a guide to the coxa. In coxa IV this toe is likewise black. To its right is the opening of the trachea on the surface of the acetabulum, while to its left is the hatchet- or halberdlike coxa. The upper part of this hatchet bears a spiral collar (double line in figure). There seems to be a cushion of chitin under trochanter IV.

Material examined: Two specimens from Middlesex Fells, Mass.; collected by Nathan Banks, slides 26B4 and 26B5 (*cotypes*).

Zetes corrugis milleri *subsp. nov.*

Figures 9

Diagnostic characters: Pseudostigmatic organs more heavily barbed, showing a tendency to divide at distal end (figures 9); lamellar bristles inserted in angle at base of lamellæ; adalar porose areas often quite slender, half width of those of the species; sculpturing of pteromorphæ more extensive, reaching well over to posterior end of pteromorphæ, anteriorly curving dorsad, as many corrugations reaching much further dorsad than in the species; ventral plate bristles not different.

Material examined: Six specimens from under dry bark of fallen Silver Maple branch under its tree, in open, grassy, very dry pasture, Brettendorf, *Iowa;* taken July 8, 1927, by August E. Miller, slide 32M114o3 (*cotypes*). Two specimens from Galesburg, *Illinois;* taken October 16, 1905, by H. E. Ewing, slides EwB15 and EwB15–4.

Zetes emarginatus (1, p. 7)

Figures 24–33

Diagnostic characters: Size medium (about 0.5 mm. long); shape somewhat slender and high; cephaloprothorax narrow, the three pairs of bristles well developed, nearly smooth; lamellar bristles frontal; pseudostigmatic organs fairly long, slightly curved, with slender, asymmetrical head (figures 29–31); pteromorphæ with ventral edge finely vermiculate-granular; notogaster with median pseudoforamen; adalar porose areas stout-cuneate.

Description: Shape seen from above, ovate (figure 26, which is seen slightly from in front and figure 28 from behind, both being foreshortened from different directions); cephaloprothorax seen from above (figures 24 and 27) conical, broadening ventrad (cf. figures 26 and 28), lamellæ forming a slight emargination, seen from the side, with high slightly bulging vertex; rostrum slender, tapering insensibly into sides of cephaloprothorax, with ventral half constricted, the edge flaring out as a thin chitinous lip (figures 24 and 27), but not far enough to be visible from above, being hidden by bulge of rostrum (figures 26 and 28). The lip is furnished with a strong, median mucro with a subordinate point on each side, making the edge three angled though the lateral angles are often very poorly developed. Figure 25 illustrates the tip of the rostrum, the dotted lines outlining the thickened area, the heavy line delimiting the thin area (pseudofenestration) just above the rim and on the inside. The point is formed by the median mucro. Lamellar bristles inserted considerably mesad of lamellæ which are sinuously emarginate opposite the bristles. Figure 24 is as viewed from below so that the bulge of the vertex is beyond the plane of sight and the lamella has risen to the horizon of vision. Lamellæ protruding as a slight rim from face of cephaloprothorax (figures 26 and 28). Interlamellar bristles the longest. Pseudostigmatic organs (figure 30) medium long (94 microns), shaft somewhat slender, widening gradually into head which is bilaterally unsymmetrical, variously but shallowly notched, the notches never opposite, apex blunt.

Notogaster much narrower than long, broadly overlapping ventral plate (figure 28), roughened by fine granulations; adalar porose areas tapering toward median line; one specimen found has this area nearly constricted in the middle, another with the division complete forming two areas, each circular and widely separated; mesonotal porose areas circular; pteromorphae with crenulate veining, groove curved, slender, ribs well developed, preceded by a sinuous, much more shallow one which is terminated distally by a distinct but hairless insertion, ventral area roughened by fine granulations (figure 27). These granulations leave a narrow, smooth band along the rim and are followed proximad (or dorsad) by fine more or less parallel ridges. This granulation of the pteromorphæ, notogaster and parts of the venter might place this species in the subgenus *Stictozetes* which I am unable to recognize for reasons set forth elsewhere (6, p. 6). Moreover I now find that at least two species with or without pteromorphal sculpturing have subspecies with the opposite condition.

Ventral plate (figure 28) broad anteriorly and finely granular, anterior ends of wings narrow, posterior ends broader than tectopedia II, but truncate to broadly expose the tectopedia behind only; tectopedia III broad, short, oblique; apodemata I straight, at right angles with median plane, with long posterior cerif; apodemata II–III straight, long, extending almost to genital aperture with short anterior and long posterior cerif; apodemata IV short, parallel to the preceding, with a long posterior to posterolateral ceriph; sternal bristle 1 occasionally present (upper half of figure 28), insertion between apodemata II–III and genital aperture lies over mesal end of the apodeme; genital aperture with anterior edge straight, posterior edge undulate, sides strongly converging, cover bristles subequally spaced though 2 and 3 are more distant from each other than the others, bristles 1 nearer lateral than median edge, bristles 2 equally distant from both edges, bristles 3 and 4 nearer median than lateral edge, bristles 4 not very near posterior margin, the bristle discerned with difficulty in ventral aspect; these bristle insertions all seem double; paramesal bristles more remote than diameter of genital aperture, diameter of a genital cover distant from genital aperture; anal aperture slightly more than its length from genital, anterior and posterior edges undulate, sides strongly converging; anterior cover bristles nearer lateral than median edges of covers, posterior cover bristles near posterior edge, also near median edge; pseudofissuræ very short, parallel to sides, at center of sides; paranal bristles posterior to pseudofissuræ; postanal bristles almost subequally spaced, mesal pair slightly more remote than their distance from the lateral.

Camerostome (figure 28) broad. Labium with bristles well developed (usually difficult to see). Palps (figure 33a) five segmented; basal segment very short, subtriangular; second segment longer than next two, with three slender bristles, the distal one inserted on ventral edge; third segment half the length of second, rapidly tapering, with a dorsal bristle inserted at center of segment; fourth segment still shorter, subcylindrical, with a recurved bristle on anteroventral edge and a long, stiff bristle on dorsal face; distal segment nearly as long as second but slender and irregular, dorsal face with a prominence from which springs a curved spine, two short, erect bristles distad of this spine (figure 76), distal bristles recurved. Mandibles strong; each ramus with three well-developed teeth; free ramus with distal tooth bifid.

Legs with triheterohamate ungues; tibiæ I the broadest tibiæ, tibiæ IV the longest and slenderest; genuals III the smallest genuals; femora I the widest femora, femora II slightly longer than the others, femora III the smallest. Legs I (figure 32) the most specialized; tarsi with three pauciciliate bristles on ventral face, the cilia long and strong; distal end of segment with four or five slender bristles; dorsal face with three heavier, decurved bristles; lateral face with two fine bristles. Tibiæ broad, compressed at distal end, pedunculate at proximal end; major bristle well developed, dorsal face with a strong, distal bristle at distal end; ventral face with a short, ciliate bristle at distal end, a long, slender, curved, barbed bristle proximad of it; lateral side with a strong, distal bristle; mesal side with a more slender bristle inserted near center of the article. Genuals long, cylindrical, with three distal bristles: a short one on ventral face, a long one on dorsal face and a shorter recurved one (foreshortened in figure 32) proximad of it. Femora gourd-like in outline but compressed; dorsal face with a slender, curved bristle at distal end, a barbed bristle at center, ventral face with a fine bristle inserted proximad of center. Legs II similar to legs I but less highly specialized. Tibiæ not nearly as broad.

Legs IV (figure 33) quite slender. Tarsi with three pauciciliate bristles on ventral face; ventrodistal bristles broad at base, bract-like; dorsal face with two prominent bristles, the proximal inserted slightly proximad of center of segment. Tibiæ shorter, ventral face with a long, ciliate bristle at distal end, another short one proximad of it; lateral side with a smooth bristle; dorsal face with a poorly developed major bristle. Genuals much broader at distal end; dorsal face with two curved bristles near distal end. Femora very broad, compressed, subrectangular, the genual attached to dorsal edge; ventral edge with a long bristle near distal end; dorsal edge with a shorter bristle inserted anterior to center of segment. Trochanters wider than long, compressed, ventral edge straight, with a strong bristle at distal end.

Legs III similar to legs IV but less highly modified. Tarsi with three pauciciliate bristles on ventral face; dorsal face with three smooth bristles; lateral side with a long bristle inserted near proximal end; distal end with four or five short bristles. Tibiæ curved, cuneate; major bristle subequal to tibiæ, held erect nearly at right angles to segment, gently recurved at center, inserted fairly close to distal end of article; ventral face with two long bristles inserted quite close to apex, the other somewhat posterior to it and more lateral, at least the posterior one multiciliate. Genuals quite short, with two fairly stout, medium long, straight bristles, one inserted on dorsal face, the other on side, both between center and distal end. Femora with a long, oblique dorsal slope, and a sharply truncate proximal end which meets the dorsal face by a short curve, keel poorly if at all developed; dorsal bristle far proximad of center, long and stout; ventral face bristle long, fairly stout, barbed, inserted at center of segment; lateral bristle inserted just above ventral bristle. Trochanters similar to trochanters IV but more oblique, the bristle quite long and slender, keel poorly developed.

Color: In life, nearly black; in mounts, mahogany red, the anterior end of abdomen appearing amber yellow.

Dimensions: Twelve specimens were measured, a male from Falls Church, Va., a male from Cliff Id., Casco Bay, Me., three males from Monroe, Conn., and seven females from various localities. The averages for the three Connecticut males and for the seven females is presented. These averages with the measurements for the males from Virginia and Maine are also given in the following table. This species is so high (compared to its breadth) that it is rare when a specimen is found mounted so as to present a true dorsoventral aspect.

	Va. Male	*Conn. Males*	*Me. Male*	*Females*
Total length of body	540	586	605	617
Length of notogastral plate	420	462	470	468*
Breadth of same	375	410	430	429
Length of pteromorphæ	290	308	330	321
Interlamellar bristle span	105	118	120	123
Median 1. of ventral plate	390	435	450	445
Camerostome of genit. apert.	85	84	80	82*
Length of genital aperture	50	74	75	74*
Breadth of same	70	80	85	83
Genit. apert. to anal apert.	105	123	125	125
Length of anal aperture	100	115	120	120
Breadth of same	125	130	135	133

From this table three things are evident: (1) the species averages larger from south to north (as in vertebrates); (2) the females average larger than males; (3) although there is a slight sexual differentiation (see items with asterisk) these differences are so slight and so swamped out by individual variation as to be rendered valueless for practical purposes.

The Virginian specimens, although averaging smaller, and more often with spiny pseudostigmatic organ head, cannot be considered as a distinct race because of the inconstancy of these characters and their appearance (though less frequently) in other parts of the known range of the species. Isolation would undoubtedly establish the form.

Material examined: One specimen from Ottawa, *Canada:* Banks coll., slide 26B43. A male from epigeous moss from spruce-balsam woods, Cliff Id., Casco Bay, *Maine;* taken August 15, 1919, slide 1933o1.

Massachusetts: Six specimens from leaf mould from top (north side) Wachusett Mt.; taken October 29, 1932, by C. R. Crosby, slide 3297o1. One specimen from Middlesex Fells; Banks coll., slide 26B4.

Connecticut: Twenty-seven specimens from well decayed stump of white cedar, epigeous moss, and litter under small white cedars surrounding open bog, Bethany; taken June 22, 1932, slide 3223o1. Four specimens from under boards, Experiment Station grounds, New Haven; taken September 25, 1932, by P. Garman, slide 3268o. Four specimens from oak leaves in Hemlock Gorge, Sandy Hook; taken June 21, 1926, slide 2612o2. Two females from moss on and scrapings from old log, from hemlock gorge below road, Sandy Hook; taken June 21, 1926, slide 2614o3. One specimen from fallen hickory shag, dump lot, Coscob headland; taken April 12, 1932, slide 3210o1. East Village, Monroe: Seven specimens from cushion moss, upland swamp; taken March 23, 1913, slide 1913o2. Twenty specimens from cushion moss, upland swamp; taken May 31, 1919, slides 1931o4, 1932o1. Twenty-seven specimens from cushion moss (grey-green and hair cap) growing on earth clumps, stones, etc. (no wood), woods, edge of upland swamp; taken July 9, 1932, slides 3227o1 and -o2. Thirty-eight specimens from lower sides of stones standing in wet meadow. They were on the stones just above the wet area in a "tide-line." An algal film greened the wet area. Thus they were following down this algal film as the water level fell. Taken April 23, 1920, slide 204o3. One specimen from short moss on north side of boulder, upland swamp; taken May 30, 1920, slide 2014o1. Three specimens from lower face of old rail in orchard, a few millimeters in the wood or between the crevices; taken August 22, 1925, slide 2527o1. Forty specimens from interior of soft, moist, rotted rail, foot of old wall in old orchard; taken June 17, 1926, slide 266o1. Fourteen specimens from under surface of old boards, edge of woods; taken June 18, 1926, slide 268o1. Three specimens picked from oak and maple leaves from a rift on the ground in dry upland woods; taken June 19, 1926, slides 2610o1, 2611o1. Five specimens from pile of very much decayed fence rails and posts, young woodland, formerly pasture; taken July 12, 1932, slide 3228o1. Twenty specimens from old rails, branches and wood chips, old orchard; taken August 4, 1932, slide 3229o3. Forty-three specimens from under face of boards, edge of upland swamp woods; taken August 4, 1932, slide 3230o2. Five specimens from moss clump, thicket, edge of swampy woods; taken January 18, 1932, slides 322o2 and -o3. Five specimens from *Selaginella apus* and epigeous moss, earth clumps, upland swamp; taken July 7, 1932, slide 3226o2. Four specimens from bole rot pocket of yellow birch, felled two years previously, woodpile; taken November 6, 1933, slide 3175o1.

New York: Three specimens from leaf mould, old hemlock grove, west slope of Miamus ravine; taken in April, slide 261o1. Long Island: Ten specimens from Sea Cliff; taken by Nathan Banks, slide 26B39 (*types*). Four specimens from subaquatic sphagnum, sphagnum swamp, Roslyn; taken by Banks, slide 26B41. Twenty-two specimens from rotten wood and under side of bark slabs, Glen Cove; taken May 8, 1920, slides 208o3 and 209o1. Three specimens from decaying logs and sticks from among dead leaves, dry woodland, Queens Woods; taken May 3, 1919, slide 1928o2. Eleven specimens from decaying and charred sticks from among dead leaves, recently burned over ground, Hollis Hills; taken April 28, 1919, slide 1927o1. A male from stick in hollow behind golf links, Forest Park, Brooklyn; taken March 8, 1919, slide 194o1. Four females from old sticks under leaves, Cypress Hills Cemetery, Brooklyn; taken February 23, 1919, slide 194o1. Central New York: Five specimens from Gloversville; taken April 2, 1926, by C. P. Alexander, slide 26B72. A female from marsh, Freeville; taken May 20, by Nathan Banks, slide 26B75. Thirty-one specimens from under surface of twigs, bark and stones, Six Mile valley, Ithaca; taken April 14, 1917, slides 176o1, 176o4. One specimen from Buttermilk ravine, Ithaca; taken May 21, by Banks, slide 26B81d. Four specimens from sphagnum about stump in swale below road below wooded ridge, Connecticut Hill, Newfield, Tompkins Co.; taken November 25, 1932, slide 32106o1. Two specimens from epigeous moss and stump lichens, wooded ridge of Connecticut Hill; same date, slide 32110o1. Nine specimens from under surface of twigs, bark and stones, Danby to West Danby; taken May 13, 1917, slides 179o2, 179n1. As last but taken May 19, one specimen, slide 1710o3.

Ohio: Two specimens under walnut bark on ground, Chillicothe; taken September 24, 1923, by A. E. Miller, slide 374 (Miller coll.). Six specimens from rotting stump of *Acer saccharum* near river, Chillicothe; taken August 8, 1922, by Miller, slide 16 (Miller coll.).

Illinois: One specimen from Chicago!; September, Banks coll., slide 26B87. Two specimens from under side of board lying on ground in open woods; taken June 25, 1926, by Miller, slides 32M5o1 and 32M5ho. Fifty-two specimens from lower side of 2″ by 6″ piece of walnut in open bluegrass pasture, three miles north of Rossville; taken August 18, 1927, by Miller, slides 0–15.1–27 and 0–15.2–27 (Miller coll.). Twenty specimens from lower side of cut fence post in open sandy woods, five miles south of Watseka; taken August 18, 1927, by Miller, slides 0–12.1–27 and 0–12.2–27 (Miller coll.). Four specimens from moist, under side of newly cut fence post lying on ground, Mt. Vernon; taken August 6, 1927, by Miller, slide 0–22–27 (Miller coll.). Three specimens from moist under side of board in thick bluegrass, Arthur; taken September 14, 1927, by Miller, slide 0–6–27 (Miller coll.). Two specimens from gallery walls of

Aphaenogaster tennesseensis in rotten oak log, Homer Park; taken May 30, 1926, by Miller, slide 0–5–26 (Miller coll.). Two specimens from under dry boards and logs in open, well drained, pastured woods, Denrock; taken July 9, 1927, by Miller, slide 32M115a. One female from under bark or log, three miles west of Arcola; taken July 9, by Ewing, slide EwB151. Urbana: Three specimens from under bark on pine stump, University Forest; taken January 18, by J. Douglas Hood and G. H. Coons, slide 26B73. A male from under bark on maple log in yard; taken October 20, by Hood, slide 26B74. A female from under heavy pieces of lumber, near University campus; taken October 23, by H. E. Ewing, slide EwB25. Two specimens from under loose bark of log, Dodson's Woods; taken June 7, 1926, by Miller, slides 0–2.1–26 and 0–2.2–26 (Miller coll.). A male from under loose bark of untopped, fallen white oak in northeast corner of Dodson's Woods, sunny exposure, two feet from ground; taken June 6, 1927, by Miller, slide 32M125o. A female from lower side of board or log lying on ground in more open part of Dodson's Woods; taken May 24, 1927, by Miller, slide 32M122o. One specimen from under side of fallen log, Dodson's Woods; taken August 18, 1928, by Miller, slide 32M2o. Three specimens from under loose, moist bark on fallen basswood log in Dodson's Woods; taken April 30, 1926, by Mrs. Miller, slide 0–7–26 (Miller coll.). Three specimens from walls of galleries in nest of *Aphaenogaster tennesseensis* Mayr. in rotten log, Dodson's Woods; taken June 7, 1926, by Miller, slide 0–1–26 (Miller coll.). One specimen from woody fungus on under side of fallen branch in shade, University Woods; taken August 29, 1927, by Miller, slide 0–11,4–27 (Miller coll.). Twenty-two specimens from under loose, moist bark on fallen tree, Brownfield's Woods; taken May 1, 1927, by Miller, slides 0–21,1–26, 0–21,2–26, and 18 specimens taken by Mrs. Miller, sildes 0–14–26, and 0–15–26 (Miller coll.).

District of Columbia: Fifteen specimens from under bark of rotten log, Somerset; taken in April by Banks, slide 26B65.

Maryland: Thirty-nine specimens from deep layer of old leaves, Plummer's Id.; taken by H. S. Barber, slide 307o1 and -o2.

Virginia: Falls Church: Nine specimens from under rotten bark; taken April 9, by Banks, slide 26B68. Eight specimens from under loose bark of dead pine stick; taken in April by Banks, slide 26B84. Also two females taken May 2, by Banks, slide 26B67. Three specimens from under board; taken August 11, by Banks, slide 26B76. Seven specimens from under stick on ground; taken September 13, by Banks, slide 26B70. Also two females taken October 10, by Banks, slide 26B71.

Tennessee: Two specimens from moss, New Found Gap, elev. 5000 feet; taken September 1, 1930, by Banks, slide 3286o3.

Florida: One specimen from lichens on oak trunk, Sugarfoot Hammock, Gainesville; taken September 8, 1929, by J. R. Watson, slide 29W9/8. Two specimens from true moss, Sugarfoot Hammock, Gainesville; taken June 10, 1928, by J. R. Watson, slides G109G1 and -G2. Two specimens from *Daedalia ambigua* on rotten log, Worthington; taken January 13, 1929, by Watson, slide 29W1/13.

Other material: An examination of the type material shows that Banks included under this designation what is now recognized as three or four species. In choosing from among these species, which should be *Z. emarginatus,* the writer was guided by two principles, (1) to choose the species which most closely fits the original description, (2) to choose the species which was represented by the greatest number of individuals. Fortunately these two principles leave no doubt as to which species was intended, and the above description and figures are based on that species, which also happens to be the commonest species of the northeastern United States.

The remainder of Banks material has likewise been studied, so that the above list should be substituted for previous records.

Ewing (4, p. 355) described as *O. emarginata* some other large (0.89 mm.) species. Thus his records of *Z. emarginatus* must be disregarded until restudied. Two of his specimens labeled "Galesburg, Ill. 10/16/05; B.15; *Oribata emarginata* Banks" now before me, are clearly of a very different species, not even having the median pseudoforamen.

Berlese (2, p. 125, pl. 1, fig. 14) described and figured *Galumna lanceatum octopunctatum* as *O. emarginatus* from material furnished him by Ewing. Oudemans (12, p. 23) recognized the inconsistency.

For such reasons all previous records must be disregarded. How much more then should identifications of *Oribata geniculata,* and such, by early writers from various countries, be disregarded?

Oribates emarginatus columbianus (3, p. 306) characterized in 1914 (2, p. 125, osservazione) is this this species. This is the only positive record of this species known to me. It was from Columbia, Missouri.

Habitat: Primarily soft, moist, decaying wood. This species is negatively heliotropic but shows a tendency to ascend. No individuals were taken by sweeping, either day or night. Secondarily occurring in moss. They belong primarily to the forest floor but may also be found on under surface of wood and stones in moist meadows and pastures. By far our commonest species of Zetes or Galumninæ.

Distribution: Maine and Ottawa west at least to Illinois and Missouri and south through New England and Long Island to Florida.

Eggs: A maximum of six eggs was found at one time. The dates when well developed eggs were found range from March 23 to July 9 and August 11. Thus oviposition extends through the three spring months and early summer. It is difficult to say which sex is most abundant until one knows if the two sexes have different habitat habits.

Zetes emarginatus bidens *mut. nov.*

Figure 34

Diagnostic characters: As the species but anterior rim of camerostome with two vertical ridges forming two, rather short, approximate, blunt teeth, projecting beyond the rim (figure 34).

Cotypes: two specimens from lot 268o1, from under surface of boards, edge of woods of upland swamp, one mile west of East Village, Monroe, Conn.; taken June 18, 1926, slide 268o1.

I have found such specimens in various lots (3229o3, 3230o2, 261o1, see under species) usually on the average of one in fifteen. It should be remembered, however, that this character can only be recognized in lateral aspect and as many specimens are mounted on their dorsal or ventral face various individuals are taken for the species. The long single tooth of the species (a character found in other species also, though not usually so highly developed) can often be discriminated in ventral aspect but I cannot affirm that it can always be so detected.

With this interesting modification I frequently find associated the following: Size of body smaller; more densely chitinized; sculpturing of pteromorphæ more rugged; pseudostigmatic organ head pointed (figure 29); lamellar bristles more mesal.

Thus the species, in specimens from the type locality and surrounding region, is paler in color; larger; with weaker sculpturing on pteromorphæ; with blunt pseudostigmatic organ head; lamellar bristles not so far from lamellæ.

Zetes emarginatus coscobensis *var. nov.*

Diagnostic characters: As the species but pseudostigmatic organ head very slender, pointed; sculpturing on pteromorphæ very restricted; anterior bristle of genital covers almost on anterior edge; paranal bristles anterior to pseudofissuræ.

Cotypes: From lower face of stones and boards, near high tide level, shore of Indian Harbor, Coscob headland, Conn.; taken April 12, 1932, three specimens, slide 329o.

Zetes nervosus (2, p. 127, pl. 1, fig. 15)
Figures 35–36

Diagnostic characters: Pteromorphæ strongly reticulate by fine ridges along ventral half; median pseudoforamen present; lamellar bristles frontal; labium and gular area sculptured by raised granules and vermiculations; interlamellar bristles long; adalar porose areas stout cuneiform; paranal bristles at sides of pseudofissuræ; ventral edge of leg cupboards passing diagonally over center of apodemata IV and II–III.

As this species was originally inadequately described and figured, as Oudemans's figures (12, pp. 32–37, figs. 41–52) are not quite complete in all specific characters, and as Willmann's caricature (13, p. 176) leaves nearly everything to the imagination, I here include a redescription and more complete figures.

Description: Size averaging 0.58×0.46 mm., fairly high; body broadly oval (figure 35), cephaloprothorax very broad, short, with steep front, outline, seen from above, interrupted by lamellæ and a vertical groove, rostrum somewhat set off, somewhat prominent, short; rostral bristles inserted close to edge of camerostome some distance from anterior end, projecting well beyond rostrum; lamellar bristles much longer, curved, inserted a fair distance from lamellæ (figure 35), curved, reaching anteriad of rostral; interlamellar bristles long, curved, inserted near shadow of tectopedia I; lamellæ with mesal edge sharply drawn out, rather prominent, extending dorsad nearly to interlamellar bristles; anterior porose areas slender, tapering a little laterad; pseudostigmatic organs long, curved, head slender, markedly decurrent, sparsely barbed (figures 36).

Notogaster with anterior end distinct, adalar porose areas stout-cuneiform (figure 35), with two posterior pseudoforamina, mesal mesonotal porose areas large, roundish, the lateral and posterior ones elongate; a pseudofissura between mesal adalar pseudoforamina and mesal mesonotal; pteromorphæ with sparse, weak veining, groove slender, well formed but its ribs short, pseudofissuræ very fine, insertion distinct, pivot distant from angle, sculpturing projecting prominently from surface when seen in dorsoventral aspect, the ridges fine, crowded on ventral half, more widely spaced, anastomosing net-like on anterior lobe, crossing the veining at various angles.

Ventral plate wings small and slender, pointed at anterior end, broadly exposing tectopedia II laterad and posteriad, as well as lateral end of acetabuli I (see rim anterior to tectopedia II in figure 35); tectopedia II broadening posteriad, posterior corner quite sharp; tectopedia III long, slender; tectopedia IV short, broad; apodemata long, undulate even more strongly than in figure 35, mesal end of apodemata I with small knob, mesal end of apodemata II–III with short anterior and quite long posterior ceriph; apodemata IV with long, oblique, posterior ceriph, a short, anterior ceriph is sometimes developed as a continuation of the posterior; gular bristles remote, insertion of sternal bristles 1 sometimes present, other bristles much as usual (see figure 35); anterior edge of genital aperture slightly undulate, posterior edge more so, sides rather sharply converging, cover bristles 1 inserted somewhat near anterior margin, slightly nearer median than lateral edge, bristles 4 inserted on posterior edge, quite close to median edge, bristles 2 and 3 decidedly nearer median than lateral edge; paramesal bristles slightly less than narrowest diameter of a genital cover from the aperture; anal aperture much as in *Z. emarginatus;* anterior cover bristles very near anterior and median edge!, posterior cover bristles as approximate as anterior; pseudofissuræ medium long, at center of sides of aperture; paranal bristles laterad of pseudofissuræ; postanal bristles subequally spaced.

The surface sculpturing is more highly developed in this species than in any other known to me from the United States. This type of sculpturing has been so carefully depicted (12, figures 46, 48 and 52) that it is needless to repeat it. The granules on the sternal region merge into long, fine, ridges over the parasterna.

Type locality: Norway. It is also recorded on the next line as from Washington, D. C., with a length of 320 (×380), which is obviously meant for 520, a 5 and a 3 being easily confounded in cursory proofreading.

Material examined: From *Regensburg, Bavaria:* Seven specimens from moss from stumps, Dechbetten woods; taken July 27, slides 3119o2 and 3121o4. One specimen from chip of wood or dead branch on cliffy slope overhanging the Danube above Kelheim; taken August 3, slide 3127o2. One specimen from stick (or stone), fairly heavy oak, pine and spruce woods, near Walhalla; taken August 6, slide 3131o5. Two specimens from moss from sides of drainage ditch and water holes in marsh with scattered spruces, Hoher Gebraching woods; taken August 24, slide 3147o1.

America: Five specimens from rotten wood, New Canaan, *Connecticut;* taken September 20, 1919, by Philip Garman, slide 27G10. Formerly described by me as *Zetes emarginatus garmani.* Nineteen specimens from under face of wood, wood margin, foot of Indian Hill along Forest Road, New Haven, Conn.; taken August 25, 1932, slide 3247o2. Three specimens from under face of boards, Experiment Station grounds, New Haven, Conn.; taken September 25, 1932, by P. Garman, slide 3268o. Seven specimens from fungus, Santa Barbara, *Cali-*

fornia; taken in October by Brown!, slides 26B91b and -c. As these were found in company with fifty-seven *Z. elimatus* Koch (both European species) one may get a good idea of the ease with which these mites may be disseminated by man.

KEY TO SPECIES

1. Ventral and/or anterior area of pteromorphæ sculptured by granulations and/or corrugations or ridges running more or less parallel to ventral edge 7
1. Pteromorphæ unsculptured (not to be confounded with veining) 2
2. Size minute (0.3 mm. long); pseudostigmatic organ head broad, short, fringed on anterior edge and distal end with cilia longer than diameter of head .... *Z. minutus*
2. Body longer than 0.4 mm.; pseudostigmatic organ head slender, clavate or, at most, with short barbs; notogaster without posterior, median, light spot or pseudoforamen 3
3. Lateral rim of lamellæ raised and projecting laterad to form a prominent rounded rim on each side of the cephaloprothorax *Z. graminetum*
3. Lateral rim of lamellæ appressed to surface of cephaloprothorax, but mesal edge projecting as a low, sharp rim 4
4. Ventral half of pteromorphæ folded outward behind notch to form an elbowlike projection; ventral edge of leg cupboards heavily chitinized as a dark band .... *Z. niger*
4. Ventral half of pteromorphæ uniformly curved; ventral edge of leg cupboards represented by a line at most 5
5. Interlamellar bristles longer than diameter of genuals .... *Z. arboreus*
5. Interlamellar bristles shorter than diameter of genuals 6
6. Paranal bristles posterior to pseudofissuræ; lamellar bristles not extending beyond insertion of rostral bristles .... *Z. elimatus ithacensis*
6. Paranal bristles on transverse plane cutting pseudofissuræ; lamellar bristles seeming to cross rostral bristles in dorsoventral aspect .... *Z. elimatus*
7. Notogaster with a single median pseudoforamen or small porose area posterior to transverse plane of mesonotal porose areas 9
7. Notogaster without posterior, median, light spot 8
8. Corrugations extending onto distal lobe of pteromorphæ .... *Z. corrugis*
8. Corrugations not extending onto distal lobe of pteromorphæ .... *Z. c. milleri*
9. Sculpturing on pteromorphæ granular and of very fine, crowded lines 10
9. Sculpturing on pteromorphæ approximating a coarse network *Z. nervosus*
10. Paranal bristles anterior to pseudofissuræ; pseudostigmatic organ head very slender, distal end acicular .... *Z. emarginatus coscobensis*
10. Paranal bristles posterior to pseudofissuræ, pseudostigmatic organ head clavate, blunt to bluntly pointed 11

11. Anterior rim of camerostome drawn out into a strong, triangular cusp, flanked (each side) by an inconspicuous angular projection (seen in lateral view only) .... *Z. emarginatus*
11. Anterior rim of camerostome with two vertical ridges forming two, rather short, approximate, blunt teeth, projecting beyond the rim (seen in lateral view only) .... *Z. e. bidens*

LITERATURE CITED

1. BANKS, NATHAN, 1895 (Jan.), On the Oribatoidea of the United States, Trans. Am. Ent. Soc., vol. 22, pp. 1–16.
2. BERLESE, ANTONIO, 1914 (Dec. 31), Acari nuovi, Manipulus IX; Redia, vol. 10, pp. 113–150, pls. 1–4.
3. *Same*, 1916 (Dec.), Centuria Terza di Acari nuovi, Redia, vol. 12, pp. 289–338.
4. EWING, HENRY ELLSWORTH, 1909 (Sept.), The Oribatoidea of Illinois, Bull. Ill. State Lab. Nat. Hist., vol. 7, pp. 337–390, pls. 33–35, 5 txt. figs.
5. *Same*, 1909 (Oct. 8), New American Oribatoidea, Jour. N. Y. Ent. Soc., vol. 17, pp. 116–136, pls. 2–6.
6. JACOT, A. P., 1929 (Jan.), American Oribatid Mites of the Subfamily Galumninæ, Bull. Mus. Comparative Zool., vol. 69, pp. 3–37, pls. 1–6, 1 txt. fig.
7. *Same*, 1933 (Nov.), The Primitive Galumninæ (Oribatoidea–Acarina) of the Middle West, The Am. Midland Nat., vol. 14, pp. 680–703, pls. 13–14.
8. *Same*, 1934 (March), The Galumnas (Oribatoidea-Acarina) of the Northeastern United States, Jour. N. Y. Ent. Soc., vol. 42, pp. 87–124, pls. 10–12.
9. KOCH, CARL LUDWIG, 1835-44, Deutschlands Crustaceen, Myriapoden und Arachniden, Regensburg.
10. *Same*, 1842, Uebersicht des Arachnidensystems, vol. 3, Abt. 1.
11. OUDEMANS, ANTHONIE CORNELIS, 1914 (March 20), Acarologisches aus Maulwurfsnestern (Cont.), Archiv f. Naturg., vol. 79, Abt. A. Heft 10, pp. 1–69, pls. 15–18.
12. *Same*, 1919 (June), Notizen uber Acari, 26 Reihe (Oribatidea, Gruppe der Galumnæ), Archiv. f. Naturg., vol. 83. Abt. A., Heft 4, pp. 1–84, 114 txt. figs.
13. WILLMANN, CARL, 1931, Moosmilben oder Oribatiden (Oribatei), in: Dahl, Friedrich, Die Tierwelt Deutschlands, Teil 22, pp. 80–200, 364 txt. figs.

PLATE VII

Zetes elimatus ithacensis (6, p. 28), adult

Figure 1. Dorso/ventral aspects, legs and mouth parts omitted; ratio x100.

Figure 2. Pseudostigmatic organs, typical above numeral; from a Californian specimen to left of numeral; ratio x440.

Figure 3. Mouth open, showing mouth parts *in situ;* ratio x150.

Figure 4. Legs I, dorsal aspect (slightly warped laterad), lateral side uppermost, showing position of mesal tibial bristle reaching halfway across cephaloprothorax or before it, and dorsal bristle of genual reaching laterad to apex of pteromorphæ or before them.

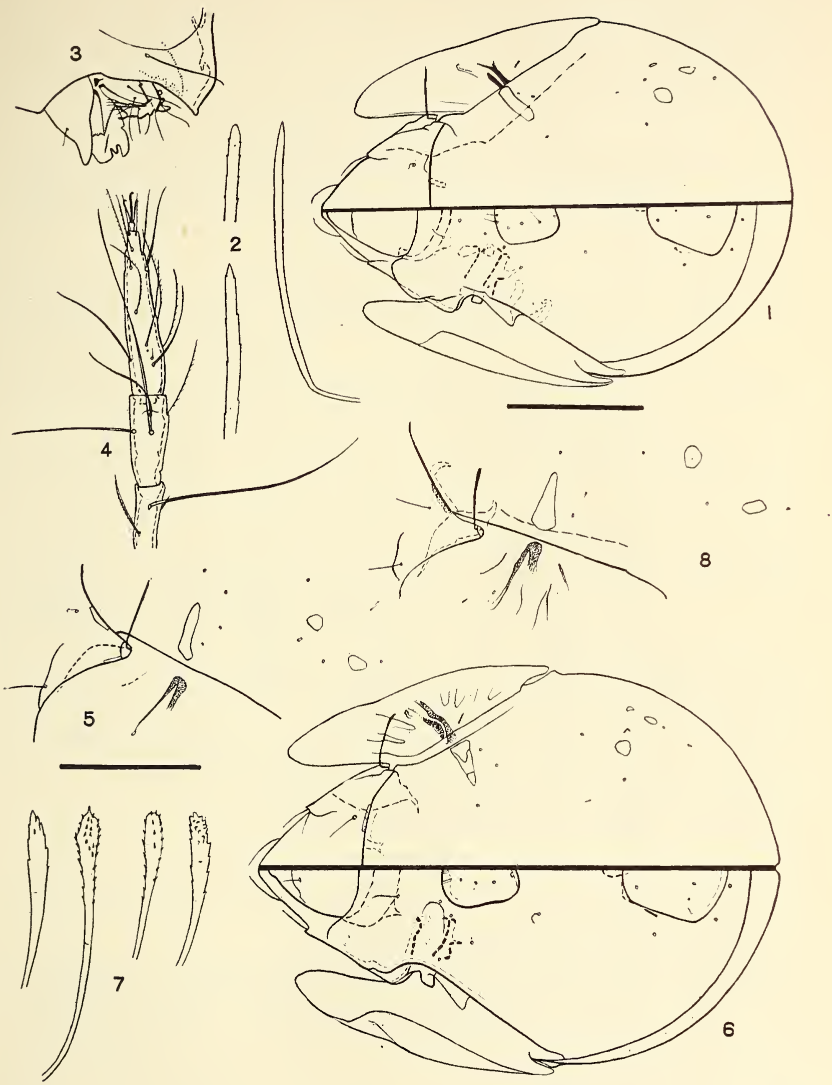
Figure 5. Dorsolateral aspect of side of notogaster, showing lamella, tectopedia I, and porose areas; ratio x100.

Zetes arboreus (6, p. 26), adult

Figure 6. Dorso/ventral aspects, legs and mouth parts omitted; ratio x100.

Figure 7. Pseudostigmatic organs, various aspects, from four individuals; ratio x440.

Figure 8. Side view showing lamella, tectopedium and porose areas; ratio x100.



ZETES

PLATE VIII

Zetes corrugis milleri *subsp. nov.*

Figure 9. Pseudostigmatic organs, figure at extreme left is from a specimen from Galesburg, Ill., possibly a little foreshortened; ratio x440.

Zetes niger (5, p. 119), adult

Figure 10. Dorso/ventral aspect, seen somewhat from behind, so as to accentuate steepness of front, mouth parts and legs omitted, ratio x75.

Figure 11. Anterior end of cephaloprothorax, viewed more anteriorly, the rostrum therefore more prominent, the frons less steep; bristles of two sides showing two usual aspects; ratio x75.

Figure 12. Pseudostigmatic organs, the one to left twisted, giving different appearance; ratio x440.

Figure 13. Lateral aspect, seen somewhat from in front and below, mouth parts and legs omitted; ratio x60.

Figure 14. Apodematal region showing how border of cupboard unites with ventral plate wing (heavy line) making an outline which corresponds with ventral edge of pteromorphæ (upper, thin line); ratio x75.

Figure 15. Femur of legs II, ventral aspect; ratio x100.

Figure 16. Legs I, lateral aspect; ratio x100.

Figure 17. Legs IV, lateral aspect, tarsus much foreshortened; ratio x100.

Figure 18. Two proximal ciliate bristles of tarsi I; ratio x440.

Figure 19. Fragment of burred bristle; free hand.

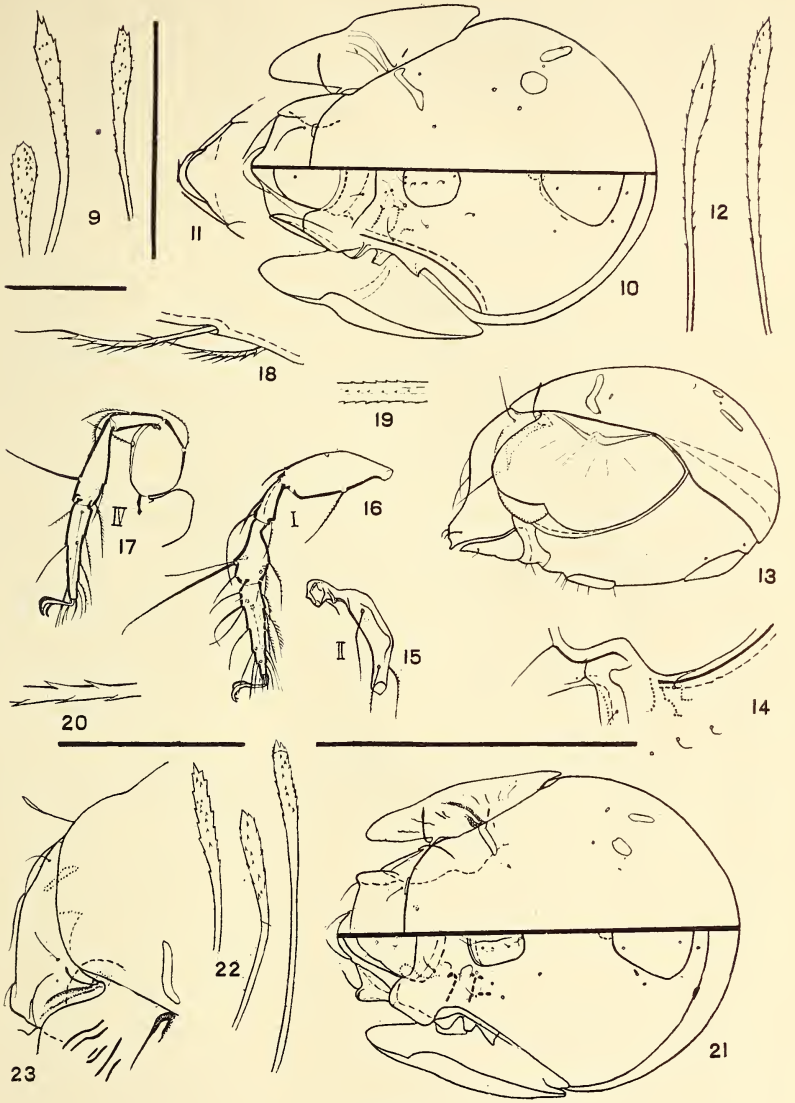
Figure 20. Fragment of barbed bristle; free hand.

Zetes graminetum *sp. nov.*, adult

Figure 21. Dorso/ventral aspects, legs and mouth parts omitted; ratio x75.

Figure 22. Pseudostigmatic organs; ratio x440.

Figure 23. Cephaloprothorax, dorso-lateral aspect, showing (1) outjutting lamella of further side, (2) lateral edge of left lamella (indicated by shaded line); ratio x100.



ZETES

PLATE IX

Zetes emarginatus (1, p. 7), adult

Figure 24. Cephaloprothorax, lateral aspect, somewhat from below, showing camerostome lip and juncture of lamellæ with ventral plate wings; mouth parts omitted; ratio x100.

Figure 25. Rostrum, dorsal aspect, with pseudofenestration; ratio x200.

Figure 26. Dorsal aspect, legs omitted; ratio x100.

Figure 27. Lateral aspect, mouth parts and legs omitted; ratio x100.

Figure 28. Ventral aspect, mouth parts and legs omitted; ratio x100.

Figure 29. Pseudostigmatic organs, from a Connecticut specimen of the *Z. emarginatus bidens* type; ratio x440.

Figure 30. *Same,* from Long Island and Connecticut specimens; ratio x440.

Figure 31. *Same,* from Virginia specimens; ration x440.

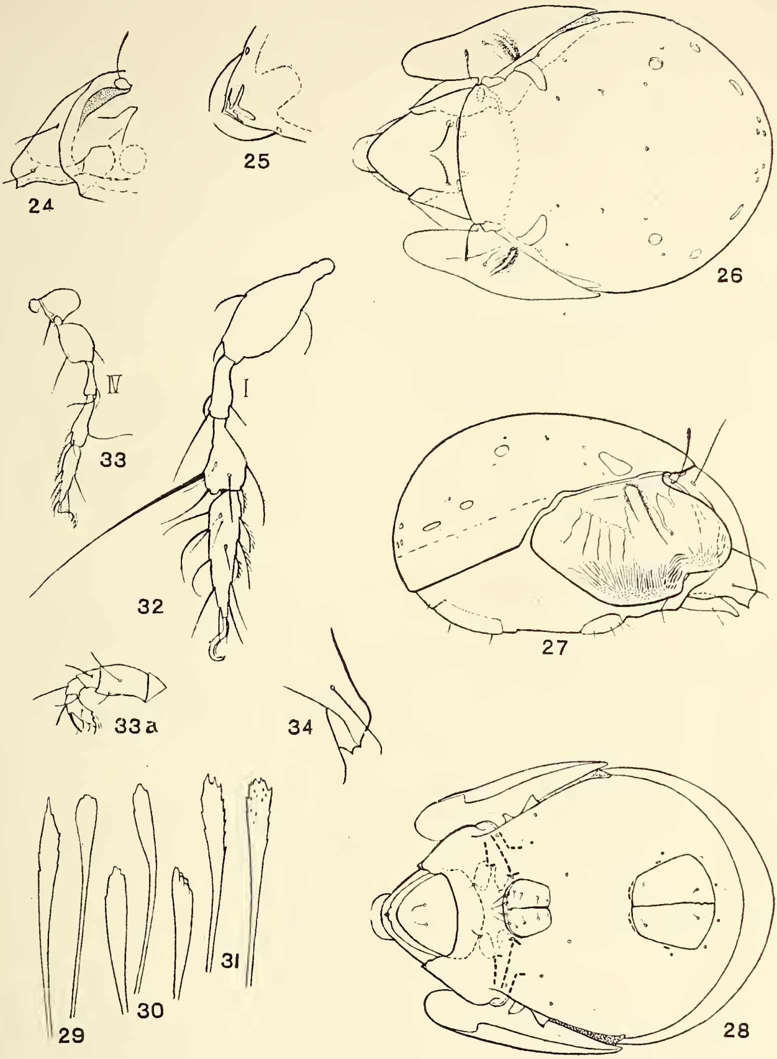
Figure 32. Legs I; ratio x200.

Figure 33. Legs IV; ratio x100.

Figure 33a. Palp; ratio x440.

Zetes emarginatus bidens *mut. nov.*, adult

Figure 34. Anterior end of camerostome, the lowest line is the top of the mandible; ratio x200.



ZETES

PLATE X

Zetes nervosus (2, p. 127), adult

Figure 35. Dorso/ventral aspects, mouth parts and legs omitted; ratio x100.

Figure 36. Pseudostigmatic organs; ratio x440.

Zetes corrugis (6, p. 28), adult

Figure 37. Dorso/ventral aspects, somewhat foreshortened, mouth parts and legs omitted; ratio x75.

Figure 38. Cephaloprothorax, cephalic aspect, slightly oblique, showing mesal and lateral edge of lamellæ and their puncture with the ental tectopedia I; note that the dorsal face of this plate is concave; ratio x100.

Figure 39. Same cephaloprothorax viewed from within, showing mandibles (in center) with their muscles attached to inner face of tectopedia I (shaded walls); trochanters I, acetabulum (lacking at right), with broken walls at left (a small part of the cephaloprothorax wall is broken away over base of right trochanter); trachea of left acetabulum I descending to and passing onto anterior side of the trochanter; ratio x200.

Figure 40. Pteromorpha; ratio x100.

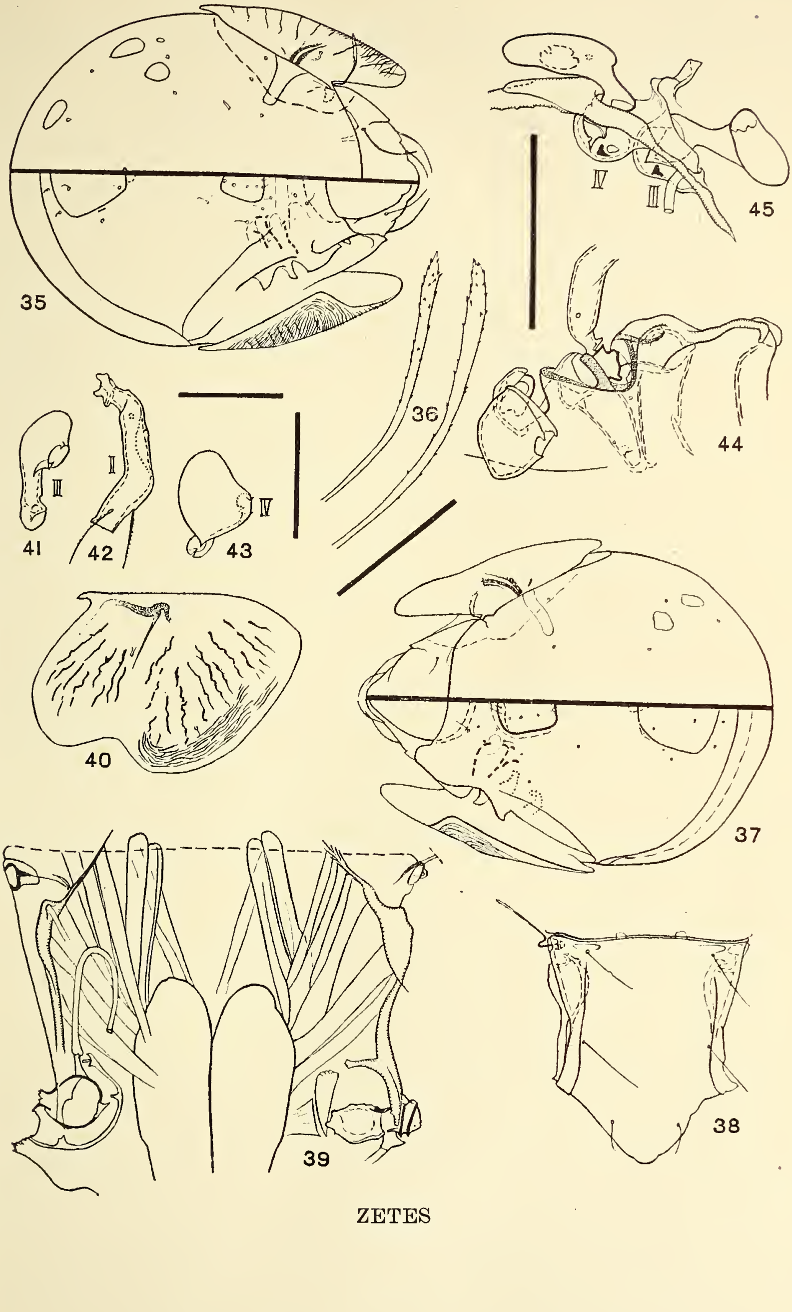
Figure 41. Trochanter III, showing two pivot articulation; ratio x150.

Figure 42. Femur II, showing high degree of curvature; ratio x150.

Figure 43. Trochanter IV, showing two pivot articulation; ratio x150.

Figure 44. Anterolateral wing of ventral plate to trochanter IV; ratio x140.

Figure 45. Trochanters, coxæ and acetabulæ III and IV; ratio x200.



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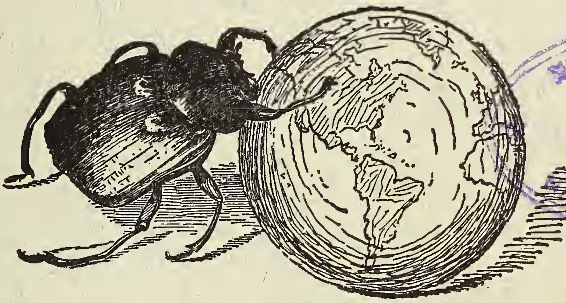

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VOL. XLIII JUNE, 1935 No. 2

A DEFENSE OF THE VIEW THAT THE GRYLLOBLATTIDS ARE DESCENDED FROM THE PROTORTHOPTERA AND LEAD TO THE TETTIGONIOID FAMILY STENOPELMATIDÆ—A REPLY TO DR. E. M. WALKER

BY G. C. CRAMPTON

It is evident that entomologists in general are becoming interested in the question of the closest affinities of Grylloblatta and its position in the general phylogenetic scheme, since Imms, 1927 (Psyche, Vol. 34, 1927, p. 36), and Silvestri, 1927–1931 (Bolletin. Lab. Zool. Scuola sup. agr., Portici, Vol. 20, 1927, p. 107, and Trans. Ent. Soc., Vol. 57, 1931, p. 291), have discussed Grylloblatta from this standpoint, and Walker, 1933 (Annals Ent. Soc. America, Vol. 26, 1933, p. 309), has recently reviewed the evidence of the head structures for placing Grylloblatta among the related Orthopteroid forms. This interest in Grylloblatta is amply justified, since it is one of the "key" forms, combining in itself many features in common with other Orthopteroid insects, and it also exhibits certain modificational trends suggestive of the precursors of certain higher insects such as the Zorapterous Psocids, certain Holometabola, etc.

Since the study of Grylloblatta is of such great interest and importance for the phylogenetic study of so many other groups of insects, no evidence of value for placing it properly in the general phylogenetic scheme should be ignored; and any views which are based upon years of study of its anatomy and that of the related Orthopteroids, etc., should not be rejected as worthless without giving some proof that these views are indeed of no value for properly placing Grylloblatta in the general phylogenetic scheme. On this account, I would object very strongly to the implications in the statement by Walker, 1933 (p. 310 of the Annals of the Ent. Soc. of America, Vol. 26 for June, 1933), who claims that "From 1915 to 1927* a number of papers by Crampton appeared dealing with the affinities of Grylloblatta. The views expressed, however, are so numerous that it would be of *little value to repeat them* here." (italics mine). This attempt to belittle my investigations of Grylloblatta is quite in line with Dr. Walker's previous attempts to give the impression that I have bandied Grylloblatta about among the various superorders of Orthopteroid insects, such, for example, as his statement on page 272 of Vol. 13 of the Annals of the Ent. Soc. of America for 1919, where he implies that in some publication (exactly where, is not revealed) I depicted the line of descent of Grylloblatta "as coming from the ancestral stock common to the Panisoptera and Panplecoptera" (which would not have been incorrect if I had actually done so), and then goes on to remark that "This view differs somewhat from former views expressed by this same author, in which he placed Grylloblatta in his superorder Panorthoptera, with the Orthoptera and Phasmoidea." What Dr. Walker means by this statement, I do not know, since I have never at any time whatsoever placed Grylloblatta in any other superorder than the Panorthoptera, from the founding of this superorder in 1917, straight through to the present time, despite Dr. Walker's attempt to give the impression that I have done otherwise! In similar vein is his implication on page 310 of the Annals of the Ent. Soc. of America for June, 1933, that I shuffled Grylloblatta about among the various Orthopteroid insects until 1927, and it was only in 1927 that I "finally" (sic) in 1927 came to the conclusion that

* In reality, I did not stop publishing on the affinities of Grylloblatta in 1927, as the wording of Dr. Walker's statement clearly implies, but continued to present fresh evidence on the subject each and every year after 1927 as well; and much of the evidence brought forward by Walker, 1933, was previously published by me many years ago, and the conclusions which I reached long since are apparently those toward which Dr. Walker is tending in his last paper.

Grylloblatta represents "a family of Orthoptera (sens. strict.) most nearly related to the Tettigoniidæ and Gryllidæ." The implication that I had never approximated Grylloblatta to the Saltatoria before 1927 is further carried out in Dr. Walker's attempt to give the impression that it was "Crampton's latest (sic) view ('26 and '27)" that Imms, 1927, combats in maintaining that Grylloblatta is nearer the Cursoria than the Saltatoria, as though I had never maintained that Grylloblatta is nearer the Saltatoria in my earlier papers published prior to 1926 and 1927! One would surely expect a fairer presentation of the facts from a fellow investigator of Dr. Walker's acknowledged ability, but anyone reading Dr. Walker's statements would most assuredly be left with the mistaken impression that prior to 1926 and 1927 I had no worth-while views concerning Grylloblatta's closest affinities, and only at that late date "finally" (sic) arrived at the conclusion that Grylloblatta is closely related to such Saltatoria as the Tettigonioids and Gryllids.

Instead of the state of affairs pictured by Dr. Walker, the actual facts are that: (1) In the very first of my discussions of the systematic position of Grylloblatta published nineteen years ago (in 1915) and in my last discussion of the same subject last year (in 1933), I placed Grylloblatta at the base of the lines of descent of the katydids (Tettigonioids) and crickets (Grylloids) which merge in such Stenopelmatids as Gryllacris, etc., the principal difference between the first opinion and the last one being that I at first regarded the Grylloblattids as the representatives of a distinct order (the Notoptera) at the base of the lines of descent of the Saltatoria, while in the last paper I treated the Grylloblattids as the representatives of a suborder (Notoptera) of Orthoptera at the base of the lines of descent of the same Saltatoria. (2) In establishing the superorder Panorthoptera seventeen years ago (in 1917) I grouped the Grylloblattids with the Saltatoria and Phasmids, and expressly stated at that time, that within the superorder Panorthoptera the closest allies of the Grylloblattids are the crickets and katydids (which merge in such Stenopelmatids as Gryllacris, etc.), and, despite the statements of Dr. Walker to the contrary, I have never removed the Grylloblattids from their position in the superorder Panorthoptera. (3) Instead of tending to remove the Grylloblattids from the vicinity of the Saltatoria, as Dr. Walker intimates that I have done, for the past dozen years (since 1922) I have maintained that the Grylloblattids and Saltatoria are so exceedingly closely related that they alone should be included in the order Orthoptera, which should be restricted to them alone, and all other insects should be excluded from this order Orthoptera in the restricted sense. This is quite the opposite of the treatment of the order Orthoptera by Dr. Walker, who in 1920 restricted the order Orthoptera to the Saltatoria alone, while in his latest paper (published in 1933) he drastically changes his views on the subject, and now includes in his order "Orthoptera" a number of rather distantly related forms, such as the Isoptera, Saltatoria, Blattids, Mantids and Grylloblattids (by implication), which might more profitably be grouped into two distinct superorders, instead of being lumped in a single order. (4) For the past decade (since 1924) I have maintained that the Grylloblattids arose from the Protorthoptera which represent the precursors of the Grylloblattoid ancestors of the Saltatorial Orthoptera, and all of the previous comparisons of the Grylloblattids with the Isoptera, Embiids, Dermaptera, etc., were made with the view of determining what *lower* forms more nearly represent the *ultimate* origin of the Gryllablattoid ancestors of the Saltatoria, instead of removing the Grylloblattids from their position at the base of the lines of descent of the primitive Saltatoria, as the wording of these discussions will clearly indicate, and as the composition of the orders and superorders of Orthopteroid insects proposed in these papers will clearly prove.

A few quotations from the papers dealing with the taxonomic position of Grylloblatta in the general phylogenetic scheme will serve to prove the correctness of these contentions, and will likewise serve to indicate what other views have been proposed concerning the position of Grylloblatta and the interrelationships of the Orthopteroid orders, by other investigators.

Nineteen years ago it was stated on page 344 of the "Entomological News" for October, 1915, that "The cricket and katydids approach one another in such forms as Gryllacris, and have apparently descended from a common stock. This common stock, in turn, was derived from forms not unlike the Grylloblattidæ—in other words, the Grylloblattidæ have not greatly changed from the ancestral forms, although they of course have developed modifications of their own as is true of all forms now living.'' This early placing of Grylloblatta at the base of the lines of descent of the lower Saltatoria which merge in such Stenopelmatids as Gryllacris, etc., is not essentially different from my last statement on the same subject on page 127 of the ''Journal of the New York Entomological Society'' for June, 1933, where I maintained that the Grylloblattids' ''closest affinities (among living forms—*i.e.,* excluding the fossil Protorthoptera) are with the saltatorial family Stenopelmatidæ, rather than with the cursorial family Blattidæ (sensu lato), with which they are allied by Silvestri, 1927 and 1931, and by Imms, 1926 and 1927, (both of whom follow Walker, 1914, in this matter).'' These quotations should prove that from first to last I have placed Grylloblatta at the base of the lines of descent of the primitive Saltatoria which merge in such Stenopelmatids as Gryllacris, etc., and it is indeed strange that an investigator of Dr. Walker's exceptional ability could fail to recognize this patent fact, and could so misrepresent my position in the matter as he has done in the previously cited paper (Walker, 1933) where he implies that after approximating Grylloblatta to various other Orthopteran insects I ''finally'' in my ''latest paper ('27)'' came to regard Grylloblatta as ''most nearly related to the Tettigoniidæ and Gryllidæ.'' (l. c. p. 310). Dr. Imms, at any rate, had no difficulty in realizing that I had long regarded Grylloblatta as more closely related to the Saltatoria than to any other Orthopteroid insects, since he states on page 36 of ''Psyche'' for Feb., 1927, that ''In so far as the main characters are concerned, Walker considered that they are nearest allied to the family Blattidæ of the Orthoptera Cursoria. The present writer (1925) also maintained that the Grylloblattidæ are more closely related to the Cursoria than to the Saltatoria. On the other hand, Crampton in his most recent publication (1926) on the subject emphasizes his *previous opinion* (italics mine) that the family should be placed along with the Orthoptera Saltatoria.'' Dr. Imms stresses the anatomical resemblance between Grylloblatta and various other Orthopteroids, which I had previously emphasized, but in so doing he does not misinterpret this as an attempt on my part to bring the Grylloblattids nearer to these other forms than to the Saltatoria, realizing, as anyone should, that the comparison of Grylloblatta with other Orthopteroids was made merely for the sake of determining the nearest living representatives of the ultimate origin of the Grylloblattoid ancestors of the Saltatoria. If Dr. Walker would be willing to state my views as fairly as Dr. Imms has done, there could be not the slightest cause for protest, despite the fact that Dr. Imms and I hold widely divergent opinions concerning the closest affinities of the Grylloblattids, and despite the fact that Dr. Walker seems to be coming to essentially the same opinion as that long held by me, in his latest paper!

Lest anyone be led to think that it was only in my first and last papers on the subject that I placed the Grylloblattids at the base of the lines of descent of the primitive Saltatoria which merge in such Stenopelmatids as Gryllacris, etc., I would cite the following quotations from numerous other papers published in between the first and last ones on the subject, so that the reader may judge for himself whether or no Dr. Walker is justified in implying that my views on the position of Grylloblatta in the general scheme are too vague to be of any value, instead of acknowledging that I have long fought for the view that Grylloblatta's closest allies are the primitive Saltatoria. Thus, for example, on page 232 of the "Journal of the New York Entomological Society" for December 1917, I stated that "Within the superorder Panorthoptera, the Grylloblattids are apparently nearer the Gryllid-Locustid group, while the Phasmids are somewhat nearer to the Acridids." Again on page 231 of the "Canadian Entomologist" for October, 1922, I referred to "The saltatorial Orthoptera (with which the Grylloblattids may be included)," thus allying the Grylloblattids even more intimately with the Saltatoria in a single *order,* instead of merely placing the Grylloblattids next to the primitive Saltatoria in the same *superorder.* On page 89 of the "Journal of the New York Entomological Society" for June, 1923, I pointed out that "The character of the cardo, stipital region, lacinia and galea of the maxilla of Grylloblatta would lend weight to the view that it is closely related to the true Orthoptera . . . rather than to the claim made by other investigators who would place Grylloblatta nearer the Blattids and Mantids,'' and here long anticipated Dr. Walker's later comparison of the maxilla of Grylloblatta with that of the saltatorial Orthoptera (Walker, 1933, Annals. Ent. Soc. America, Vol. 26, p. 327) although Dr. Walker refuses even to cite this paper in his bibliography! On page 45 of the ''Pomona Journal of Entomology and Zoology'' for 1924, I clearly stated that ''I would group Grylloblatta with the Orthoptera, sensu stricto, and would derive these from the Prothoptera,'' and on page 78 of ''Psyche'' for June, 1926, I again stressed the fact'' that Grylloblatta is practically a living Protorthopteron very closely related to the common stock from which sprang the Tettigonioid and Grylloid Orthoptera, and the closest affinities of Grylloblatta are with the Tettigonioids.'' Again on page 130 of the ''Pan Pacific Entomologist'' for January, 1927, it is stated that ''The Grylloblattids have departed but little from the Protorthopteroid ancestors of the Orthoptera in general, and their nearest relatives are the Tettigoniidæ (a misprint for Tettigonioidea) the lowest representatives of which are the Gryllacridæ,'' and on page 22 of the ''Bulletin of the Brooklyn Entomological Society'' for February, 1932, it is stated that ''the Grylloblattids are evidently members of the order Orthoptera in the restricted sense (*i.e.*, the Saltatoria or Euorthoptera* and Grylloblattids called Notoptera or Archorthoptera),'' and on page 25 it is claimed that in all probability ''the Acridoidea were descended from forms like the Tettigoniidæ, which lead back to the Gryllacrids and Stenopelmatids from which the Gryllids were descended, and all of these lead back to forms like the Grylloblattidæ.'' These passages written without any idea of quoting them at some later date will, nevertheless, indicate very clearly that I have long maintained the only correct view concerning the affinities of Grylloblatta and its proper posi-

* I do not consider that the Grylloblattids represent merely a ''family'' of Orthoptera, as Walker, 1933, states, but, as is indicated by this reference, I consider that the Grylloblattids are the representatives of a *suborder* of Orthoptera (the Notoptera), while the Saltatoria represent a second suborder.

tion in the general phylogenetic scheme, and I am convinced that Dr. Walker himself will eventually reach the same conclusion regarding the position of Grylloblatta, since the statements in his latest paper (Walker, 1933) indicate as much, although no one who reads his statements in the paper cited above would ever conclude that I have long maintained such a view regarding the affinities of Grylloblatta—or that I even had any definite ideas on the subject at all! The quotations given above, however, will speak for themselves, and the reader can draw his own conclusions in the matter.

Prior to 1917, no one had attempted to group the living Orthopteroid insects into three distinct superorders to express their more intimate interrelationships, *inter se,* and there was still much uncertainty concerning even such a fundamental matter as to what constitutes an Orthopteroid insect in the strict sense of the term. To such entomologists as Banks, and others, for example, the Isoptera were "Neuropteroid" insects (although Wheeler, Holmgren, and others before them, had indicated that the Isoptera are closely related to the Blattids), and even such acknowledged authorities as Comstock, in his various textbooks had separated the Orthopteroid order Plecoptera from the rest of the Orthopteroids and grouped it with the unrelated Ephemerids and Odonata as "Hemimetabola," following the European taxonomists who grouped the Plecoptera, Ephemerids and Odonata as "Amphibiotica," etc. Walker, 1920 (page 137 of Vol. 13 of the Annals of the Ent. Soc. of America for March, 1920), in discussing the life cycle of the Orthopteroid orders, similarly placed the Plecoptera with the Ephemerids and Odonata in a distinct group of insects, but regarded these unrelated forms as a subdivision of "Orthopteroid" insects into which the Orthopteroids might be divided, while a second subdivision of "Orthopteroid" insects was made to include the rest of the Orthopteroids together with the Zoraptera (which he separated from the Psocids), the Psocids and the Mallophaga. Used in this sense, the designation "Orthopteroid" would include most of winged insects excepting the Holometabola, etc. Finding such groupings as these of no phylogenetic value for correctly expressing the lines of descent of the various Orthopteroids and their interrelationships among themselves, seventeen years ago (in the March, 1917, issue of the Ent. News, Vol. 28, p. 408) I erected three superorders of Orthopteroid insects to express their more intimate interrelationships, and grouped the Blattoid, Mantoid and Isopterous insects into one superorder (the Pandictyoptera—later changed to *Panisoptera*), while the Embioid, Forficuloid and Plecopterous insects were placed in a second superorder (the *Panplecoptera*) and the remaining living Orthopteroids such as the Phasmoid, Grylloblattoid and Orthopterous insects were placed in a third superorder (the *Panorthoptera*); and despite statements by Dr. Walker to the contrary, I have never placed the Grylloblattids in any other superorder at any time whatsoever, although if Dr. Walker had mentioned the *Dermaptera* instead of the Grylloblattids (which he did not do) he would have been quite right in stating that I had altered my opinions concerning the position of the *earwigs,* since these puzzling Orthopteroids gave me no end of trouble, although as early as 1922, on page 215 of the "Canadian Entomologist" for September, 1922, I grouped the Dermaptera in their proper superorder with the Phasmids, Grylloblattids and saltatorial Orthoptera (as Panorthoptera)—and on the same page I referred to the Grylloblattids as "very primitive Orthoptera closely related to the Protorthoptera and the Protoblattids." Ever since this time, and with ever increasing emphasis, I have insisted that the Grylloblattids and Saltatoria alone make up the order Orthoptera, and this restricting the order Orthoptera to the Saltatoria, or at most to the Grylloblattids and Saltatoria alone, is in marked contrast to the treatment of his "order" Orthoptera in Dr. Walker's various and radically divergent opinions as to what forms should be included in his "order" Orthoptera (or what forms should even be classed as "Orthopteroid"). Thus in 1914 (on page 96 of the "Canadian Entomologist" for March, 1914), Dr. Walker evidently considered that his "order" Orthoptera should include the "families" Hemimeridæ (and by implication the Forficulidæ also), Blattidæ, Mantidæ, Phasmidæ, Grylloblattidæ, Gryllidæ, Tettigoniidæ, Locustidæ, etc., thus comprising about all of the living true Orthopteroids except the Isoptera (later also included in his "order" Orthoptera) and likewise excepting the Plecoptera, which were more closely associated with the Odonata and Ephemerida in Dr. Walker's early papers (although the Ephemerids, Odonata, Psocids, Mallophaga, etc., were also regarded as "Orthopteroid" insects by him). During the next few years, Dr. Walker's views evidently underwent a most drastic change since in 1920 (page 137 of the Annals Ent. Soc. America for March, 1920) all the forms formerly placed in his order Orthoptera, with the exception of the Saltatoria, were cast bodily out of the order, and he then restricted the order Orthoptera to the Saltatoria alone—which after all was not a bad move if he had only stuck to it! (The Odonata and Ephemerids, Psocids, Mallophaga, etc., are likewise included among his "Orthopteroid orders" in this paper, however, and this could be less easily justified). In his latest paper, in 1933, however, (on page 311 of the Annals Ent. Soc. America for March, 1933) Dr. Walker now makes his "order" Orthoptera to include a new combination of forms, such as the Isoptera, Blattidæ, Mantidæ, Phasmatodea, Saltatoria and (by implication) the Grylloblattoidea, etc. (The Odonata and Ephemerids are now however omitted from the discussion of the Orthopteroid orders). This seems to me to be a very inadmissible step backward, and in any case is wholly different from the views Dr. Walker published around 1920, but I would not seek to imply that on this account Dr. Walker's views are too vacillating to be of any value, nor would I attempt to detract from the great value of Dr. Walker's fine work on Grylloblatta and its proper position in the general phylogenetic scheme—especially since I believe Dr. Walker's own excellent studies will eventually convince him of the correctness of the conclusions concerning the position of Grylloblatta in the general phylogenetic scheme, which I have maintained for more than a decade—which is surely long enough to establish the authorship of one's maturer views! At any rate, the conclusions published in Dr. Walker's latest study of the head and its appendages in Grylloblatta and related Orthopteroids (Annals Ent. Soc. America, Vol. 26, 1933, p. 309) are almost identical with those which I have drawn from a study of almost exactly the same structures, during the past decade, despite the fact that Dr. Walker considers that my maturer views are of too "little value to repeat them" (as he expresses it) in the paper in which he records his own views on the subject; and although his latest views may differ from the earlier ones published by him, I consider that his maturer opinions are well worth repeating here, as lending additional support to the views which I have maintained for more than a decade concerning the origin and closest affinities of Grylloblatta and the related Orthopteroids. My chief objection to Dr. Walker's recent views would be that the Isoptera and Dictyoptera (Blattids and Mantids) should not be included in the same order with the Grylloblattids and Saltatoria, since I consider that the interrelationships of these insects, *inter se,* can be best expressed by grouping them into two superorders, as I have discussed in various papers from 1922 onward, with ever increasing emphasis upon the fact that the Grylloblattids lead back to the Protorthoptera and lead forward to the Tettigonioid Stenopelmatids such as Gryllacris, etc. The Protoblattids and Protorthoptera merge so imperceptibly that they constitute a single order (the Protorthoptera) in the taxonomic sense of the term, and from the systematic standpoint, the Protoblattids and the insects usually classed as Protorthoptera by Handlirsch (who, however, includes a very motley aggregation in his order Protorthoptera) would be more correctly regarded as merely suborders of the Protorthoptera (sensu lato) but for convenience in tracing the lines of descent of the various Orthopteroid groups to their ultimate Protorthopteroid ancestors, I formerly followed Handlirsch in treating the Protoblattids and Protorthoptera as distinct orders.

Dr. Walker does not attempt to determine the nature of the more immediate ancestors of the Protorthopteroid precursors of the Grylloblattids in his latest paper, but the description of Synarmogoge by Handlirsch, 1909 (Die fossilen Insekten), would indicate that the Protorthopteroids lead back to such forms as Synarmogoge instead of leading more directly to the Palæodictyoptera, as many entomologists seem to think; and a realization of this fact would prevent the assigning to the Ephemerids and Odonata of a position near the Orthopteroids, since the Ephemerids and Odonata arose from very different ancestors from

Synarmogoge which is at the base of the lines of descent of the true Orthopteroids (including the Protorthoptera and other fossil forms such as Hadentomum, Metropator, and many others).

The Ephemerids and Odonata arose more directly from the Palæodictyoptera (through such intermediate forms as the Protephemerids, Protodonata, etc., described by Handlirsch) and all of these insects constitute a subdivision of Pterygotan insects which may be called the Paleopterygota (since my former term for them, the Archipterygota, is preoccupied, as is Martynov's term ''Paleoptera'') and are characterized by their inability to lay the wings back along the top of the abdomen in repose, by the development of at most one or two basal wing plates (pteralia or axillary sclerites), by the absence of a neala, and other features. All of these Paleopterygota lead off in a totally different direction from the lines of descent of the Orthopteroids, which are connected with the Palæodictyopteroid forms only by way of Synarmogoge. The Orthopteroids in turn gave rise to the Hemipteroid (or Psocoid) and Holometabolous insects, and all of these constitute a second subdivision of Pterygotan insects called the Neopterygota (Martynov's term ''Neoptera'' was long ago preoccupied by Woodworth, 1908) characterized by their ability to lay the wings along the top of the abdomen in repose, by the presence of four or more wing plates, by the development of the neala, etc. This division of the Pterygota into Paleopterygota and Neopterygota is the really fundamental one, and brings together the forms which have a common ancestry and a common phylogenetic history, while the division of winged insects into Endopterygota and Exopterygota which Dr. Walker adopts in his latest paper (where he refers to the Exopterygota as though it were a natural group) is utterly meaningless from the phylogenetic standpoint, and should be abandoned if we are to group insects according to their closest affinities and community of descent—which after all is the sole aim of any phylogenetic study! When one really studies the matter he soon realizes that the division of winged insects into Endopterygota and Exopterygota is phylogenetically meaningless because it groups the Hemipteroid and Orthopteroid insects with the Odonata and Ephemerids, which had a wholly different origin, and separates the Hemipteroids and Orthopteroids from the Holometabola which had a common Orthopteroid ancestry. Anyone who knows that such Hemipteroid insects as the Aleyrodidæ have wings which develop internally in their larval stages and become external only in the pupal stage of the Aleyrodids, as the wings do in the Holometabola, would soon realize that the method of origin of the wings is of no value for grouping insects together, and would at once abandon a grouping which separates the Hemipteroids from their close relatives the Holometabola and groups the Hemipteroids with the unrelated Odonata and Ephemerids, as the meaningless division of winged insects into Exopterygota and Endopterygota does! The division of winged insects into Paleopterygota and Neopterygota, however, groups together the Holometabola, Hemipteroid and Orthopteroid insects, all of which had a common Orthopteroid ancestry, and separates these from the Odonata and Ephemerids which had a common Palæodictyopteroid ancestry as I pointed out a decade ago (in the June, 1924, issue of the Pomona Journal of Ent. and Zoology, p. 33) in a paper published a year after Prof. Martynov had called attention to a similar division of insects in a paragraph written in Russian and published in a Russian magazine which I had not seen. Unfortunately both of the terms "Paleoptera" and "Neoptera" which Prof. Martynov applied to his divisions of winged insects were preoccupied by Dr. Woodworth in 1908, and by myself in 1915, so that they were not available for application to the division of winged insects first proposed by Prof. Martynov in 1923; but these divisions are fundamental and phylogenetically sound, and with the designations slightly emended (to Paleopterygota and Neopterygota) to avoid using the preoccupied terms Paleoptera and Neoptera, these divisions should supersede the phylogenetically meaningless division of winged insects into Endopterygota and Exopterygota.

Although Dr. Walker in discussing Grylloblatta's position in the general phylogenetic scheme does not go so far as to attempt to derive the higher Orthopteroids from a Grylloblattoid ancestry, I am convinced that further studies on his part will lead him to conclusions essentially similar to my own in this matter, since it is quite evident that the closest allies of the Grylloblattids are the Stenopelmatidæ (including the Gryllacrinæ, Stenopelmatinæ, etc.) which may be included with the Phasmodidæ, Tettigoniidæ, etc., in the superfamily Tettigonioidea. The Grylloidea (including the Gryllidæ, Gryllotalpidæ, etc.) apparently arose from ancestors like the Stenopelmatidæ, and such Stenopelmatids as Gryllacris, etc., are very like the forms giving rise to the Tettigoniidæ, which in turn lead to the Acridoidea, so that the main paths of evolution, leading from the Synarmogage-like forms, at the base of the lines of descent of the Orthopteroid insects, through the Protorthoptera (in the broad sense of the term) to the Grylloblattoid ancestors of the higher Orthopteroids, and through forms like the Stenopelmatids to the Grylloids, on the one hand, and by way of the Tettigoniidæ to the Acrididæ on the other, have been mapped out in their essential features; and the orders of living Orthopteroid insects have been grouped in a manner indicating their true closest affinities, despite the fact that Dr. Walker implies in his last paper, that the "exact relationships" of the Grylloblattids to the other Orthopteroids and the interrelationships of the other forms are yet to be determined.

In order to preclude all possibility of claiming that the Grylloblattids and their Orthopteroid relatives have never been definitely assigned to their proper positions in the successively higher categories, such as suborders, orders, superorders, sections, divisions, subclasses, etc., of related forms in the general phylogenetic scheme, I would briefly sketch the phylogenetic scheme into which the Grylloblattids have been fitted for many years; and in order that there may be no possibility of misunderstanding the meaning of these groupings, I would emphasize the fact that the members of each successively more inclusive group are more closely related to each other than they are to the members of any other group of equal rank. The position of the Grylloblattids in these successively higher categories is as follows:

As representatives of the Orthopteran suborder *Notoptera,* the Grylloblattids are included in the order Orthoptera, which likewise includes the suborders *Saltatoria,* etc.

As members of the Panorthopteran order *Orthoptera,* the Grylloblattids are included in the superorder Panorthoptera, which likewise includes the orders *Dermaptera,* *"Phasmida,"* etc.

As members of the Paurometabolan superorder *Panorthoptera,* the Grylloblattids are included in the section Paurometabola (sensu lato), which likewise includes the superorders *Panplecoptera, Panisoptera,* etc.

As members of the Neopterygotan section *Paurometabola,* the Grylloblattids are included in the division Neopterygota, which likewise includes the sections *Parametabola* (Hemipteroid insects) and *Holometabola.*

As members of the Pterygotan division *Neopterygota,* the Grylloblattids are included in the subclass Pterygota, which likewise includes the division *Paleopterygota,* etc.

As members of the Insectan subclass *Pterygota,* the Grylloblattids are included in the class Insecta, which likewise includes the subclass *Apterygota,* etc.

As members of the Antennatan class *Insecta,* the Grylloblattids are included in the subphylum Antennata, which also includes the classes *''Myriopoda''** and *Crustacea.*

As members of the Arthropodan subphylum *Antennata,* the Grylloblattids are included in the phylum Arthropoda, which likewise includes the subphylum *Chelicerata,* etc.

This enumeration of the successively higher categories in which the Grylloblattids may be included could be greatly extended, but the groupings given above will serve to place the Grylloblattids definitely and precisely in their proper position in the general phylogenetic scheme, and will serve to indicate their closest affinities in a manner which no one who is at all familiar with evolutionary groupings can fail to understand; and I feel confident that Dr. Walker's further investigations of the subject will serve to confirm the essential correctness of the groupings sketched above!

* Recent zoologists tend to divide the ''Myriopoda'' into classes called Chilopoda, Diplopoda, Symphyla, Pauropoda, etc., but this has no bearing on the position of the Grylloblattids in the general phylogenetic scheme.

SOME BASIC PRINCIPLES OF INSECT WING VENATION

By James G. Needham

The two things primarily involved in the making of the venation of insect wings are hypodermis and tracheæ. Two other things are present: blood, bringing food and removing wastes, here as elsewhere; and nerves, maintaining lines of communication between all peripheral parts and the control centers. But blood is a fluid, and nerves are tissue lines of excessive tenuity and softness; and I know of no reason for thinking that either has anything to do directly with determining the pattern of the venation.

1. Trachae

I begin where veins begin, with tracheæ. In the nymphal wings of all the more generalized insects tracheæ grow out first and later the veins are developed about them. When the two layers of the wing sac fuse to form the wing membrane, the cylindric, tænidia-lined tracheæ keep them apart as passageways for blood and air.

Tracheæ lay down the pattern of the long veins. It is at first a simple pattern of gently undulating forks, but later it becomes complicated by conjunctions and by shifting. The veins of many of the oldest fossil insects, the Palaeodictyoptera, run across the wings forking quite after the manner of tracheæ, in relative independence and without strong cross connections.

In the nymphs of stoneflies whose wings are of the simplest sort, externally developing and growing to relatively large size, the correspondence between veins and tracheæ is very close, extending to almost every detail. It is only a little less close in other insects whose wings develop freely to the outside. Deviations from this correspondence are for cause. Tracheæ in their development tend to follow ancestral paths in absence of anything to turn them aside; and the veins continue to be laid down on the same old lines even after tracheæ have been suppressed.

The insect wing begins as the fold of skin, not very different from the fold that occurs whenever the margin of one segment overlaps another segment. This low broad fold elongates and becomes triangular as it extends to rearward, increasing in size with each successive moult. Always it is a simple flattened sac, containing no viscera. Its lumen is an extension of the body cavity. The blood of the body enters and brings it food. Tracheæ enter and bring its tissues oxygen.

Moulting, which allows for expansion of the external cuticle, also allows for extension of the tracheæ; for at each moult the gas contained in the lining of the trachea is withdrawn with that lining from the body. The soft tracheal walls are for the time being filled with fluid. Reinflation follows. Gases forming in the tissues are taken up first in some of the larger tracheal trunks. As the increasing volume of gas pushes each way along the trunk and into the branches it enters the wing and fills out and extends, more completely with each moult, those tracheæ which will compose the final pattern.

Tracheæ enter the wing bud from two sources, front and rear. It is probable that in the beginning the branches were numerous, and that a struggle for existence occurred among them like that of the sprouts of the stump of a felled tree—a struggle for place and standing room. Those most advantageously situated were near the middle of the wing, where the outward extension of the wing sac is greatest, and where the crowding of the corners is least. At any rate the middle tracheæ of the wing, R, M, and Cu, remain the largest and most regular in their type of branching. They constantly recur in like number, form, and relation, and so, bear the usual earmarks of homology.

The two primary groups of tracheæ have remained separate in nymphs of Plecoptera, and of some of the Blattidæ. In most insects they are conjoined by a basal anastomosis into one common alar trunk from which all the wing tracheæ arise. Two groups are still indicated by their basal curvature; an anterior costo-radial group, and a posterior cubito-anal group, with the median trachea, originally a member of the former group, vacillating between. It was the discovery of this fundamental tracheal plan that brought the interpretation of the venation of the orders Plecoptera, Orthoptera, Corrodentia, Hemiptera, Neuroptera and Lepidoptera into line, and placed the system upon a firm morphological basis.

The wings of insects are of extraordinary diversity, and it is not surprising that they differ in tracheation. In order to find primitive conditions it is necessary to study the more generalized members of each order; for, with specialization, tracheæ, like other organs, may be diverted or even largely suppressed. The costal trachea early disappears and at both edges of the wing base tracheæ tend to be conjoined.

When the growth of the wing is retarded as in complete metamorphosis, the entrance of the tracheæ is delayed. Wing buds (''imaginal discs'') of microscopic size, retained beneath the larval skin, are adequately supplied with air by tracheoles. These spring from adjacent tracheæ and press for entrance at the base of the incipient wing fold in tangled skeins. They ''storm the doors'' so to speak; but there is as yet no standing room inside. Only when the wing bud is released by the loosening of the larval cuticle is there space within the fold that tracheæ may enter. Tracheæ are open tubes that must not be compressed if they are to fulfill their respiratory function.

Even with complete metamorphosis there is gradation. In the Sialidæ the correspondence between veins and tracheæ is very close. All grades of diversion may be found in the Lepidoptera, while in the Diptera and several other orders tracheation is so modified as to be of no aid in determining homologies. In all such specialized forms wing growth is greatly retarded. The larval wing buds are very minute. Vein development is begun before the tracheæ can enter, the wing base is narrow, and the wing sac is open so that they are quite free to wander. All that remains of their primitive arrangement is their proceeding from two sources of the wing base.

That this should be true of the Trichoptera is not surprising when we remember that the wing buds of the larvæ are minute: they develop under the protection of the caddis; and the two layers of the wing sac remain apart until long after the tracheæ have entered. The more generalized Trichoptera have a venation pattern almost identical with that of certain Jugate Lepidoptera which have the tracheation complete and normal.

An effort has been made to cast doubt upon the validity of all evidence from tracheæ because of the fact that they are of no use in determining homologies in the Trichoptera. It is as if a mammalogist were to say that because whales have no teeth, phylogenetic evidence from mammalian dentition may be disregarded.

II. HYPODERMIS

The chitin of the wing is produced by the hypodermis, and in the beginning this does not differ from that of the adjacent body wall. The wing is in origin an outgrowing fold. As its surface expands chitin tends to be condensed around the tracheæ, forming veins. Between the tracheæ it forms a meshwork of irregular ridges enclosing areoles of thinner membrane. This is the *archedictyon,* or ancient network of Tillyard.

An archedictyon filled the interspaces in the wings of the most ancient fossils. It is still present in some Megaloptera, in the tegmina of many Locustidæ, and in the less expanded parts near the base of the wing in other Orthoptera. Net-veined expansions of cuticle occur elsewhere than on wings; as, for example, in the flat lateral prothoracic plates of the Tingitidæ. Clearly the archedictyon is primitive.

The two hypodermal layers of the developing wing sac are at first separate, but they become fused together as development proceeeds. Fusion first occurs midway of the tracheal interspaces. It gradually spreads until the tracheæ are inclosed in well-defined channels. Blood circulates in these channels and nerves lie in their walls. About them the chitin thickens to form the principal veins. Cross channels between them, at first irregular and containing only tracheoles, become the crossveins.

Hypodermis builds the veins. It builds them in the beginning around tracheæ; and at the last, even when tracheæ have been crowded out or retarded and shifted, it builds them into a framework that has for its basis the old tracheal pattern.

Vein building is a process of selective scleritization. The hypodermis at the later moultings deposits its hard substances in veins and crossveins, leaving the interveing membrane thin. It first encloses the tracheæ where they lie, and then it bends them into the shape of the veins that are to be, and binds them with strong chitinous braces. Thus it puts the strength-giving material of the wing into positions of mechanical advantage. Often it binds adjacent parts of two tracheæ into a single vein.

Hypodermis builds the basal articulations of the wing. There was skin before there were sclerites. Selective deposition of the harder material made the basal sclerites and the apodemes thick and left the sutures between them thin: thin and resilient.

III. WING SHAPING

Insect wings may have developed from parachute-like expansions of the thoracic wall, which once served only for gliding. To become wings these glider planes would have to become articulated at the base and narrowed and strongly supported there. Muscles that once served for adjusting the inclination of the planes might become adapted to moving the wings up and down.

Situated as wings are at the middle of the segments, the pleural apodeme would naturally come to be their chief fulcral point. The strongly conjoined costo-radial group of veins stands rigidly above this point. To rearward extend the islets of scleritization called axillary sclerites, and the basal thickenings of the cubito-anal veins.

The wing is still a narrow fold of the body wall, and to keep it in line for proper action it is anchored at front and rear: forward by means of tegulæ; rearward, by means of the axillary cord. Between these strong and flexible stays it swings freely, not as on a long hinge in a fixed plane but with a relatively fixed rotation at the front about the head of the apodeme, and with freedom of adjustment to the rear. The adjustment of the planes is by the pull of the muscles about the wing base.

No profound knowledge of mechanics is required for an understanding of the operation of the insect wing, but only a little careful observation of its structure and action. Whatever its venation pattern, the wing is stiff and rigidly supported at the front, and pliant and rather loosely slung in the rear. When vibrated up and down the stiff front edge cuts the air: the broad yielding hinder plane glides upon it. The action is that of sculling, the obliquity of the wing strokes alternately up and down resulting in forward progress.

Fore and hind wing were at first alike. They are alike in ontogeny. They become progressively differentiated in all orders in an ascending series.

Wings were doubtless first broad at the base. The nature of their development from a marginal fold of skin requires this. Narrowing of the hinge line and of the wing stalk has progressed along with other specializations. The folding of the wings upon the back brought well known changes in the basal articulations, and longitudinal plication of the thin membrane at the hind border. Great expansion of this membrane followed in the hind wings of certain orders.

IV. VEIN FLUTING

The wing was at first flat, or perhaps gently arched upward and somewhat concave beneath. Contraction of the base threw it into folds there, and certain of these folds have had a degree of permanence. There resulted two principal elevations corresponding to the bases of the two primary groups of tracheæ, with a depression at the base of the median vein lying between.

In support of the cutting edge, the costo-radial group of veins became consolidated and stiffened by scleritization and by furrowing. Costa, Subcosta and Radius were firmly united at base (and often at tip as well), with the subcosta settled into the bottom of the furrow between the other two and braced against them. These three veins strongly conjoined support the wing as the mainmast supports a sail. Behind this support in the more primitive Palaeodictyoptera a full complement of forking veins extended across the field. The forks exhibit only such mutual adjustment as competing tracheal branches show.

At the rear of the wing base a free-floating support, formed by cubito-anal conjunction and scleritization, is generally well developed; but its veins are less constant in their relations. Always the vein R1 is convex to the upper side, and generally Cu1 is also. The weak base of the median vein lies in the hollow between.

The principal forks of these main veins originally lay farther out toward the middle of the wing, and the more or less numerous terminal forks often tended to fall into a fluted arrangement alternately high and low, convex and concave. Wing fluting was characteristic of many of the older fossils. It has continued and has reached its maximum of development in modern mayflies. They stiffened the wing by fluting as a fan is fluted, and made little use of crossveins for wing-bracing. One may easily demonstrate the effectiveness of fluting by trying to fan himself with a sheet of plain paper, and then fluting it and fanning again. The fluting increases rigidity.

The fluting was of necessity incomplete at first, for when fluting begins forks are in the way. They flatten the surface; the conjoined veins cannot be convex and concave at the same time. Forks stood in the way of this sort of wing strengthening; and the simplest way of improvement lay in pushing them toward the wing base out of the way. Modern mayflies have perfected this process that was already well begun by Permian Ephemerida. In the fossils the forks are farther out on the wing than in recent forms, and in the latter they recede until in the most specialized mayflies all are either crowded to the very wing base or detached. Thus the fluting was extended from the margin inward.

When principal forks are deepened to the wing base, then the number of veins in the wing appears to be increased. Lameere, observing their number and the regularity of the fluted arrangement into which they have fallen, evolved a theory of vein origin of very attractive simplicity. He conceived of a primitive wing with the veins all double, the anterior branch of each convex and the posterior, concave, following each other in perfectly regular order. Thus the convex costa had its concave subcosta; radius, its subradius, the radial sector (Rs); media, its submedia (M3 + 4); cubitus, its subcubitus (Cu2); and the 1st anal, its subanal (2nd A).

That was a beautiful dream. Nature is not often so consistent in arranging the parts of a series—and with such materials! The things here involved are open tracheæ extended through the mouth of a flat wing sac, "gathered" at transformation to a narrow wing base, and thus thrown into folds.

This theory provides for the excess of long veins, but it forgets that the number of main tracheæ is not increased—in fact it forgets about tracheæ altogether, or dismisses them as of no significance. It forgets also that this excess in number of veins is found only in a few orders that have made no special use if crossveins for wing strengthening and that have deepened the forks progressively with wing-fluting.

When one considers the extraordinary diversity of wing types found among fossil insects, it does not seem likely that in all orders the veins should always be in the same relations to folds so formed. Within a single line of evolution, as for example, the Ephemeroptera, relation of veins to flutings once established would not be likely to change. Professor J. H. Comstock, in pointing this out (Wings of Insects, 222–223), made a reasonable use of wing fluting as an aid to the interpretation of homologies.

This beautiful theory was easy of application—too easy, in fact. One thing only had to be kept in mind—the fluted surface!

But there are basic facts of wing origin and vein development to which theory must conform if we are to make any real progress.

After Lameere had that beautiful dream Tillyard had a venational nightmare. His subconscious fancy conceived a primitive insect wing that had only one convex vein (R1), but it had a full complement of concave ones. He published a picture of it (Amer Jour. Sci., 9: 333, fig. 2, 1925). The other convex veins, he said, came later, *arising from the outer margin of the wing,* and gradually extending toward the wing root. Whence they came and what they were made out of and how they were supported in the making are no concern of this theory, according to which tracheæ came last of all. "They find their way into the veins."

Thus, untrammelled by reality, the air-distributing function of trachea during wing growth ignored, the archedictyon forgotten, development from the base outward reversed, we arrive at another very simple solution of a very complicated problem.

That we are not greatly helped toward an understanding of wing-fluting by such special creation theories, I have pointed out elsewhere (Science N.S. 25: 221). The wing was first smooth of surface, as the nature of its origin necessitates, and the first longitudinal ridging probably came at the wing roots with the narrowing and consequent crowding there. Lines of contraction may be seen through the transparent sheaths of nymphal wings in the instars approaching metamorphosis. They remind one of the lines at the base of a "gathered" ruffle. The fluting of the outer portion of the wing was one line of later evolution.

V. VENATION PATTERNS

Selective segregation of the chitin in the formation of the framework of the wing has followed very diverse lines. Numberless venational ventures have been tried. A good many have succeeded well enough to have persisted down to the present day. Many more have failed, as the fossil records show. In all this diversity a few main trends appear, and only with these are we here concerned.

Everywhere the framework of venation shows a stiffened front border with close-set veins, and an expanded rear margin with outspread veins. Everywhere the lines of support for this framework proceed from two basal thickenings at the costo-radial and cubitoanal conjunctions of veins at the wing base, out toward the stigmatic area of the wing. At the front is stiffness; at the rear, pliancy; between is a thin basal area traversed by lines of torsion. This makes for sculling efficiency.

In the more primitive fossils the veins were almost as independent as were their antecedent tracheæ but mutual adjustments came in as the old archedictyon was dissolved and its substance reassembled on lines of greater utility. Sometimes it emerged as rows of hexagons. More often, especially in the narrower wing spaces, as parallel crossveins. Always it went toward further strengthening of some of the main veins.

A struggle for existence among the all-too-numerous crossveins ensued and certain of them, that chanced to stand in positions advantageous for support, were preserved. Strong transverse joinings of the longitudinal veins were the result. An outcurving line of crossveins connected the two basal vein-groups of the wing. It was the line of the arculus. Another crossline was the line of joinings connecting principal forks. I have elsewhere (N. Y. State Mus. Bull. 124: 223, 1907) spoken of this, and have called it the *cord*. It is a line of conjoined forks. Those crossveins that stood at the elbows of the forks had the advantage of position and survived. They remain still as the named crossveins of Comstock's typical wing: *r, s, r-m, m,* and *m-cu,* present in the more primitive members of holometabolous orders.

Such was the mechanical adjustment when the primal forking of the veins was dichotomous. But there was, apparently from the beginning, another type, a pinnate* type, in which the forks of the veins (and of their antecedent tracheæ) were arranged in a unilateral series. This is the Neuropteroid type. It reached its zenith in the Hemerobiidæ and Myrmeleonidæ.

The forks in this type extend obliquely outward and rearward, often downcurving, like the primaries of a bird's wing. Between the forks the surviving crossveins are arranged in gradate series. The result is a very beautiful wing, but not one of great efficiency; for there is too little thinning toward the hind border: too much material there still. Even a marginal vein persists—relict from the old wing-fold channel—where for efficiency the wing should be thinnest.

Primitive insect wings carried an excess of veins, and the general tendency, it now seems clear, has been toward vein reduction, together with vein differentiation. The best fliers have often the fewest veins. The chitin has been concentrated in a supporting framework of a few strong veins placed at the front where strength is needed for support. At the rear it has been spread out thin to form a tough and pliant membrane where breadth is needed for gliding. Progressive series in vein reduction may be found in most of the insect orders.

Fluting alone did not yield very efficient wings. Better wings were evolved when strong crossveins were developed, binding together the longitudinal veins in a strong yet flexible supporting framework.

VI. MAYFLIES AND DRAGONFLIES

A few words now about the two groups whose venation is most in dispute. Ever since Latreille put mayflies and dragonflies together in one order, SUBULICORNIA, it has been commonly held that they are closely related groups. I formerly shared in this

* Better *pinnate* than *pectinate;* for the rays are appressed, oblique and arched as in *pinna,* a feather, and not apart, perpendicular, and straight as in *pecten,* a comb.

opinion, but further study has convinced me that both are very isolated groups, well apart from other insects and from each other.

They have a few very well known common features. Both groups have reduced antennæ, as Latreille's name for them indicated; but this is a departure from primitive conditions and may well have been a parallel development. Both groups have enormously developed compound eyes; but the eyes have little in common save what is common to insects generally. Both groups have a ten-segmented abdomen; but so had many unrelated fossils. Both have a certain curvature of the veins of the cubito-anal group that they share with several equally isolated fossil orders. Both groups hold their wings outspread and not folded on the back.

This last common feature on close inspection will reveal little affinity; for the wings of the two groups differ vastly in development, in mechanical arrangements, and in general evolutionary trends. The nymphal wings lie flat on the back in Ephemeroptera, inverted in Odonata. The hind wings tend to be reduced in Ephemeroptera, expanded in Odonata. They are coadapted to the fore wing in Ephemeroptera but remain free and independent in the Odonata. Huge dorsal longitudinal muscles propel the wings downward by uplift of the tergum in Ephemeroptera, while these muscles are lacking in Odonata and the down stroke of the wing is effected by direct pleural wing muscles. The base of the nymphal wing bears ingrowing callosities in Ephemeroptera that are lacking in Odonata. The stiffening of the wing has been chiefly by means of fluting in Ephemeroptera with hardly any use of special crossveins, while in the Odonata three strong cross bracings of the veins at arculus, nodus, and stigma are characteristic of the entire order. The area of the radial vein is expanded and that of the median reduced in Ephemeroptera, while these conditions are reversed in Odonata.

Other significant contrasts are seen in the life cycle; in mouthparts and feeding habits; in form and armature and segmentation of the tarsi; in gills and abdominal appendages; in hind gut and Malpighian tubules; in sex organs and copulatory apparatus of the male, etc. Here these only can be mentioned in passing.

The fluted condition of the insect wing was not primitive but secondary. It represents one of Nature's experiments in wing stiffening, tried out early, and largely abandoned, except in Ephemeroptera, where is reached perfection.

The veins in the Odonate wing are preceded by tracheæ—the usual tracheæ in their usual relations to an alar trunk at the wing base. The large tracheæ R, M and Cu fork well out in the wing as in more primitive insects. There is strict correspondence between veins and tracheæ over most of the wing in the more primitive members of the order, with progressive but very moderate departures therefrom as specialization proceeds.

When the veins are formed, they bend the contained tracheæ out of course. This happens where braces are developing, especially at arculus and triangle. This angulation increases with the approach of transformation. It shows how these wing braces arose. The bending is progressive. It reveals the lines of past evolution, and living adult forms still persist on the earth to illustrate each step in the shifting. Such consistent corroborative evidence from ontogeny and phylogeny is not to be lightly cast aside in behalf of a beautiful theory.

There are in this order several peculiarities of tracheation, as might well be expected in so isolated and peculiar a group of insects. The most noteworthy of these is the crossing of the trachea Rs over two branches of media. This occurs regularly in the suborder Anisoptera. The first formed exploratory tracheoles may or may not cross over, as Schmieder (Entom. News, 33: 257–303, 1922) has abundantly shown;* but the definitive trachea follows the predetermined route unerringly.

This crossing occurs in ontogeny long before any veins are formed. If it occurred in phylogeny before the venation pattern was established, the crossing would necessarily be incorporated into that pattern. It is, of course, impossible that chitinized veins should cross; but it is not at all impossible for tracheæ to cross and for veins to be formed about them.

The most primitive arrangement of tracheæ in the Odonata, the one that accords best with the generalized representatives of

* I hasten to acknowledge the error I once made in adducing ontogenetic evidence from tracheoles (U. S. Nat. Mus. Proc. 26: 706, 1903).

other orders, is that of the suborder Anisoptera, whose large nymphal wings are of considerable thickness. Apparently there is crowding at the front; for, as in saltatorial Orthoptera (whose nymphal wing cases are likewise inverted on the back), the area of the radial trachea is reduced, and that of the median, expanded.

Reduction occurs at both front and rear. The costal trachea atrophies. There is a single anal trunk and it is crowded forward against the base of the cubital stem. Translocation of branches may be traced, if one examine a representative series of the order. The branches of the anal trachea are transferred to the cubital, progressively as specialization proceeds and as the nymphal wings becomes narrower and thinner, until their dwindling remnants are all detached from their place of origin. Even so the trachea Rs has been transferred from the radial trunk to the median in Zygoptera. The explanation of all these translocations is *compression.* Tracheæ must remain open.

In the thinning of the wings of the slender zygopterous nymph, the trachea of the radial sector has apparently been pinched off and a new cut-off channel formed, joined it to Media. This could occur at ecdysis, when the tube is emptied of both gas and taenidia. Then the soft protoplasmic walls are easily expanded. Then with the old passage blocked by compression, a new one might be formed. Following aeration demand, as trachea seem to do in general, an outgrowth from Media would find the soft channel of the detached tip of Rs and unite with it. This is the explanation I offered in 1903 (U. S. Nat. Mus. Proc. 26: 711), and I see no reason for change.

Tillyard, while objecting to this explanation of the Zygopterous tracheal pattern, unwittingly provided the best of evidence for it (Linn. Soc. N. S. Wales, Trans. 40: 227, 1915) when he pointed out the old abandoned vein-channel in the subnodus of the Australian Diphlebia. This I have discussed elsewhere (Entom. News, 28: 171–173, 1917).

Tillyard has held that the condition of the trachea in Zygoptera is primitive and has disposed of the crossing of Rs in Anisoptera by calling it a ''tracheal specialization''; but he has not pointed out any of the usual signs of specialization, such as beginning and trend, with more or less gainful progress. How could a branch on the posterior side of the median tracheal stem detach itself therefrom and reattach itself to the more distant radial stem on the other side? Or, how could a well established branch of the median trachea be dispossessed of its field by an invading distant branch of radius? Either procedure is to me unthinkable.

He argues that if the bridge vein were a secondary development, then some fossils should show it incomplete. To this reply may be made that fossil evidence, like that of tracheation, is good for what it shows not for what it does not show. Fossils (and the more generalized recent forms as well) show the bridge indifferently developed at its proximal end, and attaching forward or rearward; to M1 + 2 in some groups and to M3 in others.

A point of departure for a new interpretation of Odonate venation was found by Tillyard when he discovered the fossil, *Kennedya mirabilis.* This for him at once solved the whole problem. With all considerations of developmental processes discarded, he was able to see in this extraordinarily specialized form the ancestral characters of modern Odonata; and that in spite of its long-stalked wings, its high differentiation between veins and membrane, and its few crossveins in fine mutual adjustment!

One little veinlet at the very base of the wing was for him the key. This veinlet, one cell long, he called Cu1. It does not look like Cu1, but he thought it to be convex and a convex Cu1 was needed here to fit his version of Lameere's theory. It seems strange that he did not deem it necessary to supply tests of a sort that he himself has demanded elsewhere: (Roy. Soc. Tasmania, Proc. of 1910, p. 17) "Where is the evidence that such a vast change as this ever took place, and where are the intermediate forms to be found?"

Tillyard's interpretation assumes that about nineteen-twentieths of the distal portion of vein Cu1 has disappeared and left no trace — has fused with Cu2 in a series wherein no signs of fusion from the margin inward are ever seen, nor approximation of vein tips looking toward coalescence; not even in related orders, recent or fossil. This interpretation is fantastic.

Or, if the thought be, that vein Cu1 has all atrophied except this little basal vein while adjacent veins and crossveins show no signs of reduction or of readjustment, that is equally preposterous.

A simpler explanation of this little vein lies near at hand. The portion of the wing in which it lies remains longest an open sac. The gathering up from the rear crowds the tracheæ of the cubito-anal group forward. It might well be that the cubital trachea was pushed ahead of the anal into the midbasal space. The weak vein formed about it in that case would be the cubital stem, with its fork farther out in the wing where it belongs. The stray vein behind it would be the ascendent anal.

A veinlet of this sort occurs in the Meganisopteran genus Typus at the posterior side of the midbasal space. A similar veinlet appears in Oligotypus at the anterior side of this same space. These are figured together by Carpenter on the same page (Amer. Journ. Sci. 21: 107, 1931). Both are probably due to a common cause — the gathering up of the wing base preparatory to transformation. I think that they should be interpreted alike. Both represent short fusions just beyond the base: M with Rs in Typus; Cu with A in Oligotypus. There is no reason whatever for assuming loss of vein tips by fusions the whole wing length.

The two suborders of Odonata, Anisoptera and Zygoptera, are very remote in origin, as shown in the nymph by different type of a respiratory apparatus and in the adult by different type of head, and by want of homology in the component parts of the accessory genitalia of the male. That they arise from common stock is shown by the common form of labium in the nymph and of venation pattern in the adult. Tillyard has sought to show by palaeontological evidence that the Zygoptera with reduced venation are very primitive but he has only succeeded in showing that they are very ancient.

Much of the primeval fluting has been preserved in Odonata; indeed, it has been both preserved and improved upon. But it is no longer the simple fluting called for by Lameere's theory. Principal veins are no longer consistently concave or convex. In Aeschna, for example, costa is convex to the nodus and concave beyond. M4 is concave in the middle and convex to both ends. With veins ajog on the bends into which they forced the tracheæ there came about of necessity a partial levelling at the junctions, giving ups and down in the course of single veins.

VII. SUMMARY

I trust I have made clear my belief that in studies of insect phylogeny all features of wing development should be taken into account and given due weight:—

1. Tracheæ, when dealing with any group that has living representatives. The principal reason for considering trachea is because veins develop about them. Also when well preserved, by their shiftings of position they retrace in ontogeny the evolution of the vein pattern in each group. This, confirmed by adult wings showing the same shifts, yields consistent and satisfactory evidence of the course of evolution. Unfortunately, for extinct groups only phylogenetic evidence is available, and that is often very scanty. However, in the more generalized fossils, tracheæ leave their traces in the manner of forking of veins. Also, when fusions have occurred often there remain oblique veins to indicate conjunctions.

2. Principal veins, their number, type and extent of branching and relative interdependence.

3. Cross-veins. These are much a part of the wing as are long veins. Their emergence from the archedictyon is progressive. Where numerous they are individually insignificant, but when few and strong they become major parts of the wing mechanism.

4. Vein patterns, as manifest in the dichotomy of main veins, and in the connections established between them by means of crossveins.

5. Fluting: convex and concave furrowing; a means of wing stiffening in absence of strong crossveins; very important when once established in a single series, but undoubtedly secondary as the nature of the wing at its origin necessitates, and not necessarily holding individual veins to the same levels in different types of wing. Along with fluting should be considered other

changes of level due to the development of lines of flexion, and lines of bracing.

When all the methods of comparative anatomy have been applied to the study of the older fossil insects the evidence will still be scanty enough, in all conscience, and not an adequate basis for cocksure pronouncements. The surface of the fossil record has only been lightly scratched.

Even yet there has been no thoroughgoing investigation of the development of a nymphal wing in any species, and no study at all of fluting to determine the limits of its dependability as a guide in studies of phylogeny. In such researches the methods both of observation and experiment must needs be applied.

I would not conclude this article without paying tribute to the excellent palaeontological work of my three esteemed Neo-Adolphian colleagues, Tillyard, Martynov, and Carpenter, with whose application of Lameere's theory I disagree. Their contributions to the knowledge of fossil insects are very great. New facts they have contributed in a large measure; and the enduring edifice of science is built on facts.

NEW GEOCORIS FROM THE UNITED STATES, WITH KEY TO SPECIES (LYGÆIDÆ: GEOCORINÆ)

BY H. G. BARBER

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
U. S. DEPARTMENT OF AGRICULTURE

Geocoris omani new species

BRACHYPTEROUS FORM. Resembling rather closely in coloration *G. uliginosus* var. *limbatus* Stål. The following parts yellow-testaceous: head except eye stalk posteriorly, apical half of third antennal segment (fourth missing), narrow costal margins of corium, head beneath, legs except the lightly embrowned fore femora, anterior margin of prosternum, margins of acetabula, odoriferous orifices, and narrow lateral margins of venter. The following parts black: antennæ except apical half of third segment, eye stalk posteriorly, cicatrices to margins of pronotum and broad central disk behind these, scutellum, pleura, and venter except the forementioned parts. The following parts sordid ochraceous: anterior and posterior lateral margins of pronotum to beyond the middle, and corium except the inner fuliginous disk. Abbreviated membrane hyaline. Eye red.

Head across eyes distinctly wider than across posterior region of pronotum (1.68: 1.44 mm.); eyes appearing stylate, not in contact with the rounded anterior angles of the pronotum; smooth, highly polished; sulcus shallowly continued to base of head; ocelli set a little closer to eyes than to median sulcus. Antennæ with the basal segment a little over one-half as long as second, which in turn is but little longer than third segment (fourth missing). Pronotum nearly twice as wide as long (1.44: 0.80 mm.), lateral margins very gently converging anteriorly to line of the cicatrices, thence abruptly, evenly rounded to anterior margin; the extreme margins finely but distinctly carinate; the cicatrices extending to the antero-lateral punctate margins; anterior submargin before these rather sparsely punctate, broad central disk behind these more finely and more closely punctate; pale humeral area more coarsely and more sparsely punctate. Scutellum a little wider than long, strongly convex, neither elevated at base nor carinate apically, with a smooth longitudinal line running from before the middle to apex elsewhere with the disk on each side of the median line more sparsely punctate than basally and laterally. Membrane abbreviated, but nearly reaching to apex of abdomen. Hemielytra (brachypterous form) with the clavus not declivous, set off from the corium by a single row of punctures; corium strongly convex, except on basal outer third evenly and coarsely punctate; lightly expanded costal margin in outline more strongly convexly rounded behind the middle. Pleura closely and coarsely punctate. Venter smooth, finely pilose. Length of brachypterous male 3.50 mm.

Type: Male, Santa Rita Mts., Ariz., June 12, 1933 (P. W. Oman). U.S.N.M. Cat. No. 50572.

The single male with abbreviated membrane has much the color and appearance of *G. uliginosus* var. *limbatus* Stål. However, as the head is not finely rugulose and the anterior pronotal angles are distinctly rounded, it is not closely related to that species or any other known species from the United States. The head has the character of a *Hypogeocoris* with the stylated eyes, smooth, polished disk, and median sulcation, but the pronotum is so totally unlike the character of that part, both in shape and punctation, as represented in *H. piceus* Say and *H. imperialis* Dist., that I consider it a true *Geocoris.* It has been named in honor of its collector, P. W. Oman, of the Bureau of Entomology.

Geocoris beameri new species

Similarly colored and with same general broad form as the palearctic *Geocoris erythrocephalus* Lep. Shining black. The following parts yellow-testaceous: head except transverse basal mark which at each end extends forward a short distance next to the ocelli, antennæ for the most part, a slight submarginal longitudinal streak of pronotum, and extreme apex of scutellum. The following part black: transverse basal mark of head, pronotum except for submarginal yellow streak, scutellum except at apex, the corium except for the embrowned lateral margins, pleura except parts hereinafter mentioned, and all of the venter. The following parts, beneath, pale straw-yellow: head, rostrum, legs, broad margins of the acetabula, odoriferous orifices, and posterior angles of the metapleura. Membrane hyaline, embrowned at base. Eyes and ocelli red.

Head smooth, polished, short and broad; two and four-fifths times as wide across eyes as long, scarcely wider than width of pronotum posteriorly, the longitudinal sulcus of the tylus continued as a fine groove nearly to base; anterior margins between eyes and tylus more straight, much less oblique than in *bullatus* Say or *uliginosus* Say; eyes almost or quite in contact with anterior angles of pronotum; ocelli set a little closer to eyes than to median line of head. Lengths of segments of antennæ as follows: I, 0.24, II, 0.44, III, 0.36, IV, 0.48 mm. Lengths of segments of rostrum as follows: I, 0.40, II, 0.28, III, 0.40, IV, 0.40 mm. Pronotum broad, not quite twice as wide as long (1.60: .812 mm.); lateral margins very nearly parallel posteriorly for three-fourths of their length, the anterior one-fourth behind the eyes abruptly converging but not angulated to anterior margin of pronotum; the cicatrices situated one fourth the way from anterior margin, transverse, not extended to lateral margins; areas before and behind cicatrices rather evenly and closely punctate, more sparsely punctate on pale submarginal streak. Scutellum a little wider than long, equal in length to pronotum, subbasally transversely elevated, followed by a slight longitudinal median carina to apex, coarsely punctate across base and on each side of median carina. Hemielytra with the clavus provided with the usual row of punctures, corium inwardly close to the claval suture provided with two regular rows of punctures; outer apical half rather closely punctate, preceded by a few scattered punctures, longitudinal central disk smooth, impunctate; costal margin slightly expanded, set off by a row of punctures. Membrane extended slightly beyond apex of abdomen, hyaline, embrowned at base. Pleura coarsely and closely punctate. Venter finely pilose in the center. Length 3.70 mm., diameter across humeral angles of pronotum 1.60 mm.

Type: Male, Yarnell, Ariz., July 25, 1932 (R. H. Beamer). Allotype: Same data as type. Paratypes: 2 females, same data as type; 1 female, Sabino Canyon, Santa Catalina Mountains, Ariz., June 27, 1933 (R. H. Beamer). Collection of University of Kansas. One paratype from Yarnell deposited in the collection of the U. S. National Museum, Cat. No. 50573.

Quite distinct from any described species from the United States, resembling in appearance the palearctic *Piocoris erythrocephalus* Lep. and most closely related to *G. scudderi* Stål. It has been named in honor of its collector, Prof. R. H. Beamer, of the University of Kansas, who has kindly sent four specimens for examination.

Geocoris davisi new species

Color testaceous-yellow, not highly polished, finely sparsely pilose on head, pronotum, and scutellum; a slight fuscous line on each side of tylus, two small clusters of fuscous punctures before posterior margin of pronotum, and a few fuscous punctures on base and lateral areas of the scutellum. Beneath in the main concolorous, mesosternum and metasternum and the venter laterally embrowed. Legs yellow-testaceous. Antennæ embrowned, with the basal segment mostly pale.

Head with the disk, except at base, very finely granulose; tylus lightly longitudinally sulcate, devoid of a longitudinal sulcus through vertex; anterior margins between eyes and tylus less strongly oblique than in *bullatus* Say. Eye stalk in contact with anterior angles of pronotum. Ocelli placed much closer to eyes than to median line of head. Lengths of antennal segments as follow: I, 0.24, II, 0.44, III, 0.28, IV, 0.44 mm. Lengths of segments of rostrum as follows: I, 0.48, II, 0.28, III, 0.40, IV, 0.32 mm. Pronotum finely sparsely pilose, not twice as wide as long (1.40: .80 mm.); lateral margins gently converging anteriorly, edges lightly carinate, anterior fourth, before the position of the cicatrices, abruptly subangularly converging to anterior margin of pronotum; except for the cicatrices and humeral angles, closely and evenly punctate. Scutellum a trifle longer than wide, a smooth somewhat oblique calloused area in each basal angle, posteriorly with a subcarinate smooth longitudinal median line; sparsely punctate at base, more closely so laterally on either side of the median carina. Hemielytra with the clavus provided with the usual row of punctures; corium with two rows of punctures next to the claval suture; the central disk smooth, beyond which in the outer apical half is a rather closely punctate area; outline of costal margin rather strongly convexly arcuated. Membrane clear hyaline, extended but little beyond apex of abdomen. Pleura closely punctate. Venter with a sparse coating of fine, incumbent hairs. Length 3.70 mm., diameter across humeral angles of pronotum 1.40 mm.

Type: Female, Las Vegas, Nev., Sept. 15, 1931 (E. W. Davis). Paratypes: 4 females, Las Vegas, Nev., June 15, 1932 (E. W. Davis); 2 females, Overton, Nev., June 15, 1930 (E. W. Davis). Collected on *Dondia nigra* and *Atriplex garrettii* (family Chenopodiaceæ). U.S.N.M. Cat. No. 50574.

Most closely related to *G. pallens* Stål (= decoratus Uhler), from which it is distinguished, besides its color and pilosity, by the much more arcuate margins of the corium, in less obvious angulated antero-lateral angles of the pronotum, and the callosities of the scutellum. Named in honor of its collector, Mr. E. W. Davis, of the Beet Leafhopper Laboratory at Salt Lake City, Utah.

Geocoris nanus new species

Geocoris bullatus bullatus McAtee (Part)

Griseous, punctate with ferruginous; head finely grayish pilose; except for pale tylus and small area either side of it, cicatrices, scutellum basally, and tergum except paler terminal segment, reddish-castaneous; beneath reddish-castaneous, with the following parts pale yellow-white: A more or less evident line beside the eyes, the anterior margin of the prosternum, margins of the acetabula, odoriferous orifices, posterior margins of the propleura and metapleura. Venter reddish-castaneous. Antennæ for the most part, basal two segments of the rostrum, and the legs, testaceous; terminal segment of the antennæ infuscated. Membrane hyaline.

BRACHYPTEROUS FORM: Head a little over twice as wide across eyes as long and plainly wider than pronotum posteriorly; not polished, very finely granulose and finely grayish-pilose; tylus lightly longitudinally sulcate, suclus not continued through the vertex; ocelli situated much closer to eyes than to middle line of head; eyes not substylate, almost or quite in contact with anterior angles of the pronotum. Lengths of antennal segments as follows: I, 0.20, II, 0.36, III, 0.24, IV, 0.40 mm. Lengths of segments of rostrum as follows: I, 0.36, II, 0.28, III, 0.36, IV, 0.28 mm. Pronotum finely pilose anteriorly, much wider than long (1.0: .60 mm.); lateral margins very lightly carinate, posteriorly parallel, anteriorly behind the eyes abruptly rounded, not angulated to anterior margin; cicatrices widely separated by a punctate area, not nearly attaining lateral margins; surface before cicatrices closely punctate, behind these more sparingly punctate with ferruginous. Scutellum finely pilose, rather flat, as long as wide, very slightly elevated at base, provided with a smooth longitudinal noncarinate line from before the middle to apex; rather closely punctate basally and on each side of the smooth median line. Hemielytra dorsally strongly convex, apex just surpassing posterior margin of fourth visible abdominal segment; clavus level with corium and set off by a closely set row of punctures; corium, except along narrowly expanded costal margin, rather closely and evenly punctate with ferruginous; posterior margin truncate beyond the inner broadly rounded angle; membrane clear hyaline, abbreviated, about as long as the diameter of the clavus at base. Tergum finely, closely grayish pilose. Pleura finely pilose; except on the smooth pale areas, closely and coarsely punctate. Venter rather densely but finely grayish pilose. Length of male 2.80 mm., diameter across humeral angles of pronotum 1.0 mm.

MACROPTEROUS MALE: With much the same general pattern of coloration, except that the pronotum and corium are more testaceous and the head beneath pale. The head is a little less wide in relation to its length; pronotal margins more evidently carinate, the scutellum plainly longer than wide, with a more evident longitudinal carina. The hemielytra are longer, extended as far as the middle of the fifth visible abdominal segment, the costal margins more expanded and in outline less convex; the clavus is declivous, the corium punctate as in other species of *Geocoris*. Membrane hyaline, extended a little beyond apex of abdomen. Length 3.00 mm.

Type: Male, Mustang Mts., Ariz., June 12, 1933 (P. W. Oman). Paratypes: Males, 7 with the same data as type (all brachypterous); 1 Sierrita Mts., Ariz., Nov. 27, 1913 (H. S. Barber) (macropterous); females, 7 with the same data as type; 1 Ft. Collins, Colo., C. F. Baker; 2 labeled A. Lam., 7–7–1 (locality unknown). U.S.N.M. Cat. No. 50575.

Paratypes in the University of Kansas: Males, 7 Mustang Mts., Ariz., June 12, 1933; 1 Sabino Can., Santa Rita Mts., Ariz., June 22, 1933; females, 4 Mustang Mts., Ariz., June 12, 1933; 1 Apache Co., Ariz., Aug. 16, 1927; Navajo Co., Ariz., Aug. 15, 1927; Beboquivari Mts., Ariz., July 19, 1932 (R. H. Beamer) (all brachypterous).

This small species is most closely related to *G. frisoni* Barber, from which it may be distinguished, besides its color and pilosity, by the narrower head and pronotum, and the more nearly truncate posterior margin of the corium in the brachypterous form.

The specimen from Ft. Collins, Colo., is more robust and more deeply colored, the head provided with an ochraceous spot behind each ocellus. One of the two more robust specimens from an unknown locality labeled "A. Lam. 7–21–1" was treated by McAtee (Proc. Biol. Soc. Wash., XXVII, p. 131, 1914, as a brachypterous form of *Geocoris bullatus* Say.

Geocoris paulus McAtee

Geocoris punctipes var. *paulus* McAtee, Proc. Biol. Soc. Wash., XXVII, p. 130, 1914.

After an examination of the type (female) from Kern Co., California, in the collection of the National Museum, I am convinced that this is quite distinct from *punctipes* Say and should be given specific rank. In *G. paulus* the head is not polished but very finely rugulose, devoid of a distinct median longitudinal sulcus continued from tylus to base of head, which is so evident in Say's species. *G. punctipes* differs from all other species from the United States in having a transverse, arcuate sulcus behind the tylus which does not reach the eyes. Furthermore, in McAtee's species the antero-lateral margins of the pronotum are gently rounded from just before the middle to the anterior margin, where the eyes are not remote but in contact with it. In addition, the scutellum is devoid of the basal callosities so characteristic of *G. punctipes*.

Geocoris frisoni Barber

Geocoris frisoni Barber, Bul. Bklyn. Ent. Soc., XXI, p. 38, 1926.

This small pale-testaceous species was originally described from Illinois. It is evidently a rather widely distributed species, as there is a female specimen in the National Museum collection taken by E. A. Schwarz at San Diego, Tex. Also Prof. R. H. Beamer, of Kansas University, collected three specimens in Texas: Kendall County, July 22, 1928, Brooks County., July 25, 1928, and Karnes County, July 23, 1928. All specimens of this species so far seen are brachypterous.

KEY TO UNITED STATES SPECIES OF GEOCORIS

1. Head smooth, polished, not at all granulose, with a fine, longitudinal sulcus extending from sulcation of tylus through vertex 2

– Head very finely granulose, sulcus of tylus not continued through vertex 5
2. Head concolorous with pronotum; a distinct, transverse, arcuate sulcus behind tylus, not attaining eyes. Basal angles of scutellum with distinct pale calloused areas .... *punctipes* Say
– Head ochraceous or reddish-ochraceous, devoid of transverse, arcuate sulcus. Scutellum noncalloused, unicolorous, black 3
3. Broad form; width of head across eyes scarcely greater than pronotum posteriorly; eyes in contact with abruptly rounded anterior angles; pronotum almost twice as wide as long. Scutellum noncarinate apically .... *beameri,* n. sp.
– Narrower form; width of head across eyes plainly greater than pronotum posteriorly 4
4. Pronotum bicolorous, antero-laterially gently symmetrically rounded, eyes not in contact with pronotum. Scutellum strongly convex, not carinate apically. (Brachypterous) .... *omani,* n. sp.
– Pronotum black, antero-laterally more abruptly rounded, eyes in contact with pronotum. Scutellum distinctly carinate apically .... *scudderi* Stål
5. Species either mostly black or mostly griseus with prominent fuscous markings. Antero-lateral margins of pronotum distinctly angulated (*atricolor* Mont., *uliginosus* Say, *bullatus* Say, *discopterous* Stål, *pallens* Stål (= *decoratus* Uhl.), *lividipennis* Stål, and *carinatus* McAtee)*
– Species pale, testaceous or griseus without prominent fuscous or black markings. Antero-lateral angles of pronotum either rounded or not distinctly angulated 6
6. Posterior margin of corium evenly, symmetrically rounded, brachypterous. Eyes not in contact with antero-lateral angles of pronotum, which are abruptly rounded; cicatrices of pronotum almost contiguous. Scutellum shorter than pronotum. Small species .... *frisoni* Barb.
– Posterior margin of corium at least outwardly truncate in both brachypterous and macropterous forms 7
7. Head and pronotal cicatrices castaneous-red or ochraceous-red. Pronotum parallel sided, antero-lateral angles abruptly rounded; posterior margin before scutellum slightly concave. Eyes in contact with pronotum. Pronotal cicatrices remote from each other .... *nanus,* n. sp.
– Head and cicatrices concolorous with pronotum. Pronotum not parallel sided; posterior margin before scutellum truncate 8
8. Pronotum with lateral margins gently, evenly rounded anteriorly from just before middle point. Eyes in contact with antero-lateral angles. Nonpilose .... *paulus* McAtee
– Pronotum with antero-lateral margin abruptly, subangularly rounded. Eyes in contact with pronotum. Head, pronotum, and scutellum finely, sparsely pilose .... *davisi,* n. sp.

* See Key—McAtee, Proc. Biol. Soc. Wash., XXVII, 1914, p. 128.

NEOAPLECTANA GLASERI

The nematode *Neoaplectana glaseri* found infesting Japanese beetle grubs near Haddonfield, New Jersey, in 1929 by Dr. Henry Fox and Dr. R. W. Glaser, and which Dr. Glaser has succeeded in successfully culturing on artificial media is being distributed in the field by the New Jersey State Department of Agriculture through its Japanese beetle suppression project. Wholesale applications were started in June and will be continued so far as the facilities of the nematode laboratory permit.

Experimental introductions made in previous years indicate that the nematode can establish itself and that it has a percentage of parasitism that is significant. Most of the field introductions are being made in the southern part of New Jersey where the Japanese beetle grub population is high.—F. A. Soraci.

ON THE LIFE HISTORY OF PIERIS VIRGINIENSIS EDWARDS (LEP., PIERIDÆ)

BY ALEXANDER B. KLOTS
COLLEGE OF THE CITY OF NEW YORK

The life history of *Pieris virginiensis* Edwards has been incorrectly known or unknown, it is impossible to tell which, ever since Edwards' notes on it in his "Butterflies of North America," (I: 34, pl. 9, 1871). In this work he described the early stages of a generalized and imaginary Pieris species, and stated that the description would apply equally well to *oleracea, rapæ* or *virginiensis*. From his later paper (Papilio, I: 95–98) it is evident that Edwards did not possess at any time authentic specimens of the early stages of *virginiensis*. In the latter paper, discussing it as a Spring form of *oleracea*, an error which has persisted until nearly the present day, he mentions a female taken by Mead in the last week of June at Stony Clove in the Catskill Mountains. From this many eggs were obtained; only one of these was reared to maturity, and from the chrysalis an *oleracea* emerged. At the time of writing this Edwards had a drawing of this chrysalis, and stated that it was exactly the same size and shape as *oleracea*. This is not surprising, as the specimen undoubtedly was *oleracea*. Stony Clove is in excellent territory for *napi* (*oleracea*), but I know of no records of *virginiensis* from there. I have, however, seen undoubted specimens of *virginiensis* from Big Indian Valley in the Catskills, where the environment is more suited to *virginiensis*. *Napi* may be regarded as essentially a Canadian Zone species, *virginiensis* as a Transition Zone one.

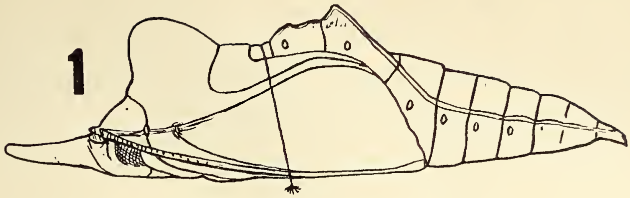
Scudder ("Butterflies of New England," 2: 1191–1204) places *virginiensis* as a synonym of the Spring brood of *oleracea*. He figures an *oleracea* chrysalis (*loc. cit.*, Pl. 84, fig. 57, 63, 64) and states that, in comparison with European *napi* the frontal tubercle curves distinctly upward, and that the carinae of the abdomen are more elevated and flared sidewise. I am not able to judge the validity of these statements because of lack of sufficient material for comparison, but should say that it is my impression that the differences cited are not valid, and that in a series of specimens there will be found no constant differences between the chrysalids of European and American *napi.* This, however, does not affect *virginiensis,* as Scudder appears to have been unacquainted with its early stages. He lists several food plants for *napi* (*oleracea*) but omits *Dentaria,* from which *virginiensis* has now been reared.

In 1931 at the Cornell University McLean Bogs Reservation, near McLean, Tompkins County, New York, I was able to obtain undoubtedly authentic eggs, larvæ and chrysalids of *virginiensis,* through watching females ovipositing on *Dentaria diphylla* Michx., the common Pepper-root or Crinkle-root. This is the only food plant on which the species has been definitely recorded.

The eggs unfortunately hatched and the shells were destroyed before they could be studied. The larva is of the conventional *Pieris* type, dark green and hairy, and is extremely close to or identical with that of *P. rapæ* L. Eggs were deposited between May 12 and May 21. None of the larvæ so obtained were reared to maturity, but others found on the same plants were. Pupation takes place by the middle of June. The pupal stage then under normal conditions lasts until the following May, there being only one brood a year.

Last Spring Mr. Cyril dos Passos of Mendham, N. J., visited the same colony of *virginiensis* at McLean, and obtained a number of eggs from a female, of which five were reared through to the pupal stage. Of these four emerged on Feb. 21, and the fifth, though alive, shows no signs of emerging. The early emergence is no doubt due to the abnormal conditions encountered in captivity, even though Mr. dos Passos kept the chrysalids in a refrigerator during the winter. There can, however, be no room for doubt that *virginiensis* is one-brooded.

The pupa (Fig. 1) is definitely different from those of both *napi* and *rapæ.* A pupa of *napi oleracea* from New Hampshire, obtained through the kindness of Mr. dos Passos, is herewith figured (Fig. 2) for comparison. The *virginiensis* pupa is noticeably more slender, and especially less deep than that of



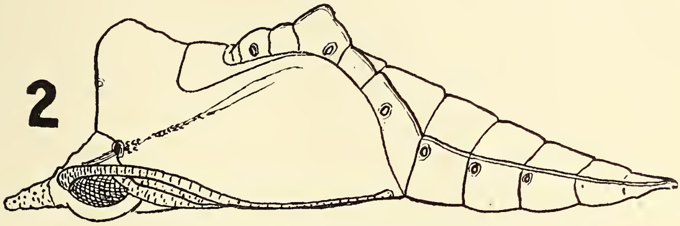


FIGURE 1. Pupa of *Pieris virginiensis* Edwards; reared from larva on *Dentaria diphylla* Michx., McLean, N. Y.
FIGURE 2. Pupa of *Pieris napi oleracea* Edwards, New Hampshire.

The figure of *virginiensis* is from a tracing from a photograph; that of *oleracea* is from a freehand drawing.

oleracea; the frontal process is longer and more slender; the dorsal keel of the first thoracic segment is thinner and more inclined forward; the lateral keels of the anterior abdominal segments have, a greater sidewise flare. All of these characters hold for the six *virginiensis* studied. In some, however, the frontal process is shorter than that figured, and in one of the specimens is strongly bent dorsad, as in the *oleracea* figured by Scudder. The pupa is a pale, yellowish green when first formed; it may later change color considerably, some specimens becoming a darker green, others fading to a pale, yellowish white.

As already stated *Dentaria diphylla* is the only food plant recorded for the species. It is possible that it is its only food plant.

The range of environment in which *virginiensis* occurs is very small. In several years' experience with the species at Blairstown, N. J., McLean, N. Y., and Rochester, N. Y., I have never seen individuals in any environment other than rich deciduous woods, where beech and maple are the dominant trees. Even though sunny fields, rich with flowers and fairly swarming with *Colias philodice* and *Pieris rapæ,* may occur within fifty feet of the haunt of *virginiensis,* I have never seen a single individual stray away from the woods. At McLean a single individual was taken at least a half-mile from the nearest *Dentaria,* but was, true to form, in the woods.

It is probable that this extremely limited environment explains, at least partially, the comparative scarcity of *virginiensis,* especially in this age of reduced forest area. I do not personally take any stock in theories of "competition" and "persecution" by *rapæ,* at least of *virginiensis.* The chosen environments of the two species are too different. I suspect that it has been the disturbance by man of the natural haunts of *virginiensis* that has caused it to become so scarce a species, if indeed it was ever more common. Certainly this species, geographically none too wide-spread, is nowhere found in abundance, even when sought in its chosen environment and at the right time of year. With such a limited range, and occurring in only one brood a year, *virginiensis* may be considered as having a rather precarious tenure of existence. The enormous increase in numbers of parasites, due to the abundance of *rapæ,* may also affect it adversely. *Virginiensis* may well become the first extinct Eastern butterfly.

ELEVEN NEW THRIPIDÆ (THYSANOPTERA) FROM PANAMA

By J. Douglas Hood
University of Rochester

This is the fifth in a series of papers descriptive of the new Thysanoptera taken in Panama by the writer and his colleagues during the summer and fall of 1933.* As previously, the holotypes, allotypes, and a portion of the paratypes are in his collection.

Genus **Enneothrips** nov.

(εννέα, nine; θρίψ, a wood worm—in allusion to the nine-segmented antennæ.)

Dorsal surface of head, prothorax, and sides of all excepting the more distal abdominal segments, with fine, raised, anastomosing lines. Head wider than long, somewhat excavated in front of median ocellus, so that the latter is directed nearly forward. Antennæ nine-segmented, the three distal segments forming a style; segments III and IV each with the usual U-shaped trichome and narrowed in apical portion, IV conspicuously so. Mouth-cone rather short and broad; maxillary palpi three-segmented. Prothorax without major setæ at posterior angles. Wings of normal form, with two longitudinal veins, the anterior one of which is bare in distal half save for about two setæ at tip, the posterior vein with numerous equidistant setæ. Abdomen of normal form; terga II–VIII each with a pair of approximate median setæ; II–VII at sides with transverse, anastomosing striæ, some of which are asperate, and with posterior margin behind these striæ similarly asperate; VIII with complete comb along posterior margin and with most of dorsum asperate; major setæ on segments IX and X moderately short, those on IX subapical and disposed in four pairs.

Genotype: E. gustaviæ sp. nov.

In the sculptured dorsal surface this genus recalls *Echinothrips* and *Cercyothrips*, but both of these have the antennæ eight-segmented. *Graphidothrips*, while having nine segments in the antennæ, has only one longitudinal vein in the fore wings and only two segments in the maxillary palpi. The number of maxillary

* The preceding papers were published in Proc. Biol. Soc. Washington, **46**: 213–216 (Nov. 20, 1933), in Journ. N. Y. Ent. Soc., **41** (4): 407–434 (Feb. 6, 1934), in Proc. Biol. Soc. Washington, **47**: 57–82 (Feb. 9, 1934), and in Proc. Ent. Soc. Washington, **36** (5): 111–114, Pl. 17 (May 25, 1934).

palpal segments is two in *Echinothrips* and presumably two in *Cercyothrips.*

Enneothrips gustaviæ sp. nov.

(Pl. XI, figs. 1–4)

Female (macropterous).—Length about 1.1 mm. (distended, about 1.4 mm.). Color brown, with bright red pigmentation in fat-body of head, thorax, and basal segments of abdomen; femora and coxæ concolorous with body, trochanters and tarsi pale yellow, tibiæ yellow, the fore pair with a brown cloud near base, middle pair with a similarly placed cloud which is larger and darker, hind pair with middle half even more darkly brown; wings of fore pair white in basal fourth, uniform brown beyond; antennæ with segments I and II concolorous with head and with orange internal pigmentation, III pale yellowish, lightly banded with gray just beyond the narrow pedicel and lightly clouded with gray in about distal third, IV and V pale yellowish in basal two-fifths, rather abruptly dark gray beyond, IV often paler in the narrowed distal portion, VI–IX dark gray; ocellar pigmentation red or maroon.

Head (Pl. XI, fig. 1) nearly 1.3 times as wide as long, broadest across eyes, cheeks nearly straight and slightly converging to base; dorsal and lateral surfaces with distinct, dark, raised lines of sculpture which form a reticulation in front of anterior ocellus and the usual type of anastomosis on occiput; setæ pale, not conspicuous, two pairs of nearly equally spaced ones forming a nearly transverse line just in advance of attachment of median ocellus, a third pair (the interocellars) arising on a line tangent with the outer margins of ocelli, longer than the latter in diameter, and somewhat closer to posterior ocelli than to median one, a fourth pair arising almost directly behind lateral margins of posterior ocelli and somewhat closer to ocelli than the diameter of later, a fifth pair slightly posterior to the preceding and close to margins of eyes, two additional pairs on cheeks, close to eyes. *Eyes* scarcely protruding, more than one-half as long as head, about three-fourths as wide as their interval. *Ocelli* forming a nearly equilateral triangle, the posterior pair about 16 μ in diameter and 17 μ apart, the median one directed nearly forward. *Antennæ* (Pl. XI, fig. 4) with nine distinct segments, about 2.4 times as long as head, segment IV conspicuously narrowed in distal portion. *Mouth-cone* rather short and broad, slightly surpassing base of prosternum.

Prothorax (Pl. XI, fig. 1) about 0.93 as long as head, about 1.6 times as wide as long; pronotum finely cross-striate with fine, raised, dark, anastomosing lines which are interrupted by four pairs of latero-dorsal foveæ, and with numerous subequal setæ; no long setæ at posterior angles. *Legs* normal. *Wings* of fore pair (Pl. XI, fig. 2) nearly 2.6 times as long as greatest width of pterothorax and about 13 times as long as their width at middle; setæ short, those in the pale basal region nearly colorless, those in the dark portion brown; costal margin with about 28 such setæ and about 22 fringing hairs; anterior vein with 4 + 6 at base (the basal group in the pale band and nearly colorless, those of the other group dark in color, separated from the first group by a short gap, and extending nearly to middle of wing) and 2 near apex of wing; posterior vein with a nearly equidistant series of about 15, all confined to dark area of wing; hairs of posterior fringe not wavy.

Abdomen of normal form; terga II–VIII (Pl. XI, fig. 3) each with a pair of approximate median setæ, those on VI about 42 μ long and 9 μ apart; terga I–VII in median half free of sculpture, at sides with subtransverse, anastomosing striæ, these striæ asperate on the more posterior terga, posterior margins of II–VII asperate behind the sculptured lateral areas; tergum VIII with a regular, complete, fine comb on posterior margin and with most of its surface minutely asperate; segment IX with a subapical circlet of eight dark brown setæ, of which the lateral pair are about 77 μ in length; segment X not divided above, with two pairs of large, dark setæ, the lateral pair about 80 μ long.

Measurements of ♀ (holotype), in mm.: Length, about 1.06 (distended, 1.39); head, length 0.119, greatest width (across eyes) 0.153, greatest width across cheeks 0.147, least subbasal width 0.140; eyes, length 0.067, width 0.046, interval 0.062; prothorax, length 0.111, width 0.182; pterothorax, greatest width 0.234; wings, length 0.602, width at middle 0.046; abromen, greatest width 0.288; tergum VIII, length 0.071, IX 0.070, X 0.043.

Antennal segments:	1	2	3	4	5	6	7	8	9
Length (μ):	20	37	48	53	40	38	17	15	19
Width (μ):	30	26	22	20	16	17	8	7	5

Total length of antenna 0.287 mm.

Male (macropterous).—Length about 0.86 mm. (distended, about 1.00 mm.). Color paler than that of female, abdomen with segments IV and V yellow, tibiæ often clear yellow. Head about 1.35 times as wide as long, the eyes more prominent and protruding. Wings with fewer setæ and fringing hairs. Abdomen with the paired median setæ, sculpture, comb on tergum VIII, and asperæ as in female; tergum IX at sides with a pair of long, stout setæ (57 μ), on dorsum with a pair of shorter and very much slenderer setæ (43 μ), and two pairs of short stout setæ (15–17 μ), these last borne on low tubercles which form a rhomboid whose somewhat shorter anterior margin is in the same transverse line as the lateral large setæ and the long slender ones.

Measurements of ♂ (allotype), in mm.: Head, length 0.100, greatest width (across eyes) 0.135, greatest width across cheeks 0.121, least subbasal width 0.109; eyes, length 0.060, width 0.039, interval 0.055; posterior ocelli, diameter 0.016, interval 0.016; prothorax, length 0.093, greatest width 0.154; pterothorax, greatest width 0.192; fore wings, length 0.490, width at middle 0.037; abdomen, greatest with 0.175.

Antennal segments:	1	2	3	4	5	6	7	8	9
Length (μ):	20	33	38	39	35	33	14	13	17
Width (μ):	28	22	17	18	15	15	6	7	5

Total length of antenna 0.242 mm.

Described from 36 females and 7 males, Barro Colorado Island, C. Z., Panama (type locality), July 29–Aug. 14, 1933, in young terminal leaves of *Gustavia superba* (H.B.K.), collected by James Zetek, Cristobal Marquinez, and the author [Hood Nos. 1022, 1057, and 1059]; and from one male, Porto Bello, Panama, July 10, 1933, probably in flight, collected by the author [Hood No. 989].

The affinities of this species were discussed under the generic heading.

Sericothrips geminus sp. nov.

Female (macropterous).—Length about 0.93 mm. (distended, 1.1 mm.). Color of living specimens yellow, with a slightly orange cast due to internal pigmentation, the abdomen somewhat paler than head and thorax and more yellowish in last few segments (preserved specimens quickly lose some of the internal pigmentation and become nearly straw-yellow); pronotum with a light gray, obscure blotch extending across disk in front of middle, the ends of this marking broader and involving the two anterior foveæ, the two posterior foveæ on each side emphasized by similarly colored subcircular maculations; mesonotum with a light gray cloud on anterior margin; metanotum with a pair of obscure gray spots; abdomen with the usual transverse brown line at bases of terga II–VII, behind which, on either side of the body, is a gray spot, the pleuræ of the same segments each with a smaller gray spot; legs slightly paler than body, the fore tibiæ and all femora with a light gray cloud on outer surface; the fore coxæ more or less brown; wings light yellowish gray, usually with a faint gray cloud behind the three subbasal setæ situated on anterior vein and another cloud on posterior margin of wing behind the next three or four setæ, the anal area or ''scale'' somewhat clouded externally, the wing veins all with distinct orange pigmentation in fresh or living specimens; antennæ with segment I yellow, II grayish brown but yellowish basally, III very pale yellowish gray, with a brown ring occupying the narrow portion just beyond pedicel, IV–VIII blackish gray, with the narrowed apical portion of IV and a narrow ring immediately beyond pedicels of IV and V pale gray (nearly white); ocellar pigmentation vermilion red.

Head, in dorsal aspect when horizontal, about 1.5 times as broad across eyes as long, the cheeks roundly converging to base; occipital line about 0.23 from base of head, marked internally by a pale yellow but complete, distinct apodeme, the area in front of this apodeme very faintly striate, that behind it somewhat more distinctly so; setæ as usual in the genus (see description of *S. sternalis*, below), except that the lateral pair in front of median ocellus is longer than the inner and measure about 50 μ, the post-ocellar pair long and overlapping. *Eyes* prominent, protruding, about 0.65 as long as head, and about 0.63 as wide as their interval, which is a trifle greater than their length. *Ocelli* of posterior pair about 16 μ in diameter and 26 μ apart. *Antennæ* nearly twice as long as width of head across eyes, with segments III and IV distinctly narrowed apically and urn-shaped, their sense-cones long (47–50 μ), segment IV distinctly longer than VI, which is not pedicellate, segment VIII about 13 μ long and separated from VII by an oblique suture.

Prothorax with the pronotum slightly longer than head and about 1.6 times as wide as long, with the usual raised, anastomosing, transverse lines, these very fine and close, not at all tending toward reticulation, not more closely spaced in the area of the pronotal blotch; seta at posterior angles long (60 μ), moderately heavy, and dark in color; minor setæ brown and distinct, three pairs forming a line across the large pronotal blotch. *Mesonotum* delicately but not especially closely striate at sides and anteriorly, nearly smooth elsewhere; metanotum very faintly subreticulate along median portion, faintly striate at sides. *Fore wings* about 20 times as long as width at middle; costal margin with about 27 setæ, longitudinal vein with a subbasal group of 3 followed by about 20, no additional setæ near tip of wing behind the longitudinal vein. *Legs* of normal form.

Abdomen of normal form and structure, with a complete comb on segments VII and VIII, the pubescence at sides of terga slightly brownish and readily seen, the major setæ brown and conspicuous.

Measurements of holotype (♀), in mm.: Length about 0.93 (distended, 1.09); head, length 0.100, length in front of occipital line 0.077, greatest width (across eyes) 0.153, greatest width across cheeks, 0.143; eyes, length 0.065, width 0.043, interval 0.069; prothorax, length 0.107, width 0.176; pterothorax, width 0.244; fore wings, length 0.658, width at middle 0.032; abdomen, width 0.274.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	23	38	58	57	46	50	11	13
Width (μ):	26	26	21	19	15	15	6	4

Total length of antenna 0.296 mm.

Described from 5 females, Barro Colorado Island, C. Z., Panama, August 9, 1933, J. D. H., on miscellaneous vegetation in an open banana plantation [Hood No. 1047].

This and *S. inversus* are the only known species of the genus which have the fourth antennal segment decidedly paler in the distal two-fifths; and, though *geminus* is in other ways closely related to *inversus,* it may be separated readily by the stronger occipital line, the longer lateral setæ on the vertex of the head, the shorter sixth and eighth antennal segments, and the dark, evenly colored, anterior margin of the pronotal blotch.

Sericothrips sternalis sp. nov.

Female (macropterous).—Length about 1.0 mm. (fully distended, 1.18 mm.). Color brown, with posterior half of dorsum and of sides of metathorax, all of abdominal tergum I excepting sides, and *all of abdominal segments VI and X, yellow;* median portion of terga II–V paler than lateral portions because of dark pubescence on the latter; terga II–VIII with the usual subbasal dark line; head brown in front of occipital line and along cheeks, somewhat paler ventrally, brownish yellow behind occipital line; pronotum brownish yellow, with a large, transverse, brown blotch whose evenly concave anterior margin is limited by a heavy black line (an apodeme) situated just in advance of middle of pronotum, its lateral and posterior margins marked by much fainter dark lines, its four corners prolonged, posterior margin deeply concave at middle, lateral margins subangulate at middle; transverse sculptural lines of pronotum blackish brown and conspicuous; legs with all coxæ brown, fore and middle femora yellow but shaded on outer surface with brown, hind femora largely brown shading to yellow in basal half or third and often at apex, remainder of legs yellow, or with fore tibiæ clouded with gray along outer surface; wings of fore pair dark brownish gray in basal seventh (inclusive of anal area or ''scale''), white in the succeeding eighth, and gray-brown beyond, paler but not white at eighth tenth; antennæ with segments I–IV dusky yellowish, II often very lightly clouded with gray in basal portion, III shaded with brown in narrow portion beyond pedicel and more darkly with brown apically, IV darker than III, with its brief pedicel darker and narrow apical portion nearly blackish brown, especially along sides and narrowly across apex, V with pedicel blackish brown, a white ring just beyond, remainder of basal half dusky yellowish, shading to gray brown in apical half, VI–VIII gray-brown, usually paler than apex of IV; ocellar pigmentation red.

Head, when in a horizontal position, about twice as wide as long and nearly three times as wide as median length in front of occipital line, much broader across eyes than elsewhere, entire dorsal surface, including the area behind the occipital line, very finely and closely striate with dark raised lines, setæ as usual in the genus (i.e., four subequal and nearly equidistant ones in front of median ocellus, one pair between median and posterior ocelli on a line tangent with their outer margins, one pair just behind posterior ocelli and on a line with their outer margins, this last pair with their points just meeting, two minute pairs close to the last and to the eyes, two pairs on dorsal surface of cheecks just behind eyes, one nearly lateral pair close to middle of cheeks, and another pair ventral to and behind the last); occipital line dark and heavy, *tangent with posterior margin of eyes. Eyes* prominent, protruding, pilose, somewhat shorter than their interval, the latter about 1.4 times their width. *Ocelli* 17 μ in diameter, the posterior pair 28 μ apart. *Antennæ* about 1.75 times as long as greatest width of head, segments formed much as usual in the genus, III and IV distinctly narrowed in apical portion, VI not pedicellate, its two long sense-cones attacked at sides and forming narrow, pale lines which originate at basal third of segment; setæ on III and IV, and inner dorsal seta on I, moderately strong and dark, the inner dorsal on III about 40 μ. *Mouth-cone about 1.6 times as long as width at base,* the three segments of the maxilliary palpi measuring 25, 9, and 23 μ, respectively, thus *totalling about 57* μ.

Prothorax with the pronotum about 1.3 times as long as head and 1.9 times as wide as long, the transverse, anastomosing lines prominent because of their dark color, more closely spaced in the area of the pronotal blotch, nowhere tending toward reticulation, those in the pale areas with numerous cross-wrinkles between them; pronotal blotch margined almost throughout with dark, apodemal thickenings, that forming its anterior margin especially heavy and usually with three pairs of setæ on or near it; one large (58 μ), dark, prominent, outstanding seta at each posterior angle of pronotum. *Mesonotum* and metanotum very finely and closely striate, with a very few, indistinct, accessory striæ between them; *metasternum with the dark brown, modified portion deeply emarginate in front, the sides of the notch chitinized and forming an angle of less than 90°, the apex of the notch connected by two, dark, parallel apodemes with the origin of the metasternal furca. Fore wings* about 20 times as long as width at middle; costal margin with about 25 setæ, longitudinal vein with a basal group of 3 followed by about 20, of which the distal ones are more widely spaced; two additional setæ near tip of wing, in a series posterior to longitudinal vein. *Legs* not markedly long and slender.

Abdomen normal, the pubescence distinct and nearly black, lacking from median portions of terga I–VII (save a minute patch at middle of basal portion of II, two or three transverse rows in the region of the dark subbasal line on III–V, and a somewhat larger subbasal patch on VI and VII), totally absent from IX, sparse and scattered on X, lacking from base and distal third of median portion of VIII; comb complete on VII and VIII, though small and very close on the former, the more basal terga (excepting I) often with patches of exceedingly minute comb in median portion; all abdominal setæ dark brown.

Measurements of holotype (♀), in mm.: Length about 1.0 (distended, 1.18); head, total median length 0.081, greatest width (across eyes) 0.165; eyes, length 0.062, width 0.048, interval 0.068; prothorax, length 0.106, width 0.202; pterothorax, greatest width 0.245; fore wings, length 0.672, width at middle 0.033; abdomen, width 0.302.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	23	38	56	53	43	52	12	12
Width (μ):	25	27	23	20	17	16	6	5

Total length of antenna 0.289 mm.

Male (macropterous).—Length about 0.67 mm. (distended, 0.78 mm.). Color and structure almost as in female, excepting that segment VII of the abdomen is pale like VI; and X, though somewhat paler than IX, is much darker than VI or VII; abdomen more slender than in female, normal to the genus.

Measurements of allotype (♂), in mm.: Head, greatest width 0.136; eyes, width 0.041, interval 0.055; prothorax, length 0.087, width 0.152; pterothorax, width 0.192; fore wings, length 0.504, width at middle 0.027; abdomen, width 0.158.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	18	33	43	47	35	42	10	10
Width (μ):	22	23	19	18	15	14	5	4

Total length of antenna 0.238 mm.

Described from 14 females and 5 males, as follows: Barro Colorado Island, C.Z., Panama, June 25, 1933, J. D. H., 7♀♀ on leaves of *Hamelia nodosa* Mart. & Gal. (determined by Dr. Paul C. Standley) [Hood No. 946]; June 26, 1933, J. D. H., 6♀♀ and 4♂♂ (including the *holotype* and *allotype*) on leaves of *Citrus limetta* Risso [Hood No. 950]; Aug. 6, 1933, J. D. H., 1♀ from miscellaneous vegetation [Hood No. 1039]. Martinique, French West Indies, March 14, 1915, Dr. C. B. Williams, 1♂ in sweepings near Fort de France [Williams No. 581].

The coloration of the body and wings, as well as many details of structure, ally this species with *portoricensis;* indeed, without careful study, it is quite likely to be confused therewith. But the characters italicized in the description above will identify it readily. Conspicuous and important is the form and structure of the metasternum, a character which has suggested the specific name.

Sericothrips burungæ sp. nov.

Female (macropterous.)—Length about 1.0 mm. (distended, 1.17 mm.). *Color* of fresh or living specimens bright orange yellow, the orange shade predominating in pterothorax and continued conspicuously into wing veins (specimens in preservative quickly lose *all* of the orange cast, which is due to internal pigmentation, and become pale straw yellow); pronotum with the usual blotch fragmented, consisting of a gray-brown transverse band whose ends involve the two anterior foveæ on each side (this band with anterior margin sharply defined, darker, and curved posteriorly at middle, where it is narrow and nearly interrupted), and two very pale gray, obscure spots on each side occupying the two pairs of posterior foveæ, the anterior spot larger, transverse, and often more or less divided into two; mesonotum shaded with gray on anterior margin and at sides, metanotum with a pair of obscure gray spots; abdomen with terga II–VII with the usual conspicuous dark brown transverse line, VIII with a short median line, those on II–VII with a brown spot behind either end, sides of segments I–VIII lightly shaded with gray; legs paler than body, femora and fore tibiæ slightly shaded with gray on outer surface; wings of fore pair light grayish yellow, with anal margin of scale shaded with gray, area behind the three subbasal setæ on anterior vein darker gray and followed by a small white spot and then by an indistinct gray cloud behind the next four or five setæ, the veins all with conspicuous orange pigmentation in fresh specimens; antennæ with segment I pale yellowish, II pale brown (in fresh material with a yellowish cast due to internal pigmentation), III pale grayish yellow, with a narrow brown line across extreme distal end of pedicel which is followed by a clear white line, the narrowed basal portion of the segment brown and its apical two-fifths lightly clouded with brown, extreme apex narrowly blackish brown, IV grayish yellow, with pedicel dark brown, apex nearly blackish brown, and distal half or more distinctly brownish, V with the brown pedicel followed by a pale line, the remainder of segment brown, becoming darker distally, its apex paler than that of III or IV and concolorous with remainder of antenna; ocellar pigmentation bright red.

Head about 1.6 times as wide as median length when in strictly dorsal aspect, much broader across eyes than across cheeks, the latter rounded anteriorly, straight and converging posteriorly; surface with indistinct transverse lines in front of ocellar area and behind occipital line, the latter distinct at sides but obsolete at middle and as far behind eyes as diameter of a facet; setæ as usual in the genus (see above description of *S. sternalis*), the postocellar pair slightly overlapping. *Eyes* prominent, protruding, about 0.82 as long as head, distinctly longer than their interval, the latter fully 1.4 times their width. *Ocelli* of posterior pair about 16 μ in diameter and 28 μ apart. *Antennæ* about 2.9 times as long as head, 1.8 times the width of head across eyes, of normal form and structure; segments III and IV slightly narrowed in distal portion, the outline of their sides concave beyond the broadest part, setæ on II–V dark brown; VI not pedicellate, its ventral sense-cone originating at basal third of segment. *Mouth-cone* scarcely attaining posterior margin of prosternum.

Prothorax with the pronotum about 1.4 times as long as head and about 1.34 times as broad as long, of the usual form, and with the usual raised anastomosing transverse lines pale, close, not tending toward reticulation; seta at posterior angles stout and dark brown, about 50 μ long. *Mesonotum* more finely striate than pronotum; metanotum transversely and finely striate at middle and base, longitudinally and more coarsely at sides. *Fore wings* about 19 times as long as width at middle; costal margin with about 28 setæ, anterior vein with a subbasal group of 3 followed by about 23; one additional seta behind longitudinal vein near tip of wing. *Legs* of normal form, hind tibiæ about 200 μ long and 28 μ wide.

Abdomen of normal form and structure, about 1.3 times as broad as pterothorax, with complete comb on terga VII and VIII; terga III–VII pubescent across base in the region of dark line; setæ brown, distinct.

Measurements of holotype (♀), in mm.: Length about 1.0 (distended, 1.17); head, length 0.090, length in front of occipital line 0.074, greatest width (across eyes) 0.145, width across cheeks 0.133; eyes, length 0.067, width 0.042, interval 0.060; prothorax, length 0.125, width 0.167; pterothorax, width 0.217; fore wings, length 0.714, width at middle 0.037; abdomen, width 0.284.

Antennal segments:*	1	2	3	4	5	6	7	8
Length (μ):	23	35	53	46	39	45	9	12
Width (μ):	25	25	19	18	16	15	6	5

Total length of antenna 0.262 mm.

* Of paratype.

Male (macropterous).—Length about 0.8 mm. (distended, 0.88 mm.). Color and structure almost exactly as in female, except that there is no dark transverse line at base of tergum VIII of the abdomen, the lines on II–VII are less distinct and are bordered behind with gray spots only on II, and the lateral abdominal shading is wanting.

Measurements of allotype (♂), in mm.: Head, length 0.077, length in front of occipital line 0.058, greatest width (across eyes) 0.129, width across cheeks 0.114; eyes, length 0.056, width 0.039, interval 0.051; prothorax, length 0.096, width 0.129, seta at posterior angles 0.037; pterothorax, width 0.172; fore wings, length 0.672, width at middle 0.027; abdomen, width 0.150.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	20	32	43	40	33	40	8	10
Width (μ):	22	23	18	16	15	14	6	5

Total length of antenna 0.226 mm.

Described from 14 females and 2 males, taken on Barro Colorado Island, C. Z., Panama, Aug. 4, 1933, by the writer, all excepting two of the females from young leafy shoots of an undetermined plant [Hood Nos. 1033 and 1034].

The pale coloration, the non-pedicellate sixth antennal segment, the presence of complete transverse dark lines on the abdominal terga, the additional seta on the fore wings near their tip, and the coloration of the fourth antennal segment distinguish this species readily from all members of its genus with the exception of *setosus* and *signifer.* The latter, described from Mexico, is clearly a larger insect, with the legs distinctly marked with darker, the seta at the hind angles of the pronotum pale instead of dark brown, and the fourth antennal segment less narrowed apically. The species *spinosus,* of the southwestern desert area of the United States, could easily be mistaken for the present one; however, its occipital line is complete and separated from the eyes by a distance about equal to twice the diameter of an eye-facet, its meso- and metanota are almost non-striate, its subbasal abdominal terga are not medially pubescent in the neighborhood of the transverse line, and the ventral sense-cone on segment VI of the antennæ originates about one-half, instead of one-third, the distance from its base.

The specific name is based upon an old Indian name of a region close to or perhaps including part of the present Barro Colorado Island.

Genus SCIRTOTHRIPS Shull

1909. *Scirtothrips* Shull, Ent. News, **20** (5): 222.

1929. *Sericothripoides* Bagnall, Bull. Ent. Res., **20** (1): 69.

In addition to the species now placed in this genus, the following belong here; type material of both is in my collection:

Scirtothrips bispinosus (Bagnall), comb. nov.; described in *Dendrothrips;* later made the type of the new genus *Sericothripoides.*

Scirtothrips andreæ (Karny), comb. nov.; described in *Anaphothrips;* possibly a synonym of *Scirtothrips dorsalis* Hood.

Scirtothrips panamensis sp. nov.

Female (macropterous).—Length about 0.7 mm. (distended, 0.8 mm.). *Color* of fresh or living specimens bright orange-yellow, due to internal pigmentation which is continued conspicuously into the wing-veins (specimens in preservative quickly lose all of the orange cast and become pale straw-yellow); front of head and front and sides of mesothorax with a faint, cuticular, gray cloud; abdominal terga II–VIII each with a dark cross-line near base, those on III–VII *nearly attaining lateral margins,* that on II finer than the others, closer to base of tergum, and often nearly or quite interrupted at middle, that on VIII shorter, broader, and darker; whole median third of III–VII occupied by a gray cloud, II more broadly but less distinctly gray, VIII and IX more or less distinctly gray at middle; sides of abdomen marked with gray; *sterna IV–VII each with a dark, basal cross-line, that on VII shorter than those on V and VI;* legs yellow, somewhat shaded with gray on outer surface of femora and tibiæ; wings dark gray, in fresh specimens with the veins orange, slightly paler at middle beyond scale and at apex, the setæ and fringing hairs dark brown; antennæ with segment I white or slightly yellowish, II rich dark brown, darker at sides, its color due to orange pigmentation beneath the gray cuticula, III–VIII nearly uniform dark gray, with pedicel of III yellowish and a pale ring just beyond pedicel of V; ocellar pigmentation bright red; setæ brown.

Head broad, its greatest width (across eyes) nearly 1.9 times the median length, cheeks straight and converging posteriorly, occiput very finely and closely striate; setæ small and normal in position, postocellars 14 μ, arising behind and slightly laterad of posterior ocelli. *Eyes* nearly 0.7 as long as head and about 0.75 as long as their interval, the latter nearly twice their width. *Ocelli* of posterior pair about 10 μ in diameter and 25 μ apart; anterior margin of median ocellus about attaining base of first antennal segment. *Antennæ* of normal form and structure. *Mouth-cone* broadly rounded, darker than rest of head in color, nearly attaining posterior margin of prosternum in non-distended specimens, its maxillary palpi three-segmented.

Prothorax nearly 1.4 times as long as head and 1.44 times as broad as long, the surface of pronotum very finely and closely cross-striate with raised anastomosing lines, except in the foveæ, and with a few scattered dark setæ; one major seta at posterior angles, this outstanding, blackish brown in color, and about 27 μ long; one pair of slender setæ on posterior margin between the major pair, and two external pairs, both of the latter curved and appressed, the inner pair longer, darker, and stronger. *Legs* normal. *Wings* of fore pair with about 22 costal setæ, anterior vein with three small setæ at base, followed by three larger and more widely spaced ones, and then by three in distal half; posterior vein with two in about distal third.

Abdomen of typical form, closely pubescent at sides, with complete, fine comb on tergum VIII; dorsal pair of setæ on IX and X about 37 μ.

Measurements of holotype (♀), in mm.: Length about 0.67 (distended 0.78); head, length 0.065, greatest width (across eyes) 0.122, width across cheeks 0.116; eyes, length 0.045, width 0.031, interval 0.060; prothorax, length 0.090, width 0.130; pterothorax, width 0.182; fore wings, length 0.476, width at middle 0.030; abdomen, width 0.193.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	17	32	38	34	32	36	7	10
Width (μ):	19	23	16	17	15	15	7	4

Total length of antenna 0.206 mm.

Male (macropterous).—Length about 0.56 mm. Color and structure essentially as in female; hind femora without comb; abdomen without drepana.

Described from 5 females and 1 male, taken from miscellaneous shoots of unidentified shrubby plants growing in a banana plantation, Barro Colorado Island, C. Z., Panama, August 4 and 9, 1933, J. D. H. [Hood Nos. 1033 and 1047].

The eight-segmented antennæ, the abdominal coloration, and the relatively short seta at each posterior angle of the pronotum distinguish this species from all of its congeners with the exception of *dorsalis* and *andreæ*. In them, however, the cross-line on abdominal sternum VII is long and nearly complete, and the dorsal cross-lines and median gray markings are far less extensive.

Anaphothrips limbatus sp. nov.

Female (macropterous).—Length about 0.85 mm. (distended, 1.02 mm.). Color dull yellowish, with obscure gray spots, several of these prothoracic and minute, metanotum with a large median one in posterior portion, abdominal segments I–VI or I–VII with a lateral pair and a large median one (the median one on tergum I somewhat the darkest), terga II–VII with a pair of round spots involving the attachments of the tergo-sternal muscles, all of these spots more or less indistinct; legs concolorous with body; antennæ with segment I pale yellowish, II brown, III and IV pale yellow in pedicel, shading to gray-brown in about distal half, each with a narrow dark chitinous transverse line just beyond the subapical setæ, the line on III darker than that on IV, the segment somewhat paler beyond it; V lighter than any except I, yellowish in basal half or more, distally shading to light gray-brown; VI–VIII dark gray-brown; wings of fore pair light yellowish brown, with a small circular clear spot at middle of basal sixth, the two longitudinal veins and the ambient vein slightly darker, the setæ dark brown and conspicuous.

Head about 0.63 as long as greatest width, which is across cheeks, the latter swollen, evenly rounded to eyes and base, and distinctly serrate; frontal costa with a minute V-shaped notch; occiput with several distinct transverse anastomosing lines, ocellar region nearly smooth, vertex in front of ocelli rugulose; setæ minute, one pair arising just in front of median ocellus and as far apart as diameter of latter, a second pair directly laterad of median ocellus, a third pair directly in front of posterior ocelli, a fourth pair behind posterior ocelli, their bases about on a line with inner margins of latter and more than half the diameter of ocellus from them, a fifth pair at inner posterior angles of eyes, a sixth pair just behind eyes, close to and on the same transverse line with another pair on profile of cheeks. *Eyes* somewhat protruding, the width across them nearly equal to greatest width of head across cheeks, their length about 0.76 that of head, their width less than their interval. *Ocelli* forming an equilateral triangle, posterior pair 11 μ in diameter and 17 μ apart. *Antennæ* about 2.6 times as long as head, thoroughly typical of the genus; segments III and IV each with a forked sense-cone which is short and inconspicuous, that on III dorso-lateral in position. *Mouth-cone* surpassing middle of prosternum; maxillary palpi three-segmented, segment I about 14 μ, II 9 μ, III 14 μ.

Prothorax fully 1.2 times the length of head, about 1.65 times as wide as long; pronotum rugulose, particularly at sides, and with numerous, short, stout, subequal setæ; no long setæ at posterior angles. *Legs* normal. *Wings* of fore pair about 2.4 times as long as greatest width of abdomen and about 13.4 times as long as their width at middle; setæ short (11 μ) and stout, conspicuous because of their dark color; costal margin with about 24 such setæ and about 17 fringing hairs; anterior vein with 4 + 4 at base and 7 or 8 nearly equidistant ones beyond; posterior vein with a series of 7–10, these nearly equidistant, commencing opposite the second series of 4 on the anterior vein, and ending before the penultimate seta of that series; anal margin of wing with about 45 fringing hairs; anal area or "scale" with the two usual, distal, ventral, converging hairs pale, and with 5 or 6 dark setæ, of which one is on the mid-line near base, and the others distal therefrom, along cubic-anal fold, the distad seta longer and stouter than the others.

Abdomen of normal form; *terga II–VII fringed posteriorly in lateral third or more with numerous, delicate, tooth like processes, VIII with complete comb of longer processes;* terga II–VIII each with a pair of long, slender setæ along mid-line, those on V–VIII farther apart, converging, and about as long as the terga themselves; laterad of these is a second series of setæ, successively longer and closer to the first series on succeeding segments; setæ on IX and X short (37–40 μ), only slightly diverging; dorsum of abdomen with fine, widely-spaced, dark anastomosing lines in the shaded areas, those on the more distal segments faintly asperate.

Measurements of ♀ (holotype), in mm.: Length about 0.85 (distended, 1.02; head, length 0.076, width across eyes 0.117, across cheeks 0.120, least width just behind eyes 0.110, least width at base 0.112; eyes, length 0.057, width 0.037, interval 0.044; prothorax, median length of pronotum 0.093, greatest width 0.154; pterothorax, greatest width 0.196; fore wings, length 0.536, width at middle 0.040; abdomen, greatest width 0.224.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	17	30	37	32	27	37	7	12
Width (μ):	22	23	18	19	18	17	6	4

Total length of antenna, 0.199 mm.

Male (macropterous).—Length about 0.67 mm. (distended, 0.79 mm.). Color paler than in female, with the gray spots less evident. Terga fringed as in female, and comb on VIII complete; IX with two pairs of slender, nearly parallel, equidistant setæ about 33 μ long, the median pair situated a little cephalad to the others.

Measurements of ♂ (*allotype*), in mm.: Head, length 0.070, width across eyes 0.101, across cheeks 0.101, least width just behind eyes 0.097, least width at base 0.093; prothorax, median length of pronotum 0.080, greatest width 0.134; pterothorax, greatest width 0.170; fore wings, length 0.434, width at middle 0.031; abdomen, greatest width 0.163.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	15	26	29	26	25	33	5	9
Width (μ):	20	21	17	17	16	15	6	4

Total length of antenna, 0.168 mm.

Described from 16 females and 2 males, all taken on Barro Colorado Island, Canal Zone, Panama, July 29, 1933, by Sabra J. Hook, Helen H. Hood, and the writer, from flowers of *Euphorbia brasiliensis* Lam. (determined by Dr. Paul C. Standley) [Hood Nos. 1020 and 1023].

In the structure of the abdominal terga, this species suggests *A. tricolor* Moulton and *A. enceliæ* Moulton (the latter is probably a synonym of the former), but the coloration is very different, the antennæ eight- instead of nine-segmented, and there is no long seta at the posterior angles of the pronotum.

Genus **Salpingothrips** nov.

(σαλπίγξ, a trumpet; θρίψ, a wood worm—in allusion to the trumpet-shaped pronotal setæ)

Body not reticulated. Head small, wider than long, without long setæ. Antennæ eight-segmented, the two distal segments long and slender; segments III and IV with short, forked sense-cones. Mouth-cone very long and heavy, surpassing posterior margin of prosternum, its long maxillary palpi three-segmented. Prothorax long, fully 1.5 times the length of head, broadening posteriorly, front margin straight, side margins nearly so, posterior margin arcuate; posterior angles each with two, stout setæ which are broadly expanded at apex. Legs short and moderately stout. Fore wings slender, with two indistinct longitudinal veins sparsely set with minute setæ. Abdomen of normal form, not clothed with minute pubescence, but with moderately heavy, transverse, anastomosing lines; posterior margin of tergum I serrate with minute teeth, posterior margins of both terga and sterna II–VIII prolonged into a thin flange which considerably overlies the following segment; tergum X completely divided; setæ on segments IX and X short and stout.

Genotype: S. minimus sp. nov.

Allied to *Anaphothrips.* The long mouth-cone and peculiar pronotal setæ are distinctive.

Salpingothrips minimus sp. nov.
Plate XII, Fig. 5

Female (macropterous).—Length about 0.74 mm. (fully distended, about 0.9 mm.).—Color uniform brown, with legs yellow, the femora sometimes shaded along outer margin at base, rarely entirely brown, in which case the tibiæ are shaded with brown; coxæ always brown; antennæ sometimes dark brown, with segment III paler, but usually with segments I and II brown (the latter pale distally and externally, and darkest along inner surface), III clear yellow, IV yellow but often somewhat shaded with brown distally, invariably much darkened beyond pedicel on inner surface, V yellow, with at least the pedicel and distal third or fourth distinctly brownish, VI yellow in basal half, quite abruptly dark gray-brown beyond, VII and VIII concolorous with distal portion of VI; wings usually pale yellowish, with brown fringing hairs and pale yellowish setæ, sometimes with a median brown basal streak (not involving scale) in basal fourth, rarely with this streak involving basal third of wing and basal two-fifths of scale, then with a dark band occupying fourth fifth of wing; no evident fat-body pigmentation; ocellar pigmentation red.

Head (Pl. XII, fig. 5) small, moderately long, its length about 0.76 its greatest width, which is across eyes, the cheeks subparallel and only slightly narrower, vertex transverse and sloping in front; dorsal surface with several heavy, transverse dark lines of sculpture which produce distinct indentations in the profile of the cheeks; setæ minute, two pairs (the median one larger) forming a line across head in front of anterior ocellus, one pair between posterior ocelli about on a line with their front margins, two pairs behind posterior ocelli and close to inner posterior angles of eyes, one pair on profile of cheeks, just behind eyes. *Eyes* with round, separated facets, nearly half as long as head, somewhat narrower than their interval. *Ocelli* not elevated, posterior pair about 10 μ in diameter and 16 μ apart. *Antennæ* about 2.9 times the length of head. *Mouth-cone* very long, surpassing posterior margin of prosternum; segment I of maxillary palpus 22 μ, II 19 μ, III 17 μ.

Prothorax (Pl. XII, fig. 5) long, the median length of pronotum about 1.27 times the width of head across eyes and about 0.83 its own greatest width; surface nearly smooth, with a few faint, well separated, transverse anastomosing lines, and scattered pale setæ; one pair of short but stouter setæ at anterior angles; the two major setæ at posterior angles brown, heavy, and much expanded apically, measuring 13–24 μ in length; posterior margin with three pairs of small setæ. *Fore legs* short and stout. *Wings* of fore pair about 1.7 times as long as greatest width of abdomen, with about 12 short setæ (the distal ones nearly invisible) and 6 fringing hairs on costal margin, 8 indistinct setæ on median vein (6 of them in basal half, 2 in apical sixth), 5 similar setæ on posterior vein, and 28–30 fringing hairs on posterior margin; anal area or ''scale'' with the two usual distal, ventral, converging hairs pale, and with five dark setæ, of which one is on mid-line one-fourth from base, and the others distal therefrom, along cubito-anal fold.

Abdomen of normal form, terga with a few dark, transverse anastomosing lines of which there are about three on each of II–VII; tergum I with posterior margin finely serrulate with acute projecting teeth, terga and sterna II–VIII prolonged into a thin flange which considerably overlies the following segment; tergum X completely divided; setæ minute, excepting on IX and X where the dorsal pairs measure 60–64 μ and about 68 μ respectively.

Measurements of ♀ (paratype), in mm.: Length about 0.74 (distended, about 0.91); head, length (middorsal) 0.064, greatest width (across eyes) 0.084, greatest width across cheeks 0.083; eyes, length 0.041, width 0.027, interval 0.036; prothorax, median length of pronotum 0.107, greatest width 0.129; pterothorax, width 0.168; fore wing, length 0.350, width at middle 0.023; abdomen, width 0.203; tergum VIII, length 0.069, IX 0.066, X 0.057.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	17	27	27	29	27	35	12	13
Width (μ):	20	20	17	17	15	13	5	4

Total length of antenna, 0.187 mm.

Male (macropterous).—Length about 0.7 mm. (distended, about 0.8 mm.). Color and structure essentially as in female, the departures from above description as follows: Head perhaps longer, 0.8 as long as wide; eyes about 0.6 as long as head; posterior ocelli about 9 μ in diameter; antennæ about 2.6 times the length of head. Pronotum about 1.2 times the width of head across eyes; inner seta at posterior angles about 13 μ, outer seta about 17 μ. Abdominal sterna III–VII each with a transverse, narrow, granulate, specialized area at middle, that on V somewhat longer than the others and measuring about 46 μ transversely and 6 μ longitudinally; tergum IX with a slightly curved row of four setæ at distal third, the inner pair longer, the outer much stouter, and a pair of strong dark lateral setæ measuring 29 μ; lateral setæ on segment X curved inward at tip, dark brown in color, 60 μ long.

Measurements of ♂ (allotype), in mm.: Length about 0.71 (distended, 0.81); head, length 0.071, greatest width (across eyes) 0.088, greatest width across cheeks, 0.089; eyes, length 0.043, width 0.027, interval 0.034; prothorax, median length of pronotum 0.103, greatest width 0.126; pterothorax, width 0.157; fore wings, length 0.343; abdomen, width 0.161.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	17	27	28	28	27	35	11	13
Width (μ):	20	20	16	16	15	13	5	4

Total length of antenna, 0.186 mm.

Described from 11 females and 9 males, all taken on Barro Colorado Island, Canal Zone, Panama, August 8–14, 1933, by the author [Hood Nos. 1041, 1051, and 1057]. Most of the specimens were taken among young terminal leaves of *Cajanus bicolor*

D.C.; two came from *Machærium purpurascens* Pittier; and two were collected from plants which were too young for Dr. Paul C. Standley to place generically.

The form of the large setæ at the posterior angles of the pronotum, and the minute size, distinguish this species at once. Dr. H. Priesner studied one of the types, and agrees that the species cannot be placed in any described genus.

The long, heavy mouth-cone makes it nearly impossible to mount specimens without some distortion or deflection of the head; and it is possible that in the description and measurements of the female, the head and eyes are said to be shorter than they should be. The proportions given in the description of the head and eyes of the male are thus quite possibly correct for the female also, because the head of the allotype is more nearly in what I should consider a normal position.

The two specimens from *Machærium purpurascens* and one of those taken on undetermined plants, are much darker in coloration than the remainder of the series. Their dark femora and antennæ, and the banded wings, give them a somewhat different facies; but no structural differences can be detected. They appear to represent an environmental modification, and for that reason I see little point in giving them a distinctive name. It is possible, too, that they are older, and consequently darker, individuals of an earlier generation, and that the same coloration would ultimately be attained by the paler individuals.

Frankliniella diversa sp. nov.

(Pl. XI, figs. 5–7)

Female (macropterous).—Length about 1.0 mm. (distended, 1.3 mm.). Color brown, abdomen darker, head indistinctly paler in front of ocelli; coxæ brown, tibiæ, tarsi, and trochanters yellow, fore and middle femora yellow, clouded with brown on outer surface, hind femora brown, but paler than abdomen, narrowly yellow at tip; fore wings uniform light brown, with setæ darker; antennæ with segment I yellowish gray and much paler than II, the latter gray-brown and nearly as dark as VI–VIII, but with an orange cast due to internal pigmentation largely concentrated at tip, III bright yellow, IV yellow in pedicel, lightly clouded with brown beyond, V largely gray-brown and darker than IV, yellowish in narrow basal portion, VI–VIII dark gray-brown; ocellar pigmentation red.

Head (Pl. XI, fig. 5) about 0.72 as long as greatest width, broadest across eyes, narrowed posteriorly, cheeks nearly straight; interocellar setæ brown, long (about 30 μ), much longer and stronger than other dorsal cephalic setæ. *Eyes* about 0.65 as long as head. *Antennæ* (Pl. XI, fig. 6) about 2.25 times as long as head; *segment II about as wide as long, inner and outer surfaces with a conspicuous bulge at middle,* apex thickened and bearing a pair of heavy, conspicuous, dark brown setæ about 21 μ long; III much narrower than II, its pedicel (Pl. XI, fig. 7) with the subbasal shelf-like thickening angulate in profile, dorsum of segment with a pair of very stout black setæ about 37 μ in length. *Mouth cone* not elongated, but surpassing middle of prosternum.

Prothorax (Pl. XI, fig. 5) about 1.4 times as wide as long and 1.14 times the length of head; setæ brown, about concolorous with pronotum, anterior marginals 37 μ, outer pair at posterior angles 53 μ, inner 62 μ; surface of pronotum with anastomosing lines pale and inconspicuous. *Wings* of fore pair with about 26 setæ and 25 fringing hairs on costal margin, 4 + 14 setæ on anterior vein, and 18 setæ on posterior vein.

Abdomen of normal form; posterior margins of most terga faintly crenulate, VIII with complete comb of fine spines arising from about 17 crenulations; setæ on IX and X dark blackish brown, dorsal pair on IX 81 μ, dorsal pair on X 110 μ; tergum X divided nearly to base.

Measurements of ♀ (holotype), in mm.: Length about 1.04 (distended, 1.32); head, length 0.106, greatest width (across eyes) 0.147, least width (at base) 0.130; prothorax, median length of pronotum 0.121, greatest width 0.170; pterothorax, greatest width 0.245; fore wings, length 0.644, width at middle 0.055; abdomen, greatest width 0.277.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	25	33	44	41	32	43	9	12
Width (μ):	30	31	20	19	17	18	7	6

Total length of antenna 0.239 mm.

Described from 1 female taken by the writer at Porto Bello, Panama, July 10, 1933, on a dead branch [Hood No. 988].

The form of the second antennal segment is unique and should enable the species to be recognized at once. It is a member of my Group II of the genus, and in general appearance suggests *parvula, zeteki,* and the new species *standleyana,* described below.

Frankliniella standleyana sp. nov.

Female (macropterous).—Length about 1.14 mm. (distended, 1.41 mm.). *Color* brown, abdomen darker, head darker than prothorax, all of thorax with an orange cast due to internal pigmentation; coxæ and femora brown, the fore femora yellow apically and along inner surface; tibiæ and tarsi yellow; fore wings uniform brown, with setæ darker; antennæ with segment I gray-brown, paler than head and segment II, the latter with orange pigmentation which gives it a rich brown color; III and IV bright orange-yellow, the latter with a very slight shading of gray beyond widest portion; V yellowish, with less orange pigmentation than IV, lightly shaded with gray in about distal half; VI–VIII brownish gray, nearly as dark as II, base of VI paler and yellowish; ocellar pimentation red.

Head about 0.73 as long as greatest width, broadest across eyes, narrowed posteriorly, cheeks nearly straight; interocellar setæ brown, long (about 49 μ), much longer and stronger than other dorsal cephalic setæ. *Eyes* about 0.63 as long as head. *Antennæ* about 2.4 times as long as head; segment II considerably thickened on dorsum at apex and distinctly produced, with a pair of prominent dark setæ about 26 μ long, *ventral surface with a heavy, dark, transverse carina near apex;* III with basal portion overlain and obscured by dorsal prolongation of II, its *pedicel with the subbasal thickening very broad* (*14* μ) and angulate in profile, the segment itself nearly three times as long as wide, dorsum with a pair of strong dark setæ about 42 μ in length. *Mouth-cone* not enlongated, but surpassing middle of prosternum.

Prothorax about 1.44 times as wide as long and nearly 1.1 times the length of head; setæ dark brown, anterior marginals 58 μ, anterior laterals 38 μ, outer and inner pairs at posterior angles 77 μ; surface of pronotum with anastomosing lines pale and inconspicuous. *Wings* of fore pair with about 24 setæ and 24 fringing hairs on costal margin, 4 + 12–14 setæ on anterior vein, and 13–14 setæ on posterior vein.

Abdomen of normal form; posterior margins of most terga faintly crenulate, VIII with complete comb of fine spines arising from about 15 crenulations; setæ on IX and X dark blackish brown, dorsal pairs on IX and X each 100 μ; tergum X divided nearly to base.

Measurements of ♀ (holotype), in mm.: Length about 1.14 (distended, 1.41); head, length 0.121, greatest width (across eyes) 0.165, least width (at base) 0.140; eyes, length 0.076; prothorax, median length of pronotum 0.132, greatest width 0.190; pterothorax, greatest width 0.260; fore wings, length 0.700, width at middle 0.057; abdomen, greatest width 0.298.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	26	40	61	52	36	51	10	16
Width (μ):	32	27	22	21	16	18	7	5

Total length of antenna 0.292 mm.

Male (macropterous).—Length about 0.87 mm. (distended, 1.04 mm.). Color about as in female, but paler; legs yellow, femora lightly shaded with gray on outer surface; antennæ somewhat paler than in female, segment II scarcely darker than I. Head about 0.65 as long as greatest width, interocellar setæ about 42 μ; antennæ about 2.5 times as long as head; setæ on dorsum of segment II about 24 μ long; segment III as in female. Prothorax about 1.6 times as wide as long; anterior marginal setæ 53 μ, anterior laterals 55 μ, outer pair at posterior angles 63 μ, inner pair 69 μ. Abdomen narrow; sterna III–VII each with a sensory area which is transversely elongate and narrowed at middle, those on IV and V subequal, about 74 μ in their longest dimension, 14 μ broad near ends, and 9 μ across middle; sensory areas on other sterna somewhat shorter; tergum VIII without comb, but with irregular, pointed projections; tergum IX with two pairs of short (17–20 μ), stout, dark setæ behind middle, the inner pair more posterior than the lateral pair; setæ at sides of segments IX and X curved and nearly black, each pair 74 μ long.

Measurements of ♂ (allotype), in mm.: Head, length 0.098, greatest width (across eyes) 0.151, least width (at base) 0.130; eyes, length 0.063; prothorax, median length of pronotum 0.110, greatest width 0.177; pterothorax, greatest width 0.224; fore wings, length 0.574, width at middle 0.043; abdomen, greatest width 0.182.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	20	35	52	44	32	47	9	12
Width (μ):	30	26	21	18	15	18	7	5

Total length of antenna 0.251 mm.

Described from 1 female and 1 male, both taken by the writer on Barro Colorado Island, Canal Zone, Panama, the female in a flower of *Clibadium surinamense* L., July 4, 1933 [Hood No. 977], the male on a flower bud of *Conostegia speciosa* Naud., August 1, 1933 [Hood No. 1029].

The character of the base of the third segment of the antenna distinguishes this species from all other members of Group II of the genus. It is named after Dr. Paul C. Standley, whose manuals on the *Flora of the Panama Canal Zone* and *The Flora of Barro Colorado Island,* Panama, have made it possible to gain in the field a knowledge of some of the food plants of the Thysanoptera, and whose careful determination of the plant specimens have furnished much accurate data for the present series of papers.

Frankliniella pulchella sp. nov.

Female (macropterous).—Length about 1.4 mm. (distended, about 1.7 mm.). *Color* dark brown, with bright *vermilion* fat-body pigmentation in thorax; *legs very pale grayish yellow, with hind femora brown* and the other femora (occasionally the tibiæ also) *lightly shaded with gray on outer surface;* antennæ with segments I and II dark brown and nearly concolorous with head, the apex of II paler, III grayish yellow, paler basally, IV–VIII much darker than III, but *much lighter than I and II, pale gray in color,* the basal portion of IV paler, especially so at distal end of pedicel, V with pedicel dark and a pale cross-line at end of pedicel; wings of fore pair brown with a small pale spot before basal fourth; setæ on body and wings nearly black.

Head long, its greatest width across cheeks negligibly greater than its *length* (this in specimens mounted so that the posterior margin of the head is a straight line in dorsal aspect; in specimens with the head tipped downward the length is of course apparently much less), but broader across eyes than across cheeks, the latter broadest just behind eyes, thence straight and converging to base; vertex sloping evenly downward, frontal costa narrow, not notched; *interocellar setæ especially long* (70 μ) and prominent, situated midway between median and posterior ocelli on a line connecting their centers; other dorsal and lateral cephalic setæ minute, one approximate pair directly in front of anterior ocellus, another close to eyes directly laterad of median ocellus, and six pairs margining eyes behind posterior ocelli, two of these close to the ocelli, one behind middle of eyes, one (the longest, 18 μ) on widest portion of cheeks, the other two respectively above and below this last; dorsal surface with a moderately strong, dark, transverse, occipital line and several fine anastomosing lines which produce a faint serration of the cheeks. *Ocelli* of posterior pair 18 μ in diameter and 27 μ apart. *Antennæ* fully 2.2 times as long as head and *particularly slender,* segment III being fully three times, and VI nearly four times, as long as wide; *IV decidedly shorter than III or VI;* III with subbasal thickening not abrupt and not appearing in profile as a sharp angulation on each side of pedicel; forked sense-cones on III and IV long, that on IV about attaining middle of V. *Mouth-cone* long, about attaining posterior margin of prosternum.

Prothorax about as long as least basal width of head and 1.35 times as wide as long, its surface with a few faint anastomosing lines and a very few minute setæ, its extreme posterior margin with a narrow, dark, chitinous, internal thickening and only two or three pairs of minute setæ; *major setæ long and prominent, the anterior marginals about 73* μ, *anterior laterals and the two pairs at posterior angles about 100* μ. *Wings* of fore pair with about 22 long setæ on costal margin, anterior vein with one minute seta near base followed by three successively longer ones and then by 14–17 which are somewhat shorter, posterior vein with 13 or 14 of which the distal one is longest.

Abdomen of normal form and structure; tergum VIII with comb on posterior margin complete but very delicate, short, and sparse; tergum X divided in somewhat more than distal half; dorsal pair of setæ on IX about 154 μ, on X about 168 μ.

Measurements of holotype (♀), in mm.: Length about 1.43 (distended, 1.76); head, length 0.166, width across eyes 0.180, width across cheeks 0.169, least width at base 0.157; prothorax median length of pronotum 0.158, width 0.213; pterothorax, width 0.312; fore wings, length 0.896, width at middle 0.061; abdomen, width 0.370.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	31	47	73	65	45	70	14	23
Width (μ):	36	29	23	22	16	18	8	5

Total length of antenna, 0.368 mm.

Male (macropterous).—Length about 1.0 mm. (distended, about 1.2 mm.). Smaller and more slender than female, and somewhat paler in color, with all legs beyond the brown coxæ very pale, uniform yellowish, the hind femora not dark; antennæ with the two basal segments about concolorous with head (excepting the paler apex of II, as in female), but with III–V concolorous with the very pale legs save only the slightly grayish, narrowed distal portion of IV, and the darker pedicel and distal third of V; VI–VIII light gray, VI with a dark line across base and paler basally; fat-body pigmentation brilliant vermilion; fore wings colored as in female; body and wing setæ dark blackish brown. Sterna III–VII each with the usual, transverse, pale sensory area at middle; tergum IX with inner and more posterior pair of major setæ 27 μ and stouter than the longer (67 μ) outer pair, its lateral setæ 103 μ; lateral setæ on segment X about 89 μ.

Measurements of allotype (♂), in mm.: Head, length (when horizontal) 0.136, width across eyes 0.168, width across cheeks 0.153, least width at base 0.135; interocellar setæ, length 0.053; prothorax, median length of pronotum 0.133, width 0.187; anterior marginal setæ 0.038, anterior laterals 0.080, outer pair at posterior angles 0.080, inner pair 0.075; pterothorax, width 0.231; fore wings, length 0.648; abdomen, width 0.195.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	28	43	70	59	44	63	12	17
Width (μ):	32	27	18	18	14	17	7	5

Total length of antenna, 0.336 mm.

Described from 36 females and 9 males, all taken on Barro Colorado Island, C. Z., Panama, July 25–December 29, 1933, by Silvestre Aviles, James Zetek, and the author, in flowers of *Adenocalymna flos-ardeœ* Pittier, *Passiflora menispermifolia* H.B.K., *Drymonia spectabilis* H.B.K., *Bixa Orellana* L., *Clitoria arborescens* Ait., and on an unidentified bignoniaceous plant [all determinations by Dr. Paul C. Standley].

This belongs in the so-called Group III, or *intonsa* group, of the genus. The long interocellar and reduced postocular setæ would appear to ally it closely with the Brazilian *speciosa* described by Moulton. The coloration, however, is very different and the sixth antennal segment is much longer, as are also the setæ on the anterior angles of the prothorax. The italicized parts of the description above emphasize the differences between it and *speciosa*. In life it is a very pretty insect with its pale legs and antennæ and the bright vermilion, internal pigmentation. It is common in the flowers of a number of typical rain-forest plants.

Isochætothrips striatus sp. nov.
(Pl. XII, figs. 1–4)

Female (macropterous).—Length about 1.2 mm. (distended, about 1.6 mm.). Color light brown, abdomen somewhat darker distally, head darker in occipital region but pale in front of ocelli, pterothorax somewhat paler than remainder of body, it and prothorax with orange pigmentation; legs much paler than body, femora and tibiæ (particularly those of hind pair) shaded with brown; antennæ with segments I and II dark brown, II with orange pigmentation at tip, III yellow basally, shading to brown before middle, the narrowed apical portion yellow, IV and V yellow in about basal third, remainder of antenna brown, pedicels of III–V slightly clouded with darker; wings of fore pair light brownish in basal third, darkest just beyond, becoming paler in apical portion, their setæ brown; ocellar pigmentation deep red.

Head (Pl. XII, fig. 1) rather long, its greatest width, which is across eyes, less than 1.2 times the mid-dorsal length, somewhat excavated between eyes in front of median ocellus; cheeks nearly straight, abruptly incised at eyes, and converging posteriorly; *entire dorsal and lateral surfaces very closely set with fine, transverse, anastomosing lines, these averaging about 2 μ apart* and producing a minute but deep serration of the cheeks; frontal costa narrowly but sharply notched; cephalic setæ small, one pair in front of median ocellus and close to mid-line, a second pair close to inner margins of eyes and somewhat in advance of attachment of median ocellus, a third pair about midway between anterior and posterior ocelli and on a line tangent with their outer margins, a fourth pair nearly directly behind middle of posterior ocelli, and five pairs of postocular setæ, of which the innermost is longest (23 μ) and close to its neighbor, the others on cheeks, one of them below the profile. *Eyes* somewhat protruding and prominent, coarsely faceted and strongly pilose, about seven facets only forming the lateral profile, their length about 0.6 that of head, their width more than 0.8 their interval. *Ocelli* subequal in size, 20 μ in diameter, the median one directed nearly forward, interval between posterior pair about equal to their diameter. *Antennæ* more than 2.3 times as long as head, segment III decidedly narrowed at apex, its forked trichome moderately long and subequal to that on IV, outer sense-cone on VI stout and very short, inner one on VI about attaining tip of VIII, this last segment much longer than VII; microtrichia on II–VI long and conspicuous. *Mouth-cone* somewhat surpassing middle of prosternum.

Prothorax (Pl. XII, fig. 1) only slightly shorter than head, its surface, like that of head, *very closely and finely transversely striate with anastomosing lines* (Pl. XII, fig. 3) and with a number of small pale setæ; posterior angles with one pair only of strong setæ, these dark brown and 37–50 μ long, the outer pair smaller (21 μ) and paler; posterior margin with three pairs of setæ between the large pair at posterior angles. Meso- and metanota even more finely striate than pronotum. *Legs* normal. *Fore wings* (Pl. XII, fig. 2) with about 32 setæ on costal margin, 23–30 on anterior vein (6 or 7 of them often forming a separate group at base), and 15–19 on posterior vein.

Abdomen of normal form; sides only of terga I–VIII (Pl. XII, fig. 4) striate with oblique lines, one pair of these lines on terga III–VIII bearing a distinct comb in a portion of its length; posterior margins of terga II–VII at extreme sides with a similar comb; tergum VIII with a strong, regular, complete comb on posterior margin, the teeth about 27 μ long; abdominal setæ brown, the dorsal pair on tergum IX 90 μ, dorsal pair on X 108 μ, the latter sclerite divided in distal half or more.

Measurements of holotype (♀), in mm.: Length about 1.22 (distended, 1.55); head, length 0.130, width across eyes 0.152, width at posterior edge of eyes 0.137, width across cheeks 0.147, width at base 0.131; eyes, length 0.079, width 0.048, interval 0.058; prothorax, median length of pronotum 0.126, greatest width 0.170; pterothorax, greatest width 0.260; wings, length 0.812, width at middle 0.053; abdomen, greatest width 0.286.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ):	25	40	67	59	40	56	8	13
Width (μ):	31	27	22	21	18	19	10	6

Total length of antenna 0.308 mm.

Described from 4 females taken by Silvestre Aviles on Barro Colorado Island, Canal Zone, Panama, October, 1933, in flowers of *Coutarea hexandra* Jacq. (Schum.) (determination by Dr. Paul C. Standley) [Hood No. 1077].

The closest ally of this species is doubtless *I. dampfi* Priesner, described from Mexico, with which it agrees in the closely striate head, pronotum, mesonotum, and metanotum, and the smaller size of the outer seta on the posterior angles of the prothorax. Dr. Priesner, who has kindly compared one of my specimens with his types of *dampfi,* states that *striatus* is ''smaller . . . , outer prothoracic bristles rather weak, certainly a different species.''

Plates drawn by Mrs. Philip T. Bassett (Helen E. Rearwin); *camera lucida.*

PLATE XI

Figure 1. *Enneothrips gustaviæ* gen. et sp. nov., head and prothorax, ♀, paratype; all setæ and sculpture omitted from appendages.

Figure 2. *Enneothrips gustaviæ,* right fore wing, ♀, holotype.

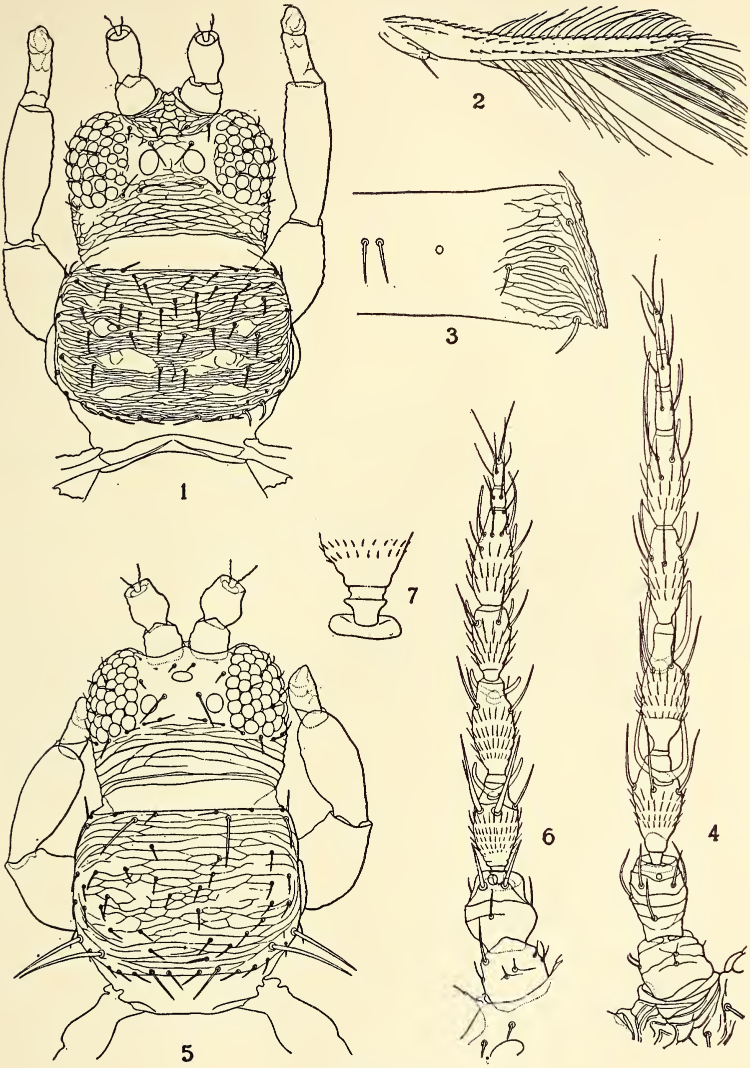
Figure 3. *Enneothrips gustaviæ,* right half of abdominal segment II, dorsal aspect, ♀, paratype.

Figure 4. *Enneothrips gustaviæ,* right antenna, ♀, holotype.

Figure 5. *Frankliniella diversa,* sp. nov., head and prothorax, ♀, holotype; all setæ and sculpture omitted from appendages.

Figure 6. *Frankliniella diversa,* right antenna, ♀, holotype.

Figure 7. *Frankliniella diversa,* basal portion of segment III of right antenna, ♀, holotype.



THRIPIDÆ

PLATE XII

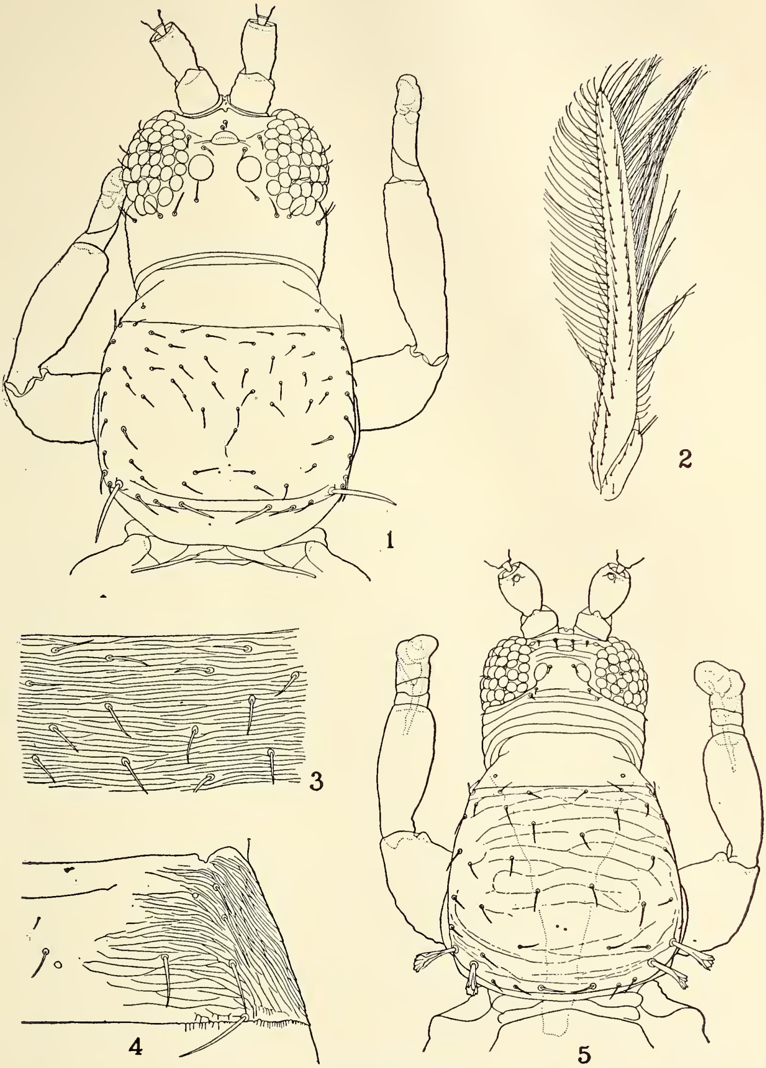
Figure 1. *Isochætothrips striatus* sp. nov., head and prothorax, ♀, paratype; all setæ omitted from appendages.

Figure 2. *Isochætothrips striatus,* right fore wing, ♀, paratype.

Figure 3. *Isochætothrips striatus,* sculpture of median anterior portion of pronotum, ♀, paratype.

Figure 4. *Isochætothrips striatus,* right half of abdominal segment II, dorsal aspect, ♀, paratype.

Figure 5. *Salpingothrips minimus* gen. et sp. nov., head and prothorax, ♀, paratype; all setæ omitted from appendages.



THRIPIDÆ

NEW CICADAS WITH NOTES ON NORTH AMERICAN AND WEST INDIAN SPECIES

BY WM. T. DAVIS
STATEN ISLAND, N. Y.

Among the eleven large black cicadas of the genus *Tibicen* to be found in the southeastern United States, two are known to vary to pronounced greener phases in the more southeasterly part of their range. *Tibicen chloromera* variety *australis* in Florida is a notably greener insect than specimens of *chloromera* from the middle states, and *Tibicen lyricen* variety *virescens* is shown in this paper to have a similar distribution. The small *Melampsalta calliope* varies to the green from *floridensis* in the same way.

The more western *Tibicen pruinosa* has been shown by Dr. Raymond H. Beamer to have a tan-colored variety in Kansas, which he has described as variety *fulva,* and in the writer's collection there is a male of this variety from San Antonio, Texas, collected in August, 1928. Likewise in the genus *Okanagana* in the west, if a species varies from the usual black or near black normal coloring, it is toward tan-colored forms, and not to green ones as in the southeast. Thus we have a number of tan-colored varieties of *Okanagana,* two of which have recently been named by F. H. Wymore in the Pan-Pacific Entomologist, October, 1934, pp. 167 and 174.

The mid-west has some green cicadas, as for example *Tibicen superba, Okanagana viridis, Okanagodes gracilis* var. *viridis, Melampsalta kansa,* and, in the Chisos Mountains of Texas, the green *Okanagodes terlingua* occurs.

The color in these naturally green cicadas, as in katydids and some other Orthoptera, can be preserved by soaking the specimens for a few days in one part formalin to nineteen parts water. Otherwise the color may and usually does gradually fade. Some of the specimens of *Okanagodes terlingua* mentioned in this paper were so treated, and now, after 10 months, they are bright green in color, while those not so treated have faded to a yellowish green.

In the preparation of this paper I am indebted to Mr. George B. Wilmott for all but two of the photographs, and to Hans L. Stecher for the text figures.

Tibicen latifasciata Davis

In my trip with Howard H. Cleaves to Southern New Jersey, August 22 to 25, 1932, I wished to learn if *Tibicen latifasciata* sang at twilight as does its close relative *Tibicen winnemanna.* We, however, heard it sing only when the sun was shining. At "Camp Two Katydids," on the morning of August 25, we heard one singing after the sun was well up, but we did not hear any during the previous evening.

We heard quite a number of *latifasciata,* but they were not as common as in August, 1910, when they also sang during the sunny hours of the day. The three that we saw, two at Reed's Beach and one at Town Bank, escaped.

It would appear that the beautifully marked *latifasciata* with its broad white stripes, and living close to the Atlantic Ocean from Cape May County, New Jersey, southward, should be considered as a distinct species from both *pruinosa* and *winnemanna,* and it is also of interest that it resembles *pruinosa* of the Mississippi River region more than it does *winnemanna* of the general region of the Blue Ridge Mountains.

Tibicen lyricen DeGeer and Its Varieties

In their account of *Cicada lyricen* DeGeer, 1778 (*fulva* Osborn, 1906), in "Entomological News," April, 1907, Smith and Grossbeck record that they had for comparison 15 specimens of each sex collected from New York to Florida and westward to Indiana. They state: "The pronotum in some is all black, except for a broad central line, and the mesonotum in such is also black, with narrow fulvous lines indicating the usual pattern. In other examples fulvous is the predominating color, the black maculation being reduced, but the posterior and lateral borders of the pronotum are always black, except for a small spot which is sometimes present near the head. Green occasionally replaces the fulvous and, rarely, both are present on the same insect, the fulvous occupying the lateral portions of the mesothorax, the green the remainder of the background.''

The black individuals described above probably came from the uplands of Virginia southward into Georgia, and is now known as variety *engelhardti* Davis. It often presents a remarkable contrast to typical *lyricen.* The greener individuals mentioned by the authors very likely were the Florida examples referred to, and here described as a new variety.

Tibicen lyricen variety **virescens** new variety

Type male, Paradise Island, Homestead, Florida, August, 1919. Davis collection.

Allotype female, Gainesville, Florida, July 17, 1934 (M. E. Griffith). University of Kansas collection.

Pronotum with the color pattern of typical *lyricen,* except that the usual fulvous areas have a greenish tinge. The collar is black. On the mesonotum the obconical spots, a small spot each side, another at the base of each fore wing and a small area immediately anterior to the cruciform elevation, black. The remainder of the mesonotum is centrally green, fulvous or chestnut colored on the sides. The basal areas and the costal margin, of the fore wings, are often bright green, with the marginal areas clouded or smoky, much more so than in northern specimens. This beautiful variety, differing greatly in appearance from the nearly all black *engelhardti,* occurs along the coast to at least as far north as North Carolina.

The type is one of four specimens, all colored alike, and collected in August, 1919, near Homestead, Florida. They were sent for identification in 1920 by Prof. R. H. Pettit of the Michigan Agricultural College. The paratypes are: male, Paradise Key, Fla., July 16, 1919 (C. A. Mosier); female, ''South Carolina''; male, Charleston, S. C., June, 1912 (W. H. Cogswell, Jr.), and female, Beaufort, N. C., September 10, 1913 (Francis Harper). Occasional examples of this variety, or at least specimens approaching it, have been examined from further north from Beaufort, all coming from near the Atlantic coast.

Tibicen resh Killed by the Long Horn Grasshopper or ''Cricket,'' Rehnia spinosa

Under date of July 9, 1934, Mr. H. B. Parks, Chief of the Division of Agriculture, San Antonio, Texas, wrote me as follows: "Last night just at dusk I heard the note of *T. resh* in a guajillo bush just at the corner of the laboratory. In the midst of its song it started a peculiar note which sounded like a fly caught in a spider web. I started to find it and in pulling away the branches I was very much surprised to discover the cicada had been captured by one of those very large green, spinose crickets that are common some years here in Texas. I attempted to catch the pair but in the darkness I was unable to follow the cricket with its prey through the bush. I am in hopes that I can find the living cricket and the wreck of the dead cicada."

On August 8, Mr. Parks sent me another letter in which he continued: "The female cricket is the one about which I wrote you and in this letter you will find the evidence to prove the statement. You will have no trouble in identifying the species of cicada from the wing and the part of the abdomen enclosed. I found the remains of the cicada only a few feet from where I saw the cricket eating the cicada. You will note the mandible marks on the base of the abdomen."

The Shield-Bearer that killed the cicada is a large and powerful insect as big as the cicada itself, and in addition is armed with formidable jaws and long spinous legs. Being without wings it does not wander far, and when its green body lies stretched out along a limb, it has indeed a menacing appearance as the writer can testify from personal observation. From the remains of the cicada it would appear to be *Tibicen resh*, as identified by Mr. Parks.

Tibicen marginalis and **Tibicen dealbata**; their Relationship and Broods

On August 8, 1934, Mr. H. B. Parks sent me 36 *Tibicen marginalis*. This insect had appeared in great numbers during part of July at Mitchell Lake; along San Antonio River, along Cibolo Creek and elsewhere near San Antonio, Texas.

It was evidently a Brood Year for the species in that part of Texas, and in one of his letters Mr. Parks stated that "one cannot carry on a conversation in the vicinity of where they are found for the noise. . . . During the period when these cicadas were obtained one could have secured literally thousands of them had he had the time and the ability. Our long drought ended on the 26th of July and since that time I have heard no cicadas singing. As it ended with a Gulf storm I presume the fifty mile wind killed large numbers of insects.'' In a later letter he added that it was his belief that *marginalis* occurs only where willows are common. ''I never have seen a specimen on any other kind of tree. They prefer the larger branches and always sit with their heads up the tree. While hunting them at Cibolo Creek twenty-five (all males) were killed from one tree and there were many other trees in the neighborhood which would have yielded a like number had the cartridges not run out.''

In his ''Biology of Kansas Cicadidae,'' University of Kansas, 1928, Dr. Raymond H. Beamer states that *marginalis* occurs in the eastern part of Kansas and that it is most commonly found in groves of willow and cottonwood along streams, although may be heard in other trees. He adds that: ''The males are the most persistent and prolonged singers of any of the Kansas species. Their song begins as soon as the sun warms them in the morning and continues far into the night. Specimens have been heard as late as 1:30 o'clock in the morning.''

The closely allied *Tibicen dealbata* also occurs in vast numbers at times and Miss Anna Bennett in 1916 sent me 302 specimens from Foss, western Oklahoma, with the statement that they had been ''almost a pest'' (see this JOURNAL, March, 1921, p. 47).

Dr. Beamer finds that in Kansas, *dealbata* occurs over the western two thirds of the state and practically always in trees along water-courses, willow and cottonwood being preferred. He adds: ''While *Tibicen dealbata* (Davis) occurs west of *Tibicen marginalis* (Walker), and its emergence time is a little shorter (perhaps due to higher altitude), no difference has yet been detected in the behavior of the two. The song sounds identical, the habits of singing are the same, the nests of one might be mistaken for those of the other, the same types of hosts are used, and the time and method of hatching and the appearance of the eggs and nymphs are identical.'' He records a large brood of *dealbata* as occurring in Logan County, Kansas, in June, 1925.

Tibicen dealbata was described in 1915 as a variety of *marginata* Say = *marginalis* Walker, the type coming from Colorado.

It has the head narrower across the eyes than in *marginalis;* the fore wings are proportionately broader and are not so narrowed toward the outer extremities as in *marginalis;* a profile view shows the opercula extending further beyond the lower hind angles of the tympanal coverings immediately above them than is usual in *marginalis.* In *dealbata* the pruinose areas are conspicuous and usually well defined, and there is commonly a prominent dark band on the tergum containing a central row of white spots, while each side the abdomen is heavily pruinose. The uncus in *dealbata, dorsata* and *marginalis* does not differ greatly and is subject to some slight variations. In *dealbata* it is usually more narrowly wedged shaped when viewed from behind than in the other two species. Specimens of *marginalis* and *dorsata* are usually black behind the eyes, but those from southwestern Texas are pale. In *dealbata* the rear of the eyes is pale in Texas, Oklahoma, and Kansas specimens, with occasional exceptions, but black in those from Nebraska, Colorado and the Dakotas. Some of these characters are very plain when the insects are seen in series. (See figures in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for 1915, plate 12, figures 1 and 2, and plate 18, figure 2.)

While the areas of distribution of the two species overlap, *marginalis* is found much further east than *dealbata.* It occurs in Iowa, Missouri, Arkansas, Louisiana and eastward to Ohio, Kentucky, Tennessee, Alabama and northwestern Florida. *Tibicen dealbata* is more common west of the Mississippi, from near the 100th meridian westward to the Rocky Mountains.

Tibicen minor Davis. Plate XV, Fig. 5

This species was described in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for March, 1934, from Mexico, from the male type and four male paratypes. Recently Mr. E. P. Van Duzee sent me a male and female from Basuchil, Chihuahua, Mexico, August 29, altitude 6,700 feet (Mrs. Y. Mexia, collector).

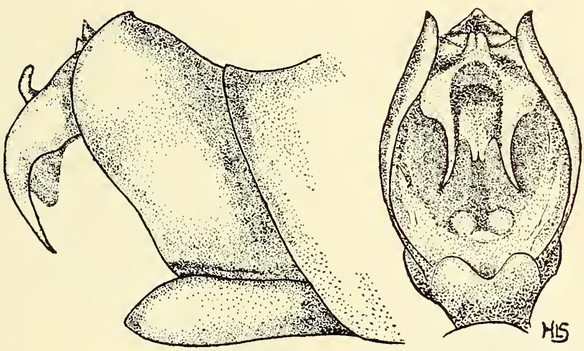
The female closely resembles the male type, except that it is larger, expanding 57 instead of 47 millimeters. The basal areas of all of the wings are pale orange, and the notch in the last ventral segment is broad and single, that is there is not one notch within the other. The head is much broader and the sides of the abdomen much more extensively pale than in *Tibicen hilaris* as described and figured by Distant in Biol. Centr.-Americana (1881). With the exception of segments one and two the sides of the abdomen are pale and pruinose.

Diceroprocta canescens new species. Plate XIII, Figs. 1 and 2.

Type male and allotype female from San Vincente, Brewster County, Texas, June 24, 1934. (C. H. Gable, Jr.). Davis collection.

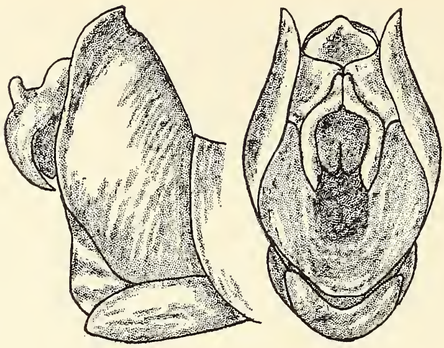
An orange and black species with clear wings resembling *Diceroprocta eugraphica* described and figured in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, March, 1916, but generally larger and more canescent. The front of the head is more prominent and the curved claws of the uncus are very much longer than in *eugraphica*. The following description is copied largely from that of *eugraphica*, changed where necessary to cover *canescens*.

Head black with an orange spot above the base of each antenna and a larger one each side nearer the eyes; also one each side contiguous to the hind margin. The transverse rugæ black, with an orange spot on front of



DICEROPROCTA CANESCENS

head. Pronotum orange and black, the central longitudinal stripe conspicuously orange with a dissected black band each side, which is widened anteriorly and posteriorly; grooves blackened; collar orange, irregularly blackened along the front margin, also at the humeral angles. Mesonotum with four obconical black spots, the inner pair short, the outer pair longer and extending backward to the elevated ×. There is also a black stripe extending along each side from the × to the base of each fore wing. Between the × and the two central obconical spots, there is an irregular cross-shaped spot, and the two depressed black points, common to many species, and near to the anterior extremities of the ×, are also present. The × and lighter



DICEROPROCTA EUGRAPHICA

lines on the mesonotum are orange. The tergum is a dark brown, conspicuously covered with a fine, white, silvery pubescens. The area at the base of the abdomen between the tympana is conspicuously hoary, which is not so in *eugraphica*. Segments narrowly edged with orange posteriorly. Fore wings with their costal margins orange for about half of their length, beyond which they are blackened; the subcostal veins are very dark brown or black. First and second cross veins of the fore wings are not clouded; both pairs of wings are orange at the base with the anal areas grayish white. Beneath lighter colored and pruinose, the legs orange, streaked and spotted with testaceous. Abdomen with the segments darkened along each side. Opercula pale; straw colored; a little less than half as long as the abdomen and rounded at the extremities, the inner edges touching or nearly so. The uncus is as figured, and for comparison the figure of *eugraphica* is reproduced.

MEASUREMENTS IN MILLIMETERS

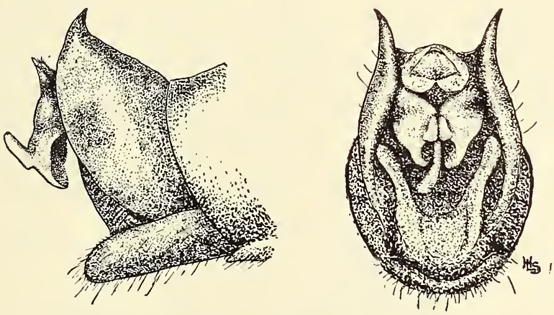
	Male Type	Female Allotype
Length of body	30	25
Width of head across eyes	11	10
Expanse of fore wings	78	75
Greatest width of fore wing	12	11
Greatest length of operculum	6	......

In addition to the type and allotype, the following specimens are in the writer's collection: 15 males from San Vincente, June 24, 1934; 5 males, 50 miles south of Marathon, June 27, 1934, and 1 female from a few miles north of the Chisos Mountains, June 27, 1934. These localities are in Brewster County, Texas, and the specimens were collected by C. H. Gable, Jr.

The writer has about 350 specimens of *D. eugraphica* from Kansas, Oklahoma, Arizona, New Mexico and Texas. He and others have collected specimens of *eugraphica* close to the Texas localities where *D. canescens* was found in 1934, but nothing was learned of that insect before that year when one of its broods may have appeared. Mr. Gable found both *eugraphica* and *canescens* at San Vincente on the 24th of June, 1934.

Diceroprocta biconica Walker, of Cuba, and Closely Related Species

Cicada biconica was described from Cuba in "List of the Specimens of Homopterous Insects in the Collection of the British Museum," Part 1, 1850. Some of the characters mentioned by Walker were: Body ferruginous above, tawny and powdered with white beneath, hind margin of pronotum pale green; mesonotum adorned with two obconical pitchy stripes which are united on the fore border and extend about half the length; wings colorless, fore border green, black towards the tips, first and second cross veins and tips of first and second longitudinal veins clouded with brown. Length of body 13½ lines; of the wings [expanse] 45 lines or nearly 100 millimeters.



DICEROPROCTA BICONICA

In 1926 Mr. W. E. China of the British Museum kindly sent me a photograph of the female type of *biconica* here reproduced. Plate XIII, Figs. 3 and 4. In the writer's collection there are the following specimens like the one figured, all from Oriente Province: male, Santiago, Sept. 15, 1903; female, Baracoa, Sept., 1915, and two males, Guantanamo, June 1, 1916 (C. T. Ramsden), one of which is figured on Plate XIII, figures 5 and 6.

In Genera Insectorum, Plate 4, Fig. 24, 1912, Distant figured a male cicada as *biconica,* which the writer in this JOURNAL for March, 1930, described and figured as *Diceroprocta cleavesi* from Grand Cayman Island south of Cuba. Also in this JOURNAL for 1932, p. 246, twenty additional specimens of *cleaveri* are recorded from Grand Cayman and the characters of the species reviewed.

Diceroprocta (*Cicada*) *bonhotei* from Nassau, Bahama Islands, was described by Distant in "Entomologists' Monthly Magazine" (2), Vol. XII, p. 71, 1901, and although Distant did not record the fact, *bonhotei* in size and markings closely resembles *biconica* of Cuba. The females of *biconica* are said to have the spine at the tip of abdomen straight, that is not bent upward as is usually the case in females of *bonhotei.* The pruinose markings also appear to differ. A figure of the type of *bonhotei* from a photograph furnished by Mr. China appeared in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for December, 1928, Plate XVII.

In Florida there is a cicada that has been identified as *D. biconica.* In the "Transactions of the Maryland Academy of Sciences," 1892, P. R. Uhler reports having examined a *biconica* from "southern Florida." After comparing twenty specimens collected on August 9, 1930, by Dr. Raymond H. Beamer and his three companions from the University of Kansas on Key Largo, Florida, and others taken elsewhere along the same coast, it was found that in the Florida specimens the terminal dorsal spine on the last abdominal segment of the females varied, and that the specimens, when viewed together, more strongly resembled those from the Bahamas than from Cuba, as stated in this JOURNAL for June, 1932.

On July 23, 1934, Dr. Beamer and his associates once more visited the Florida coast and collected 29 male and 19 female *Diceroprocta* on Key Largo and on Second Key. Again we find the terminal dorsal spine of the females variable, and in the pruinose markings of the males, especially the conspicuous white area at the base of the abdomen between the tympanal coverings, more like Bahama specimens than those from Cuba. In some of this extensive series the colors are dark, but they all have a rusty brown appearance and the triangular opercula are somewhat variable.

It is possible that when the habits and songs of these insects are compared, that they will become more readily separable, as in the case of some individuals of *Tibicen canicularis* and *Tibicen linnei* in North America, which often resemble each other quite closely but sing quite differently, and have somewhat different habits.

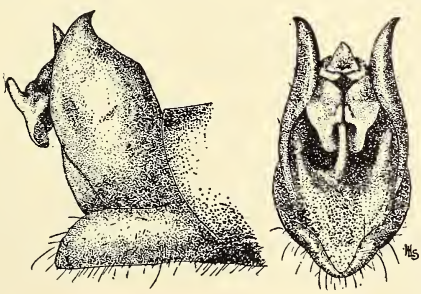
Returning to a consideration of the Cuban specimens the writer is of the opinion that there is a well marked variety of *Diceroprocta biconica* which may prove in time to be a separate species.

Diceroprocta biconica variety **obscurior** new var. Plate XIV, Figs. 1, 2 and 3

Type male and allotype female from near Santa Fe Beach, Punta Brova, Habana Province, Cuba, June, 1934. Davis collection.

Smaller than *D. biconica*; almost black and with the pruinose areas differently arranged (see plates).

Front of the head prominent; eyes prominent and median sulcus shallow. Slightly broader across the collar than across the eyes. Costal margin of the fore wing beyond the radial area slightly more bent than in *biconica*, quite apparent when viewed in series. Opercula triangular as in *biconica*; reaching the fourth abdominal segment in the type but slightly shorter in some of the paratypes. Terminal dorsal spine of the last abdominal segment of the female short, and with a slight upward bend. Head and pronotum very dark brown, variegated with black as in *biconica;* collar green; the four obconical spots reaching backward from the front margin of the mesonotum strongly marked. In *biconica* the central pair are often the only ones present and generally they are but faintly represented. Tympanal



DICEROPROCTA BICONICA VAR. OBSCURIOR

coverings black with the pruinose space between containing two prominent white dots. The abdomen with segments 3, 4, 7 and 9 with pruinose areas each side, and the dorsum of segment 8 almost entirely pruinose. In the males of *biconica* the pruinosity is much more extended as shown on the plate. Beneath the abdomen is pruinose along the sides, leaving a central dark brown stripe. The wing venation is much darker in variety than in *biconica,* and the first and second cross veins more prominent.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	29	26
Width of head across eyes	12	11
Expanse of fore wings	86	84
Greatest width of fore wing	13	12
Greatest length of operculum	9	......

In addition to the type and allotype, one male collected in June, and six males collected October 10, 1934, at the same locality, were sent to me by Brother Chrysogone.

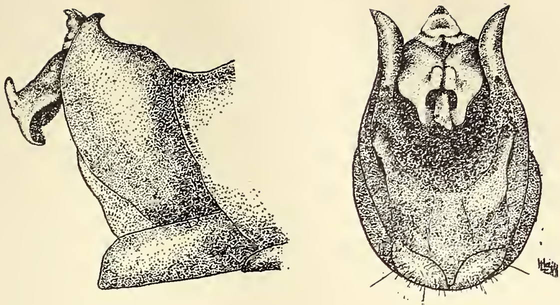
In the writer's collection there is a cicada from the Isle of Pines, about fifty miles south of Cuba, which is distinct from *D. biconica.*

Diceroprocta pinosensis, new species. Plate XIII, Figs. 7 and 8.

Type male, Santa Barbara, Isle of Pines (George Y. Payzant). Davis collection.

Differs from *biconica* in having a much narrower head; the rounded opercula black on the inner margins, and the basal area of the fore wing rather broadly black at its outer anterior margin.

Front of head more prominent than in *biconica,* mainly black with paler areas over the antennæ and on the posterior margin. Pronotum brown, with the grooves black, collar green narrowly black along the anterior margin and each side near the base of the wings. Mesonotum dark brown, the obconical spots black; cruciform elevation pale. Abdomen brown, anterior margin of each segment darker; tympanal coverings black; first segment with two pruinose dots; segments 2 to 7 pruinose each side leaving a central, dorsal brown area with nearly parallel sides; segment 8 pruinose, black on anterior margin. Beneath, head nearly black about the eyes and much darker than in *biconica. Opercula* pale straw-color, black at extreme base and on the inner overlapping margins; abdomen black at base, brown centrally and pruinose along the sides, the last ventral segment black at the rounded extremity; valve black.



DICEROPROCTA PINOSENSIS

MEASUREMENTS IN MILLIMETERS

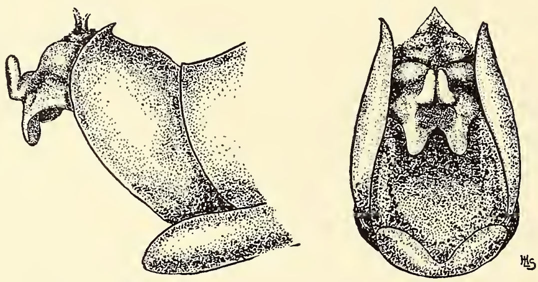
	Male Type
Length of body	32
Width of head across eyes	12.5
Expanse of fore wings	98
Greatest width of fore wing	13
Greatest length of operculum	9

The type is an old specimen from which the wings on the left hand side have been broken. In some respects it resembles *D. cleavesi* from Grand Cayman Island, but it has shorter and more rounded opercula, edged with black in the inner margins, instead of entirely pale; it is dark gray and black at base of wings instead of orange, and the dorsal dark area on the abdomen has the sides nearly parallel and not oval in shape as in *cleavesi.*

Diceroprocta ornea Walker. Plate XIV, Figs. 4 and 5.

In 1850 *Cicada ornea* was described from "Mexico" in List of Homopterous Insects in the collection of the British Museum. Some of the characters mentioned by Walker were: Scutcheon of the middle-chest [mesonotum] adorned with several tawny marks; a middle pair curved and widened at one end; a net-work mark on each side, and an oblique stripe near each side of the chest; two tawny spots above the cross-ridge which is tawny and has a pitchy spot in the middle . . . abdomen pitchy, a little longer than the chest; opercula [dorsal tympanal coverings] large, close, reddish-pitchy; drums [opercula] pale yellow, large, triangular, more than half the length of the abdomen . . . wings colorless; fore border green, tinged with tawny as far as the brand . . . first and second cross-veins slightly clouded with brown; fore-flaps grayish brown; hind-flaps grayish brown at base and along the veins.

In 1881 Distant figured Walker's type of *ornea* in Biol. Centr. Am. Rhynchota Homoptera. The figure shows numerous marks on the mesonotum, and the very long pale opercula mentioned in the original description are also shown, but the head, as figured, appeared to be extraordinary.



DICEROPROCTA ORNEA (WALKER)

Mr. W. E. China, of the British Museum, has recently examined the type of *ornea* and writes that: "The figure in the Biologia is very bad and positively inaccurate. Under separate cover I am sending you as a loan a specimen of *Diceroprocta ornea* Walk. It differs from the type only in the slightly fewer pale markings on the mesonotum. Otherwise it is identical with type."

The specimen from Dr. Swale loaned by the British Museum is figured on Plate XIV, Figs. 4 and 5, and in the writer's collection there is a male like it in every respect from Guadalajara, Mexico, 1901 (M. Diguet). Both of these specimens are rusty brown in color; have prominent eyes, but proportionately narrower heads and longer opercula than in the usually darker *Diceroprocta semicincta* from Arizona, etc., described and figured in this JOURNAL, March, 1925. Also in *semicinta* the outer sides of the opercula converge, whereas in *ornea* they are nearly parallel.

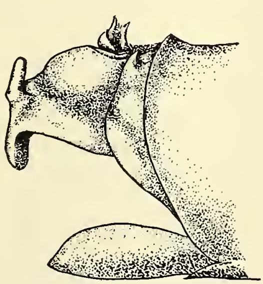
Diceroprocta fraterna, new species. Plate XIV, Figs. 6 and 7.

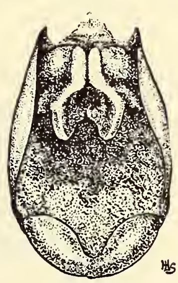
Type male from near Compostela, Nayarit, Mexico, April, 1934. Davis collection.

. Resembles in size and general color *Diceroprocta semicincta*, and *D. ornea* as here figured but differs in the shape of the uncus and in color pattern.

Head with eyes not prominent and but little wider than front margin of pronotum and not as broad as hind margin. The large opercula slightly overlap on the inner sides near the base; the outer sides are parallel for part of their length, and the attenuated points reach the seventh segment. In some of the paratypes they do not go beyond the sixth segment, and are somewhat broader. Uncus as figured.

Head olive green and black; the transverse ridges of the front olive green and the grooves between them black; a broad irregular black band in which the ocelli are included, connects the eyes, and each side on the hind margin between the eyes and the ocelli there is a black spot. Pronotum olive green and black, the central longitudinal mark or stripe widened at both extremities. On each side there is a shorter, oblong spot parallel to the central one and the grooves are irregularly blackened. Collar olive green with the black band of the anterior margin extending to the base of the wings. Mesonotum black with two curved narrow pale marks extending backward from the front margin and widened at the extremities near the X elevation, which is pale in color, as is also the hind margin. Each side near the wings there is a short pale spot, and in some of the paratypes there are two spots between the fore limbs of the X. Abdomen above, including tympanal coverings, shining black, with a few silvery hairs each side particularly on segment three. Fore wings with the costal margins olive green to end of radial area; beyond black. First and second cross veins slight clouded. A conspicuous oblong spot at the anterior margin of the basal cell and the posterior margin of the anal cell black. Anal membranes of both pairs of wings gray, or grayish white. Beneath, pronotum and mesonotum yellowish white, the legs variegated with black or dark brown and yellow. Opercula pale, almost white, narrowly darkened at extreme base. Underside of the abdomen black or





DICEROPROCTA FRATERNA

nearly so, causing by contrast in color the small white spots each side at the spiracles on segments three to seven inclusive, to become conspicuous. If the position of the opercula permit, white spots will be seen in each of the cavities which they ordinarily cover. The white spots at the spiracles occur in numerous *Diceroprocta,* but in this species they are more conspicuous than usual.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	23
Width of head across eyes	9
Expanse of fore wings	72
Greatest width of fore wing	11
Greatest length of operculum	9

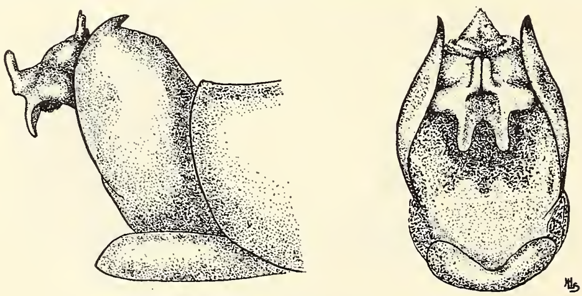
In addition to the type, five males collected at Compostela, April, 1934, have been examined.

Diceroprocta bicolor, new species Plate XV, Figs. 1 and 2.

Type male from Jojutla, Morelos, Mexico, June, 1929. Davis collection.

Head across eyes much broader than the front margin of the pronotum and about as broad as the hind margin; eyes prominent; front moderately produced and somewhat angulated; median sulcus shallow. The long opercula touch on the inner side near the base, the outer sides are nearly parallel for part of their length, and the attenuated points reach the seventh abdominal segment. In one of the paratypes they reach the eighth segment. Uncus as figured.

Head yellowish green and black; the transverse ridges of the front yellowish green with the grooves between them black; a broad irregular black band in which the ocelli are included, connects the eyes, and each side on the hind margin between the eyes and ocelli there is a black spot. Pronotum olive green, brown and black, the central longitudinal mark pale centrally and



DICEROPROCTA BICOLOR

widened at the extremities. On each side there is a shorter oblong spot, parallel to the central one and the grooves are irregularly blackened. Collar olive green very narrowly edged with black on the front margin, and a small black spot near base of each fore wing. In one of the paratypes the collar is entirely green except for the small dark spot near the extremities. Mesonotum greenish brown with four obconical blackish spots extending backward from the front margin, the inner pair shortest, black and unbroken, the outer pair brown and much lacerated. The depression in front of the cruciform elevation or X, contains a large, irregular black spot with an attenuated line leading forward between the inner pair of obconical spots. A curved black band crosses the fore limbs of the X and extends to the base of each front wing. The posterior margin of the mesonotum is olive green. Abdomen black with the tympanal coverings narrowly brown on the anterior margins, and the sides of segments eight and nine pale. Under side with the front blackish, the pronotum and mesonotum paler; legs pale, striped with brown. The very long opercula yellowish white on about the outer half and black on the inner half. The abdomen is chocolate brown with a pale spot each side on segments seven and eight, and the spiracles on segments three to eight whitish.

MEASUREMENTS IN MILLIMETERS

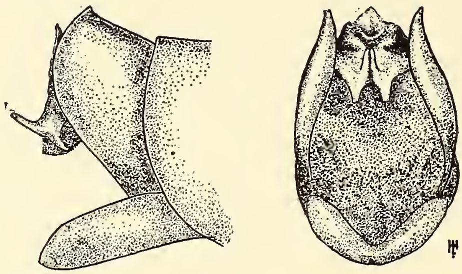
	Male Type
Length of body	23
Width of head across eyes	10
Expanse of fore wings	73
Greatest width of fore wing	11
Greatest length of operculum	9

In addition to the type the following have been examined: Male labeled "Mexico," closely resembling the type except that the opercula are even longer and the outer sides more parallel to each other; a smaller male expanding 63 millimeters from Manzanillo, Mexico, July 22, 1924 (Stephen E. Aguirre) and a female labeled "Matamoros, Pueb.," Mexico, expanding 72 millimeters, that may belong to this species. The under side of the abdomen instead of being almost completely chocolate brown, has a broad yellow band each side of a central brown area.

Diceroprocta oculata, new species. (Plate XV, Fig. 6).

Type male from Compostela, Nayarit, Mexico, August 20, 1933. Davis collection.

Head across the eyes much broader than the front margin of the pronotum and about as broad as hind margin; eyes prominent; front moderately produced and somewhat angulated (not rounded); median sulcus shallow and broad, with the transverse ridges pale and the grooves between them brown. The opercula triangular touching at base on innner margin, and with the rounded extremities reaching the fourth abdominal segment. Last ventral segment broadly rounded, truncate or shallowly sinuate at the extremity. Uncus as figured.



DICEROPROCTA OCULATA

Body above pale brown, head yellowish brown, dark brown at front and about the ocelli. A brown spot touching each eye, with several minute spots between the eyes and ocelli. Pronotum pale brown with an hour-glass shaped spot centrally and a shorter dark spot each side parallel to the central spot. Grooves clouded. Hind margin or collar green, or greenish brown in the paratypes. Mesonotum greenish brown with four obconical brownish spots (the outer pair longest) extending backward from the front margin toward the green cruciform elevation. A small dark spot each side at the extremities of the anterior pale limbs of this elevation. The posterior margin of the mesonotum is pale. Abdomen brown; tympanal coverings slightly paler. Under side pale brown; a shining black spot each side extending from the antenna to the eye. Legs pale; opercula pale or greenish; abdominal segments pale brown. Fore wings clear; costal margin greenish; basal cell clear; anal areas gray. Hind wings clear, anal areas grayish.

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	18
Width of head across eyes	7
Expanse of fore wings	52
Greatest width of fore wing	8
Greatest length of operculum	5

In addition to the type two paratypes from Compostela, Nayarit, Mexico, are in the writer's collection.

PROARNA

Entomologists have found much difficulty in identifying some of the species placed in this genus, and there is evidently considerable confusion in the use of the various names.

In any collection of Cicadas female specimens of *Proarna* are likely to far outnumber the males. At Suretka, Costa Rica, in April, 1917, the late Alanson Skinner collected for me, chiefly at light, 55 specimens of one species, all of which were females but one. In 1927 I received for examination from the University of Michigan 57 specimens of *Proarna insignis* Distant, collected in the Dept. Magdalena, Columbia, May and June, 1926. In this lot there was but a single male. In connection with other characters the shape of the last ventral segment in the female, including the notch, will help in separating the species, even if satisfactory names cannot at present be assigned to all of them.

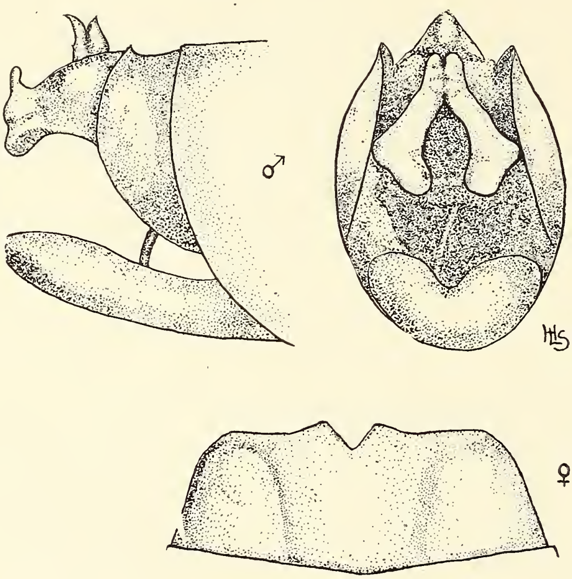
Through the kindness of Mr. Edward P. Van Duzee, I have received two male *Proarna* from Cocos Island which represent a different species from those of the mainland of Costa Rica to which the Island belongs. In the following description it is compared with the above mentioned male from Suretka, Costa Rica, which it most closely resembles. This specimen was sent to the British Museum in 1927, and found by Mr. W. E. China to be under *germari* in that collection. In Homoptera Indina, 1907, A. Jacobi describes and figures what appears to be a somewhat different *Proarna* as *germari* Distant, but this is still more unlike the specimens from Cocos Island, which lies about 400 miles from the mainland and might well have an endemic cicada.

Proarna cocosensis, new species. (Plate XV, Fig. 3).

Type male, Cocos Island, July 18, 1905 (F. X. Williams), collection California Academy of Sciences, and allotype female, Cocos Island, April 19, 1930, found dead in a damaged condition by Dr. James P. Chapin and now in Davis collection.

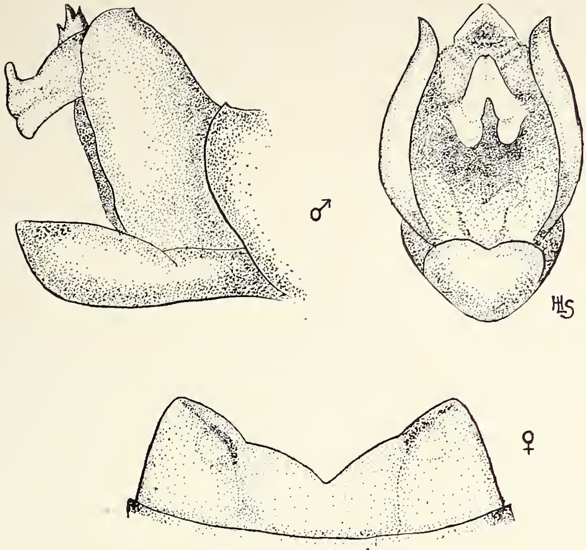
Resembles the male from Suretka, Costa Rica, identified provisionally as *Proarna germari*, but differs in having larger and more prominent eyes; a differently shaped uncus as here figured; more pointed fore wings and vein Cu 1b much heavier.

Front of head rounded, median sulcus shallow and eyes conspicuous by reason of their size. Opercula with the outer margins more sinuate and revolute, and not as rounded at the extremities. Last ventral segment with a shallow sinuation at the extremity; in the allotype this segment is shaped as illustrated. Uncus as illustrated, and of the same general form as the Suretka male and differing greatly from the *Proarna albida* or *insignis* type.



PROARNA COCOSENSIS

Head green with four black spots between the eyes—one above each antenna and one each side of the frontal sulcus. Ocelli in an irregular blackened area, and a very small spot each side near the hind margin. Pronotum green with a central, hour-glass shaped area outlined in brown, present in the allotype but not in the paratype. Grooves in type and paratype brown or nearly black; collar and sides bright green. Mesonotum greenish with four obconical spots extending backward from the front margin, the outer pair longest and broken centrally. A crescent-shaped spot behind the central and shorter pair. The X green with a small spot each side near the anterior extremities. Abdomen brownish green, each side with pruinose areas particularly on segments one, two, five, six and seven; segment eight more pruinose centrally. Under side pale greenish about the transverse rugæ and femora; opercula uniformly pale green; abdomen brownish green and sparsely pruinose.



PROARNA GERMARI?

Fore wings with the costal margin greenish to end of radial cell, darker beyond. The first transverse vein and the veins at base of all of the marginal areas slightly clouded. A row of spots along the outer margin; usually one to each area. The transverse nodal line well marked, ending with the rather heavy Cu 1b. Basal cell but slightly clouded at the outer extremity; anal area gray; base of wings greenish or bluish-green. Hind wings clear except at base; anal area nearly white, or clouded along margins.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	20	22
Width of head across eyes	7	8
Expanse of fore wings	59	about 65
Greatest width of fore wing	9	10
Greatest width of operculum	4	

Okanagodes terlingua Davis. Plate XV, Fig. 7.

This species was described and figured in this JOURNAL for June, 1932, from the type and a single male paratype collected at Terlingua, Brewster County, Texas, July, 1931, by C. H. Gable, Jr. In their visit to western Texas in 1934, Mr. Gable and his son C. H. Gable, Jr., made a special effort to collect *O. terlingua,* with the result that 11 males and one female were found at Terlingua, June 20 and a single male at San Vincente, June 22.

These specimens are green in color and otherwise closely resemble the type in the shape of the uncus, in the small head with the front less protruding than in *gracilis,* and in having vein Cu 1b of the fore wing almost straight; in *gracilis* it is considerably curved.

The only female of *terlingua* thus far seen is here figured and can be separated from *gracilis* and its varieties by the characters given above. The specimen is practically all green in color, except for the dark veins surrounding the marginal areas of the fore wings. The measurements in millimeters are as follows: Length of body 16.5; width of head across eyes 4; expanse of fore wings 45; greatest width of fore wing 8.

Platypedia latipennis Davis.

This species was described and figured in this JOURNAL for March, 1921, from a single male collected at Douglas Spring, Routt County, Colorado, June 26, by J. W. Frey. The type, by permission of Prof. T. D. A. Cockerell was placed in the collection of the American Museum of Natural History.

On June 12, 1931, Prof. George F. Knowlton, of the Utah Agricultural College, collected a male on a Russian thistle at Vernal, Uinta County, Utah, and recently sent it to me for determination. This second known specimen agrees closely with the type, and has the same shaped broad fore wings and uncus.

PLATE XIII

Figure 1. *Diceroprocta canescens* new species. Type.
Figure 2. *Diceroprocta canescens* new species. Allotype.
Figure 3. *Diceroprocta biconica* (Walker). Female. Type in British Museum.
Figure 4. *Diceroprocta biconica* (Walker). Type. Underside.
Figure 5. *Diceroprocta biconica* (Walker). Male. Eastern Cuba.
Figure 6. *Diceroprocta biconica* (Walker). Underside enlarged. Eastern Cuba.
Figure 7. *Diceroprocta pinosensis* new species. Type. Underside enlarged.
Figure 8. *Diceroprocta pinosensis* new species. Type.

CICADIDÆ

PLATE XIV

Figure 1. *Diceroprocta biconica* var. *obscurior* new variety. Type.

Figure 2. *Diceroprocta biconica* var. *obscurior* new variety. Allotype.

Figure 3. *Diceroprocta biconica* var. *obscurior*. Type. Underside enlarged.

Figure 4. *Diceroprocta ornea* (Walker). In British Museum.

Figure 5. *Diceroprocta ornea* (Walker). In British Museum. Underside enlarged.

Figure 6. *Diceroprocta fraterna* new species. Type.

Figure 7. *Diceroprocta fraterna* new species. Type. Underside enlarged.

CICADIDÆ

PLATE XV

Figure 1. *Diceroprocta bicolor* new species. Type.
Figure 2. *Diceroprocta bicolor* new species. Type. Underside enlarged.
Figure 3. *Proarna cocosensis* new species. Type.
Figure 4. *Proarna germari* Distant. Costa Rica.
Figure 5. *Tibicen minor* Davis. Female.
Figure 6. *Diceroprocta oculata* new species. Type.
Figure 7. *Okanagodes terlingua* Davis. Female.

CICADIDÆ

THE BEES OF THE GROUP DIEUNOMIA

By BEULAH HIX BLAIR

Introductory Note

The group called *Dieunomia* has been treated as a genus, but it is probably best regarded as a subgenus of *Nomia*. The genus *Nomia* (see American Museum Novitates, No. 433) is very richly represented in Africa, tropical Asia and Australia, and is doubtless of Old World origin. It is evident, however, that the relatively meagre *Nomia*-fauna of America includes at least three different groups, the ancestors of which must have come over from Asia at different times. Probably the oldest of these is *Dieunomia,* which is widely distributed, but not represented in the Pacific Coast region. The case is analogous to that of the pipits among the birds. The genus *Anthus* is a typically Old World type, which has become widely distributed in North America. Our common western bird is considered a subspecies of the *Anthus spinoletta* of Europe. But in the interior plains, evidently representing a much earlier migration, is *Anthus spraguei* Audubon, so distinct as to be placed in a separate subgenus *Neocorys.*

The *Dieunomia* group has two subgroups, represented by *D. bolliana,* a relatively small species found in Texas, and lately by Timberlake in New Mexico; and by *D. apacha* of Colorado, New Mexico and Texas, of which *D. mesillæ* is presumably the male. Mrs. Blair's paper is primarily concerned with the very interesting case of *N. heteropoda* Say, with its races and varieties. This is a species of sandy regions, which is shown by Mrs. Blair to have two races or subspecies. The northern one, very likely Post-Pleistocene in origin, is found from Minnesota to Illinois, and east to Maryland. The actual distribution is not known in detail, but it is probably discontinuous, depending on suitable environments. The southern, more robust, race occurs in Texas and adjacent states. It is very interesting to find that both races vary independently in the color of the wings and pubescence, so that each presents four varieties, very distinct in appearance, exactly parallel and undoubtedly due to the combinations of Mendelian factors. There are in addition two forms of the southern race, *atripennis* and *semirubra* (Novitates 697, p. 6) which appear to be more than Mendelian varieties, and are perhaps to be regarded as subspecies. They presumably have no representatives in the north.

Thus we have a case which should be of interest to biologists generally, illustrating as it does the phenomena of evolution and variation.

T. D. A. COCKERELL

The collection of bees sent from the University of Minnesota by Dr. Clarence Mickel contained some specimens of *Nomia heteropoda* which were somewhat smaller, with a narrower abdomen and a neater appearance, not so robust as those collected in Kansas and other more southerly states. Immediately upon seeing these specimens, Dr. T. D. A. Cockerell remarked that they must indeed be the same as the original *N. heteropoda* that Thomas Say described after his trip to this region.

The description is given in "Major Long's Expedition to the Source of St. Peter's River, Lake Winnepeck, Lake of the Woods, etc.," published in 1824. St. Peter's River is now known as the Minnesota River, and these *N. heteropoda* Say were collected on July 19, 1923, on the Barden Sand Dunes, between Savage and Shakopee, about twenty miles from the mouth of the Minnesota River. Say passed through here in 1823 on July 10.

The latitude of the mouth of the river is 44° 53′ 49″ N., which they passed on the afternoon of July 9. On the evening of July 12 the party camped at Lat. 44° 33° 59′ N. Sand hills are mentioned as being seen along the river. Say's party followed the left bank on land until July 11 when he crossed the river to the right bank. Long's party went up the river. During July 10, therefore, Say passed through the Barden Sand Dunes. These Dunes have a latitude of about 44° 45′ N.

Dr. Clarence E. Mickel, of the University of Minnesota, said that when he and Dr. E. W. Dawson collected these large black bees, they noticed them going in and out of burrows in the sand. They dug into these, hoping to find some cocoons or some evidence of mutillids but found none. They found, however, that the burrows of the bees extended down into the sand vertically for a distance of three or four feet.

Until the present, because no *N. heteropoda* Say were listed from the Northern states, as far as I know, it was supposed that they were only found in the southern sandy regions. For this reason it was believed that Say found his species on his western trip in 1818–20 though it was not described until 1824, after his return from his northern trip. The description, however, is published with the report of the northern trip.

Now that we have specimens from this territory through which he passed it is quite obvious that the original *N. heteropoda* Say came from somewhere in the north country. To say exactly where the type locality is would likely be impossible, because I also have some *N. heteropoda* Say from Meredosia on the Illinois River (Grace Wiley). However, this locality is one hundred and fifty miles south of Say's path.

In my collection, I also have a *N. heteropoda* Say from Budd's Ferry, Maryland, collected in August, 1914, by R. C. Shannon. This is the same as those found in Minnesota and Illinois. Say, in his description, gives three habitats: Northwest Territory; Arkansas; and Maryland. Since we have specimens, which are the same, from two of the habitats, and which fit the original description exactly, it seems that we have conclusive evidence that typical *N. heteropoda* Say is not the larger subspecies of the southwest.

The original description exactly fits that of the northern subspecies, but not quite that of the southern subspecies. It is, therefore, necessary to apply the original name *N. heteropoda* Say to the northern subspecies, and to treat the southern form as a subspecies.

The *N. heteropoda* group is one species with subspecies and varieties. These divisions are based principally upon the color of the pubescence and the wings.

Probably the difference in the amount of dark pigment is due to various factor combinations in the genes, thus giving a variety of color among the bees of the same species. Of those bees I have examined, black outnumbers the ashen colored about four times. This is also true of the wings, the entire dark wings being the more common. The number I have examined, however, is limited to about forty specimens.

Until the present only one series was known, that found in the more southerly states. We must now recognize a northern series.

Description:

The *Nomia heteropoda* Say group belongs to the sub-genus, *Dieunomia* Cockerell, 1899. (*Eunomia* Cresson 1875 preoccupied). The species are large, with black bodies and no iridescent bands. The apical joint of the male antenna is flattened and broadened; flagellum crenulated above. (American Bees of the Genus Nomia, Cockerell, 1910).

General description of *N. heteropoda* Say group:

Male. Hind legs.—Black; femora greatly swollen; tibiæ much enlarged and greatly modified, being triangular in shape and compressed; excavated on inner side. They bear two spurs. The basitarsi are very much elongated and are about five-sevenths of the length of femur plus the tibia. They bear a fringe of hair on the inner side.

Middle legs.—Black; femora greatly swollen, more so than hind legs. The simple tibiæ bear no spurs.

Abdomen.—Densely punctured; anterior part of the first sternite is greatly indented on median line. Dorsal side of the first sternite has a shallow concavity.

The fourth tergite has a narrow median suture parallel sided at the posterior edge but spreads into a broad triangle at anterior edge; posterior corners are slightly extended.

The fifth tergite has two small tubercles, one on each side of the median line.

Thorax.—Punctures on scutellum coarse and irregular; on mesothorax, large and more regular. Pubescence very dense on dorsal side.

Wings.—Venation is slightly different from the Paranomia group. The third cubital cell is somewhat smaller in comparison, whereas, the second cubital is larger. The basal nervure is nearly straight. More detail is given under Morphology.

Tongue.—Median length, broad at base, narrows to apex. Paraglossa comparatively long. See Morphology for details.

The female has the legs and antennæ of the ordinary Andrenid type.

The Northern Series:

This series of the *N. heteropoda* Say group is smaller than those of the southern series. The males are about 17 mm. in length; width of abdomen 5 mm.; anterior wing 14 mm. long. Females.—Length 14 mm.; width of abdomen 4 or 5 mm. There are no hairs in region of ocelli. The head and thorax are highly polished. The abdomen is brownish black.

N. heteropoda (Say)

The northern species bears this name. A male was described in 1824 in "Major Long's Expedition to the Source of St. Peter's River, etc." The description fits exactly the species I have before me from Barden San Dunes, Minnesota; Meredosia, Illinois, and Budd's Ferry, Maryland.

Male: Wings.—Yellowish hyaline with dark apical border.

Body.—Abdomen brownish black with reddish brown hair bands.

Thorax.—Shiny black.

Pubescence.—Ashen colored on thorax and face. Hair fringe of hind basitarsi red.

Localities: Males; Barden Sand Dunes, Scott Co., Minnesota. July 19, 1923 (R. W. Dawson).

Meredosia, Morgan Co., Illinois. August 19, 1913.—Sand Pit (Grace Wiley).

Budd's Ferry, Maryland, August, 1914. (R. C. Shannon).

This is parallel to the southern species *N. marginipennis* Cresson.

N. heteropoda valida (Say)

Dr. Cockerell explains in a recent publication, American Museum Novitates No. 697, March 6, 1934, how *Andrena valida* of Say was really a species of *Nomia*. Dr. Cockerell, however, applied the name to a southern *Nomia heteropoda* variety, because he was not aware of the northern species since no record of them had been published as far as we know. Now that we have species from this region, the name naturally applies to the species of the northern series which is parallel to this one of the southern series.

Male: Wings.—Fuliginous throughout; tegulae very dark.

Body.—Abdomen, brownish black with black hair.

Pubescence.—Coal black on dorsal part of thorax, on side of thorax and face, brownish black.

Hair fringe of hind basitarsi red.

Female: Length of body 14 mm.; width of abdomen 4 mm.

Pubescence.—Coal black on thorax, face and ventral side of abdomen.

Otherwise same as male. Legs normal. Antennæ normal.

Locality: Barden Sand Dunes, Scott Co., Minnesota. July 19, 1923 (R. W. Dawson).

15 males. 2 females.

This form is parallel to *N. validor* of the southern series.

N. heteropoda **validescens** new variety

General description and measurements given above.

Male: Wings.—Fuliginous throughout, tegulæ very dark.

Body.—Abdomen brownish black with very dark brown hair.

Pubescence.—Ashen colored on thorax and face. Fringe of hair on hind basitarsi red.

Type locality: Barden Sand Dunes, Scott Co., Minnesota. July 19, 1923 (R. W. Dawson).

Type specimen: University of Minnesota. Date as shown above. This variety is parallel to *N. semivalida* Ckll. of the southern series.

N. heteropoda **subvalida** new variety

General description given above.

Female: Wings.—Yellowish hyaline with dark apical border; tegulae nearly black; length of anterior wing 14 mm.

Body.—Length about 15 mm.; brownish black with black hair.

Pubescence: Coal black, on thorax and face. Fringe of basitarsi brownish black.

Type locality: Budd's Ferry, Maryland, August, 1914 (R. C. Shannon). From U. S. National Museum.

This species answers to the description of the female *N. marginipennis* Cresson with the exception of size. ("Report upon the Collections of Hymenoptera made in portions of Nevada, Utah, Colorado, New Mexico and Arizona—1872, 1873, 1874." E. T. Cresson. Chap. VII.) The description gives the bordered hyaline wing in combination with black pubescence. The male described, which is designated as the type of *N. marginipennis* Cresson, has the combination of the bordered hyaline wing in combination with ochreous pubescence.

N. marginipennis Cresson based on the male, is the southern subspecies of *N. heteropoda* Say. *N. heteropoda subvalida* is a variety of *N. heteropoda* Say. The female described as *N. marginipennis* is really a variety of the subspecies *N. marginipenns* Cresson.

The above described form therefore belongs to the northern series, which is parallel to the female described by Cresson, *N. heteropoda subvalidior.*

The Southern Series:

The southern series are about 20 mm. long; abdomen about 6 mm. wide; anterior wings about 17 mm. long. The metathorax is slightly more hairy, giving it a duller appearance than the northern species. Abdomen is black or brownish black. Females about 18 mm. long; 5 to 6 mm. wide.

N. heteropoda marginipennis (Cresson)

Because this species is very much like *N. heteropoda* Say and because it was thought that *N. heteropoda* Say referred to a southern species, as does *N. marginipennis,* Dr. Cockerell believed them to be the same species and since *N. heteropoda* was first described it was designated as the type. Now that *N. heteropoda* Say has at last been found, *N. heteropoda marginipennis* Cresson is again correctly applied to a subspecies which must be considered valid. The male, *N. marginipennis* Cresson was designated by Cresson as the type, the locality being given as ''Colorado.''

Wings.—Yellowish hyaline with dark apical border.

Body.—Black; head and thorax duller in appearance than northern variety, due to small hairs.

Pubescence.—Ashen colored on face, thorax and front legs.

Hair fringe of hind basitarsi red. Localities: Bexar Co., Texas—July 13 and June 24.

(Mr. H. B. Parks); Wellington, Kansas (E. G. Kelly); Rocky Ford, Colorado (Prof. C. P. Gillette.)

This form is parallel to typical *N. heteropoda* Say of the northern series.

N. heteropoda kirbii (Smith)*

General description and measurements given above.

* Since this was written, I have found that the name *N. kirbii* Smith, 1865, is applicable to the present variety as will be explained in a later paper.

Male: Wings.—Fuliginous throughout, tegulae very dark.

Length 3 mm. longer than *N. heteropoda valida* Say.

Body.—Black with black hair. Head and thorax somewhat duller than northern series.

Pubescence.—Coal black on dorsal part of thorax; on side of thorax and face chocolate colored. Hair fringe on basitarsi red.

Female: Length of body 18 mm. Wings nearly 16 mm.

Pubescence: Black on thorax, face and ventral side of abdomen. Legs and antennæ normal, otherwise, as male.

Type locality: Bexar Co., Texas, June 24, July 13 (Mr. H. B. Parks).

This variety is parallel to *N. heteropoda valida* Say of the northern subspecies.

N. heteropoda **subvalidior** new variety

This variety was described by Cresson as the female of *N. heteropoda marginipennis,* but the male is designated as the type. It is another variety. General description given above.

Female: Wings.—Yellowish hyaline with dark apical border.

Pubescence.—Black on thorax and face. Hair on legs brownish black.

Locality: Cresson recorded his *N. marginipennis* from "Colorado, New Mexico." This species is parallel to *N. subvalida.*

The remaining forms of the southern series are discussed in the American Museum Novitates No. 697, March 6, 1934, described by Dr. Cockerell.

KEY TO DIEUNOMIA

(Based on males unless otherwise specified.)

1. Hind tibiæ with a large oblique flattened quadrangular process, either all reddish yellow or black with honey colored lobe. (Similar to Paranomia.) (Female.—Length about 13 mm. or less. Not so deep a basin in 1st tergite) 2

   Tibiæ of hind legs short, triangular flattened undulate beneath, the apex beneath, dilated and truncate or subbilobate, their tarsi slender and fringed with long hair on inner side, nearly as long as femora and tibae together (Fig. 7) *N. heteropoda* Say, races and varieties. (Female.—Length 14 mm. or more. Deep basin in 1st tergite) 3
2. Length about 15 mm. Anterior wing 13 mm. Gray pubescence. Legs.—Black; hind, with honey colored lobe on tibiae and honey colored tarsi. Hind femora enormously swollen and covered with long gray hair. (Apparently the male of *N. apacha.*) *N. mesillae* Ckll.

Female.—First tergite polished, with widely separated punctures. Abdomen gray above; rusty red hair on sternites and legs. Legs normal. *N. apacha* Cresson.)

Length about 13 mm.; Anterior wings 11 mm.; Sandy red pubescence. Legs.—Orange fulvous; hind femora black, swollen and covered with sandy red hair. Tibiæ and tarsi orange fulcous.

Female.—Generally orange red hair including legs. Rusty red hair on sternites. Length about 11 mm. (Texas; and also a male taken by Mr. Timberlake at Albuquerque, New Mexico.) *N. bolliana* Ckll.

3. Robust; anterior wing 17 mm.; body about 20 mm.; abdomen brownish black or black. Female.—about 17 mm. long. Kansas, Colorado and Southwest 4

Not so robust; anterior wing 14 mm.; body about 17 mm.; abdomen brownish black.

Female.—About 14 mm. long. Minnesota, Illinois, Maryland 12

4. Hind margins of segments with distinct pale hair bands, gray, ashen or reddish yellow. Tegulæ light fulvous; pubescence of thorax gray to reddish yellow.

Female.—Sandy red to gray hair on sternites. *N.* variety *xerophila* Ckll.

Hind margins of segments testaceous; no distinct hair bands; segments covered with brownish black hair; tegulae piceous 5

5. Wings fuliginous throughout 6

Wings yellowish hyaline with dark apical border 8

6. Pubescence on thorax and face ashen color. *N.* variety *semivalida* Ckll.

Pubescence not ashen color 7

7. Pubescence black on thorax and chocolate color on face. Female.—Black face. *N.* variety *kirbii* (Smith).

Pubescence on dorsum of thorax red, on underside of abdomen black. *N.* variety *atripennis* Ckll.

8. Pubescence ashen color on thorax and face. *N. heteropoda marginipennis* Cresson.

Pubescence not ashen color 9

9. Pubescence rusty red brown. Hair on underside of abdomen black. *N.* variety *semirubra* Ckll.

Pubescence black. (Described by Cresson as female of *N. marginipennis*). *N.* variety *subvalidior* n. v.

10. Wings yellow hyaline with dark apical border 11

Wings fuliginous throughout 12

11. Pubescence ashen color. *N. heteropoda* Say.

Pubescence black on abdomen, thorax and face; brownish black on legs. (Female) New variety *subvalida* n. v.

12. Pubescence coal black on thorax; chocolate colored hair on face of male. Female.—Black face. New variety *valida* Say.

Pubescence ashen color on thorax and face. New variety *validescens* n. v.

Morphology of *N. heteropoda valida* Say

The male genital armatures of *Nomia* have very good characters for determining groups or sub-genera within the genus. (Fig. 1.)

Genitalia:

The cardo (anterior end) is rounded. The ventral side is about three times as long as the dorsal side. On the ventral side along the median line is a large elliptical hole, which reaches almost from the anterior edge to the posterior edge of the genitalia.

The stipites have large basal lobes next to the cardo, these almost meet on the median line. These lobes extend posteriorly on each side beyond the sagettae, forming the posterior end of the genitalia. These extensions or flanges have smaller flanges parallel to them on the dorsal side.

The sagittæ, the two independent structures along the median line, are partly covered by the lobes of the stipites and the cardo. They flare broadly at the posterior end, but are pointed at the anterior end. Near the center of the sagittæ are several wings extending from them. Across from these wings and slightly posterior are small wings on the stipites. The posterior tips of the sagittae bend over toward the ventral side, as do the ends of the stipites.

Sternites:

The eighth sternal plate fits tightly over the ventral surface of the genitalia. The point fits down between the sagittæ pointing posteriorly (Fig. 2).

The seventh sternal plate, with its few but long slender hairs, fits over the eighth plate. (Fig. 3.)

The sixth plate fits over the seventh under which is the eighth and entirely covers them. A small portion of this plate is exposed. The posterior edge bears plumose hairs. (Fig. 4.)

The fifth sternite is interesting because of the two tubercles. Upon these are chitinous hairs while the outer edges of the tubercles are very thickly covered with short chitinous structures that are very dark. Long plumose hairs extend from the posterior edge of the plate. They are especially thick on the points. (Fig. 5.)

Mouth parts:

The Nomias have no special division of the class. They have a well developed inner comb bearing about twenty-four teeth. This comb is mesad of the palpus on the basal part of the gala. The lacina, a small finger-like structure is beset with bristles. (Fig. 12.)

The labial palpi are four jointed broad but compressed. The *N. heteropoda* have much stouter joints than do those of *Paranomia* and *Dieunomia.* The first joint is nearly three times the length of the second. The paraglossa seem to be longer and stouter than those of *Paranomia* and *Dieunomia.* The mentum is completely dark colored. This is not true of the other groups which have a lighter color across the mentum where the glossa and palpi join. (Fig. 11.) The maxillary palpi are six jointed, the second joint being larger which is true of the other *Nomia.*

Legs:

The legs are elaborate and bear plumose hairs. The femora of the middle and posterior pairs are greatly swollen. The hind basitarsi are about five-sevenths of the length of the femur and tibia combined. (Fig. 7.) The lack of spurs on the middle tibae is typical of this group. (Fig. 8.) The spurs on the hind tibiae are serrated. The hairs of the tarsi are quite interesting. There is one main branch which has hairs growing from it that are arranged alternately. (Fig. 9.)

The two claws are bidentate and bear hairs. A pad is present which also bears hairs some of which are quite long.

Wings:

The venation of *Dieunomia* is slightly different from those of *Paranomia.* The third sub-marginal is not so long, and the second sub-marginal is larger in comparison with the other cells. *Dieunomia* differs from the *Epinomia* by the larger second sub-marginal cell.

The whole venation of the *Dieunomia* is somewhat straighter and not quite so graceful as the other groups. The color of the wings is darker. (Fig. 6.)

Miss Helen Gibbons, who is working on the corrugations or folds along certain lines in the wings, called my attention to the folds of the *N. heteropoda* Say group. I therefore included these in my drawing of the wing. (Fig. 6.) She described these thus: "The upper branch of the median furrow is not so definite or well marked as the lower. In the *N. heteropoda valida* Say specimen it appears considerably longer than in the *N. heteropoda validior.* In the lower branch of the median furrow, extending from the base of the stigma is seen a spine-like projection which I interpret to be the remnant of a vein which at one time divided the first cubital in two—the first cubital is thus considered to be the coalesced first cubital and first marginal cells, the large marginal cell representing, morphologically speaking, the second and perhaps the second and third marginals. This remnant is very faint in these two *Nomia* specimens. The upper branch of the median furrow is not marked by the presence of bullae in the veins it crosses. The bullae of the lower part of the transverso-cubitae, first and second recurrent, lowest part of discoid nervure and nervulus are strongly developed. In the *N. heteropoda valida* Say bulla are seen in the lower part of the third transverso-cubital nervure. In the *N. heteropoda validior* no bulla are seen here. The upper branch of the median furrow cuts through the first and second transverso-cubital nervures in *N. heteropoda valida* Say whereas in *N. heteropoda validior* the upper branch cuts through only the first transverso-cubital nervure." However only a few specimens were examined.

POSTSCRIPT

In the collection sent from Cornell University, by Dr. J. C. Bradley, I found the following:

N. heteropoda (Say).

1 male; Georgia, Bainbridge. Sept. 3–7, 1910. (J. C. Bradley.)

7 females; Georgia, Butler's Ferry. Aug. 12, 1931. (Bradley and Knorr).

N. heteropoda validescens Blair.

3 males; 1 female; Alabama, Mobile. Aug. 10. (Löding.)

11 males; 1 female; Georgia, Butler's Ferry. Aug. 12, 1931. (Bradley and Knorr.)

N. heteropoda valida (Say).

6 females; Georgia, Butler's Ferry. Aug. 12, 1931. (Bradley and Knorr.)

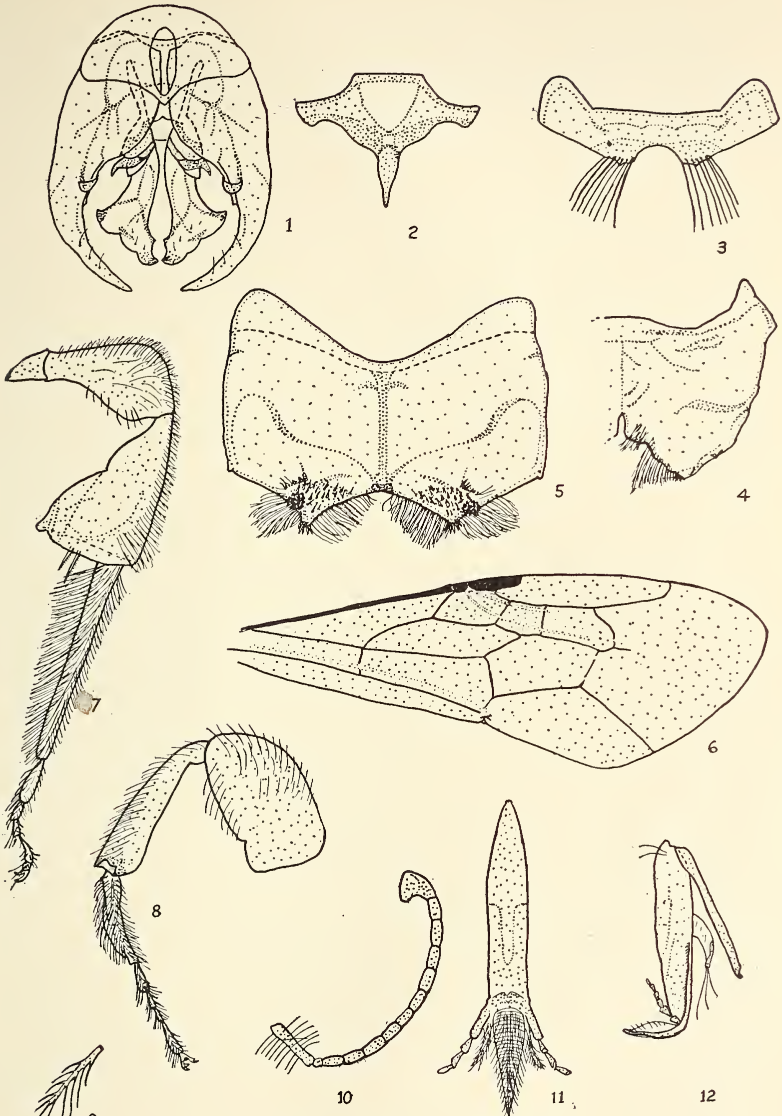
1 female; Florida, Marianna. Aug. 12–13, 1931. (Bradley and Knorr.)

[The extension of the range of the supposed northern form, as shown by the above records, was quite unexpected. The relative ranges of *N. heteropoda* and *N. marginipennis* are now seen to be similar to (though not strictly identical with) those of *Dasymuttilla occidentalis* (L.) and *D. occidentalis comanche* (Blake). The range of the typical subspecies of *N. heteropoda* is similar to that of the Sugar Maple (*Acer saccharum*) or the Red Ash (*Fraxinus pennsylvanica*).—T. D. A. C.]

PLATE XVI

N. heterapoda valida Say. Male. Fig. 1. Ventral view of genitalia. Figs. 2–5. Ventral view of tergites; 2, Eighth; 3, Seventh; 4, Sixth; 5, Fifth; Fig. 6, Anterior wing; Fig. 7, Hind leg; Fig. 8, Middle leg; Fig. 9, Basitarsus hair enlarged; Fig. 10, antenna; Fig. 11, Glossa and Mentum; Fig. 12, Maxillary blade.

Note. 1–5. Posterior ends down. Figs. 1–5, 11, 12, drawn to same scale. Camera lucida was used.



DIEUNOMIA

STUDIES IN AMERICAN SPIDERS: MISCELLANEOUS GENERA OF ERIGONEÆ

Part I

By S. C. Bishop and C. R. Crosby

For a number of years we have been studying the American species of Erigoneæ with the object of placing them in natural genera. In former papers we have considered those species that can be grouped into fairly well-defined and distinct genera each containing a considerable number of species differing from each other only in minor characters; Ceraticelus, Grammonota, Ceratinopsis, Erigone and Eperigone are good examples. We now come to a long series of more or less isolated species which seem to represent all that is left of separate lines of development. Numerous small genera are required for their reception, each containing only one or two species. It is quite likely that additional members of these small genera will be found in other parts of the world. With this possibility in view we have studied a large series of species from Europe, but in many cases without finding any close relatives. The spider fauna of Siberia and eastern China is still very imperfectly known and it is probable that the nearest relatives of many of our American forms will be found there. For exotic material we are indebted to Lucian Berland and Louis Fage of Paris, to Mr. A. Holm of Sweden, to Dr. E. Hesse of Berlin, to Dr. E. Schenkel of Basel, to Fen Hsueh of Tientsin, China, and to S. A. Spassky of Novotcherkassk, Russia. We are especially indebted to Dr. A. Randell Jackson of England for specimens and for comparing American material with specimens of rare species from Europe and elsewhere.

Most of the drawings were made by Miss Helen M. Zorsch; a few by Mr. Albert W. Force.

Coreorgonal new genus

Type, *Delorrhipis bicornis* Emerton.

The male has the head armed with a clypeal horn, slender in *monocerus* and thickened in *bicornis*. In *bicornis* the anterior median eyes are borne on the tip of a stout cephalic horn. The embolic division is of the spiral type. The patella of the male palpus is long and enlarged ventrally. The tibia is very short, armed dorsolaterally with a long process of characteristic form and dorsolaterally with a long stout spine.

Both species have been placed in *Delorrhipis* with which they have little in common. In *fronticornis*, the type of that genus the tibia, the embolic division and the median apophysis are of an entirely different type.

Coreorgonal bicornis Emerton
(Figures 1–4)

Delorrhipis bicornis Emerton, Can. Ent. 55: 242, fig. 7. 1923.

Male. Length, 2.5 mm. Cephalothorax dark yellow-orange, a band across head between the lateral eyes and the horns yellow; viewed from above evenly rounded on the sides to the lateral eyes without any constriction at the cervical groove. The upper horn, which bears the posterior eyes on its base and the anterior median eyes on the tip, rather stout, bluntly rounded at tip, gently and broadly constricted beyond the eyes, and clothed with numerous short stiff hairs, dusky at tip; the upturned tip of the lower horn visible in front of the upper horn. Cephalothorax viewed from the side arched over the back to the cervical groove where there is a broad shallow depression, then gently rounded over the head to the base of the upper horn. The lower horn arising from the lower half of the clypeus, the distal half greatly swollen, upturned, and clothed with hairs directed upward; the opening between the two horns nearly circular. Sternum very dark gray over orange. Endites pale. Legs orange. Abdomen greenish gray.

Posterior eyes in a recurved line, the median smaller than the lateral, close together on the base of the upper horn, separated by the diameter and from the lateral by a little more than twice the diameter. The anterior median eyes close together on the tip of the upper horn, widely distant from the lateral.

Femur of palpus stout, nearly cylindrical. Patella long, slender at base, greatly swollen ventrolaterally, clothed dorsally with numerous dark stiff hairs, the mesal angle deeply excavated for the insertion of the tibia, where a white, spherical enlargement of the intersegmental membrane is evident. Tibia with the base cylindrical, armed dorsally with large stiff black spine and mesally with a long thin process, which ends in a sharp black hook, and has a blunt tooth on the mesal margin. Cymbium strongly convex, truncate at apex with a distinct groove opposite the paracymbium. Paracymbium with a broad base which bears the rather stout hooked terminal part. Bezel narrow and very high, the duct showing distinctly. The embolic division consists of a spirally coiled, grooved tail-piece and a black embolus similarly coiled, the terminal turn the largest. The entire palpus is very much like that of *Coreorgonal monoceros.*

Type locality: Terrace, British Columbia.

Redescribed from 1 ♂ from the type lot, given us by Mr. Emerton.

Coreorgonal monoceros Simon

(Figures 5–8)

Delorrhipis monoceros Simon, Ar. Fr. 5: 697, fig. 554. 1884.

Erigone monoceros Keyserling, Spinn. Am. Therid. 2: 156, pl. 16, fig. 222. 1886.

Delorrhipis monoceros Simon, Hist. Nat. Ar. 1: 617, f. 668, 1894.

Male. Length, 2.3 mm. Cephalothorax yellowish strongly suffused with dusky, narrowly black at margin, cephalic lobe lighter. Cephalothorax viewed from above very broad, evenly rounded on the sides to the cervical groove, then strongly converging in a straight line to the truncate, gently convex front. Cephalic lobe rounded behind, bluntly pointed in front. The clypeal horn of nearly the same width throughout. Cephalothorax viewed from the side, low behind, gently convex to the base of the cephalic lobe, then abruptly elevated and rounded over the back of the head to the anterior median eyes. Median ocular area clothed with stiff hairs curving forward. Clypeus very broad, slightly convex and slightly protruding, bearing the horn about its diameter from the margin. The horn nearly cylindrical, bent upward a little at base and slanting upward and forward, clothed at tip with a few small hairs directed backward.

Sternum smooth and shining, yellow under a black reticulation, black at margin. Endites yellow suffused with gray. Legs and palpi pale yellow. Abdomen black.

Posterior eyes in a recurved line, the median slightly oval, separated by a little less than twice the short diameter, and from the lateral by three times the diameter. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by a little less than the diameter and from the lateral by five times the diameter.

Femur of palpus compressed, armed at base on the inner side with a rounded tubercle bearing the stridulating cusp. Patella very long, strongly swollen towards the tip, depressed just back of the dorsomesal margin, clothed dorsally with many stiff hairs, the tip hollowed out for the insertion of the tibia. Tibia very short, armed dorsolaterally with a stout straight sharp-pointed spine and dorsomesally with a long, thin, slender process which is armed on the mesal side with a blunt tooth; the tip is black and strongly hooked. The paracymbium armed at base with a row of long stiff hairs, thin and flat, broad at base, the tip strongly hooked with a broad rounded notch on the inner side. Tail-piece very long, grooved and spirally coiled. The embolus a long black style, in a spiral coil of more than two turns, the outer one the larger.

Type locality: Washington Territory.

Washington: Paradise Camp, Mt. Rainier, near snow, Aug. 19, 1927. 1 ♂.

Oregon: Tellamook Co., Aug. 20, 1931, 1 ♂ (Macy).

Gnathonagrus new genus

Type: *Tmeticus unicorn* Banks.

Very closely related to Gnathonarium from which it differs in having a well-developed clypeal horn in the male. The embolus does not pass back of the bulb but remains on the mesal side. There is no tooth on the face of the cheliceræ.

Gnathonagrus unicorn Banks

(Figures 9–13)

Tmeticus unicorn Banks, Phila. Acad. Nat. Sci. Proc. 1892, p. 38, pl. 4, fig. 13.

Delorrhipis monoceros Simon, Hist. Nat. Ar. 1: 620, 1894.

Delorrhipis unicornis Crosby, Phila. Acad. Nat. Sci., 1905, p. 328, pl. 29, fig. 4.

Delorrihips unicorn Banks, Phila. Acad. Nat. Sci. Proc. 1916, p. 74.

Male. Length, 1.4 mm. Cephalothorax orange-yellow, lightly suffused with dusky, darker at the margin; viewed from above, evenly and broadly rounded on the sides without any constriction at the cervical groove, the sides strongly convergent towards the front, bluntly rounded across the front. The clypeal horn long and slender, constricted in the basal half. Cephalothorax viewed from the side rather steeply ascending in a straight line to the cervical groove where there is a distinct depression, rounded over the cephalic lobe to the posterior median eyes. Clypeus hollowed out below the eyes, the clypeal horn slants upward so that its tip is on a level with the lateral eyes. Below the horn the clypeus is slightly concave and protruding. Sternum gray with scattered yellow flecks, broad, strongly convex, broadly produced between the hind coxæ which are separated by a little more than the diameter. Endites orange-yellow. Legs yellow. Abdomen light gray.

Posterior eyes in a straight line, the median a little larger than the lateral, separated by a little less than the diameter and from the lateral by the radius. Anterior eyes in a procurved line, the median very much smaller than the lateral, equidistant, separated by the radius.

Femur of palpus long, cylindrical, slightly curved inward, armed above on the median line with a row of 7 or 8 curved hairs. Patella viewed from above slightly constricted in the middle. Ratio of length of femur to that of patella as 20 to 12. Tibia ventrally very short, dorsally armed on the mesal angle with a short triangular black tooth and in the middle of the mesal side with a similar pale tooth. The lateral angle produced into a very long process which is curved mesally and ventrally; there is on the under side, on the basal third, a low hump. The cymbium armed dorsally on the basal third with a single row of short stiff hairs increasing in length distally. Paracymbium thin, nearly flat, tip broadly rounded with a shallow notch. The embolus arises from a thin irregular tail-piece that extends out on the ventral side of the bulb, curves along the mesal side to the base, then along the lateral side, across the tip, across the face of the bulb, the tip lying between the tip of the cymbium and a broad dark process thickened along each side.

Female. Length, 1.5 mm. Similar to male. Head normal. Posterior eyes in a straight line, equal, the median separated by the diameter and from the lateral by the radius. Anterior eyes in a procurved line, the median much smaller than the lateral, separated by the diameter and from the lateral by a little less. The epigynum a convex, semicircular plate, the middle lobe triangular, narrower in front, the posterior margin crenulate.

Type locality: Six Mile Creek, Ithaca, N. Y.

New York: Crosby, April, 1904, 1 ♂; Ithaca, March, 1904, 2 ♂ 4 ♀; Barrington, Oct. 27, 1918, 1 ♂.

GNATHONARIUM Karsch

Arch. Naturg. 47: 10. 1881.

Type: *Gnathonarium rolfsianum* Karsch which equals *Theridion dentatum* Wider.

This genus is characterized by the structure of the genital bulb of the male palpus. We give a description and figures of the type species.

Gnathonarium dentatum Wider
(Figures 14–16)

Theridion dentatum Wider, Zool. Miscl. Ar. p. 223. 1834.
Argus dentatus Walckenaer, Ins. Apt. 2: 345. 1841.
Erigone dentata Westring, Ar. Suec. p. 262, 1861.
Neriene dentata Blackwall, Spid. Gt. Brit. p. 258, pl. 18, f. 174. 1864.
Tmeticus dentatus Menge, Preuss. Spinn., p. 187, pl. 35, f. 87. 1868.
Tmeticus cristatus Menge, Preuss. Spinn., p. 189, pl. 36, f. 88. 1868.
Erigone taczanowskii Cambridge, Zool. Soc. Lond. Proc. 1873, p. 444, pl. 41, f. 10.
Neriene dentata Cambridge, Spid. Dorset, p. 115. 1879–81.
Gnathonarium rohlfsianum Karsch, Arach. Naturg. 47: 10, pl. 1, fig. 7. 1881.

Gongylidium dentatum Simon, Ar. Fr. 5 : 492, f. 276–279. 1884.
Trachygnatha dentata Chyzer & Kulczynski, Ar. Hung. 2 : 91, pl. 3, f. 41. 1894.
Gongylidium dentatum Müller & Schenkel, Naturf. Ges. Basel. Verh. 10 : 736. 1895.
Œdothorax dentatus de Lessert, Rev. Suisse Zool. 12 : 327. 1904.
Œdothorax exsiccatus Bösenburg and Strand. Jap. Spin., p. 166, pl. 12, f. 265, 1906.
Œdothorax dentatus de Lessert, Rev. Suisse, Zool. 15 : 96. 1907.
Œdothorax dentatus de Lessert, Cat. Ar. Suisse, p. 194. 1910.
Gnathonarium dentatum Simon, Ar. Fr. 6 : 476. 1926.

Male. Length, 2 mm. Cephalothorax orange-red, viewed from above evenly rounded on the sides, narrowed forward and gently constricted at the cervical groove, eyes in profile; viewed from the side, steeply ascending behind, then more gradually to the back of the head with a slight depression at the cervical groove, nearly level on top of head. Clypeus slightly concave and retreating. Sternum dusky over reddish orange, darker at edge. Endites pale towards tip, armed on the side with many setigerous tubercles. Cheliceræ armed with a large tooth on the face and a group of small teeth on the anteriolateral face. Legs long, pale orange-yellow. Abdomen light gray, with a tinge of red, blackish at tip. In specimens from France the stripe on the abdomen, especially in the female, is more distinct than in those from China.

Femur of palpus nearly straight, armed on the mesal side with a series of 9 or 10 setigerous tubercles more widely separated distally. Patella long and stout, widened distally, the tip angulate ventro-laterally, armed laterally with a series of 7 long slender curved hairs and on the mesal side near the base with 3 or 4 long hairs. Ratio of length of femur to that of patella as 26 to 19. Tibia not greatly widened distally, armed on the lateral angle with a very long apophysis which is gradually narrowed distally and armed mesally with a small triangular tooth, the tip of the process sharp and incurved. The terminal part of the paracymbium flat, nearly quadrate, with a deep rounded notch before the tip. The tegulum and subtegulum very narrow; the embolus arises from a geminated bulb near the base of the cymbium and passes immediately under the mesal edge of the latter, proximad to the attachment of the bulb to the alveolus, emerging on the opposite side from beneath the paracymbium and then curves up along the face of the bulb, the very slender tip lying within a sheath the tip of which is pointed and extends beyond the edge of the cymbium.

Female. Length, 2 mm. Similar to the male in form and color but the abdomen has an indistinct light stripe, more pronounced in specimens from France. The setigerous tubercles on the cheliceræ less developed, the large tooth lacking. The epigynum is a transverse, convex plate, with a small triangular notch in the hind margin, the receptacles show through as two circular dark areas separated by about the dimeter.

Type locality: Ginster, near Beerfelden.

France: 4 ♂ 1 ♀, Simon det.

Tripoli: Ain Schersozura, 1 ♂, type of *Gnathonarium rohlfsianum* Karsch, kindly lent us by Dr. E. Hesse, of the Zoological Museum of the University of Berlin.

China: Peiping, Sept. 15, 1925, 1 ♂ (P. W. Claassen); Tien Tsin, 1 ♂ 2 ♀ (Fen Hsueh).

Gnathonarium famelicum Keyserling
(Figures 17–18)

Erigone famelica Keyserling, Spinn. Am. Therid. 2: 186, pl. 17, f. 246. 1886.

Erigone famelica Banks, Wash. Acad. Sci. Proc. 2: 480, pl. 29, f. 7–8. 1900.

Gongylidium columbianum Emerton, Can. Ent. 55: 238, f. 2. 1923.

Male. Length, 2.6 mm. Cephalothorax bright chestnut brown, head darker, viewed from above, broadly and evenly rounded on the sides to the cervical groove, then gently converging to the bluntly rounded front; viewed from the side, rather low, moderately ascending behind to the cervical groove where there is a slight depression, then evenly and broadly rounded over the head to the posterior eyes. Clypeus straight and retreating. Cheliceræ large, swollen at base, armed on the face with a very large tooth and in front and on the side with many small tubercles. Sternum gray over chestnut, margin scalloped, rather pointed behind. Endites orange-yellow. Legs orange. Abdomen dark grey.

Posterior eyes in a straight line, equal, the median oval, separated by the long diameter, and from the lateral by a little less. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by a little less than the diameter.

Femur of palpus rather long, slender, only moderately curved, armed on the mesal side with a row of small setigerous tubercles mostly confined to the basal half. Patella nearly straight, greatly widened distally, the lateral angle produced into a large blunt tooth. Tibia gradually widened on the mesal side, nearly straight on the lateral side, armed dorsolaterally with a long, stout apophysis the tip of which is smooth and black and curved mesally, the mesal side of this process armed with a small black triangular tooth. Ratio of length of femur to that of patella as 5 to 3.

Paracymbium almost square in outline with a very deep rounded notch on the side next to the cymbium. The embolus arises from a geminate bulb, curves across the mesal side of the bulb, passes under the cymbium to emerge on the other side at the base of the paracymbium, it then passes up across the face of the bulb in a broad, deep groove in what seems to be an enormously developed bezel. The terminal part of the embolus is extremely fine and hair-like.

Type locality: Sitka, Alaska.

British Columbia, Terrace, 1920 (the type of *Gongylidium columbianum* Em.).

The type of *Gongylidium columbianum* Em. is much larger than specimens of *dentatum* from China. We have not been able to compare specimens but Miss Elizabeth B. Bryant did so for us. She writes as follows: "The most striking difference is the size, as the Chinese specimen is about one half as large as the American species. These are the differences as I found them—*Gongylidium columbianum,* maxillæ and base of palpus smooth, femur of palpus with granules, patella ½ length of femur, plainly concave below, and broadest at tip, ventral tooth at tip as long as diameter of patella at base (in Mr. Emerton's drawing the patella is lengthened and the tooth foreshortened), tibial apophysis abruptly constricted at tip and ending in a long sharp curved point which rests in a depression of the cymbium. The palpal organs are very similar, the conductor ending in a more slender tip than Mr. Emerton figures."

TMETICUS Menge

Preuss. Spinnen, p. 184, 1866.

Type: *Tmeticus leptocaulis* Menge, which equals *Neriene affinis* Blackwall.

In this genus the tibia of the male palpus is relatively long and without a process. In the type species there are two small teeth on the outer distal angle. The patella is long and bears a distinct process on the under side at tip. In both species the embolic division has a nearly flat tail-piece and ends in two points, the duct opening in the one nearest the tip of the cymbium.

In this genus we place only one American species, *Gongylidium ornatus* Emerton.

Tmeticus affinis Blackwall

(Figures 19–21)

Neriene affinis Blackwall. Ann. Mag. Nat. Hist. (Ser. 2) 16: 121. 1835.

Neriene affinis Blackwall. Spid. Gt. Grit., p. 259, pl. 18, fig. 175. 1864.

Tmeticus leptocaulis Menge. Preuss Spinn., p. 185, pl. 35, Tab. 85. 1868.

Erigone affinis Thorell. Remarks on Synonyms, pp. 127, 444. 1871 and 1873.

Tmeticus affinis Bösenberg. Spinn. Deutschl., p. 165, pl. 14, fig. 223. 1903.

Anglia hancockii Smith. Quekett Micr. Club Jour. (Ser. 2) 9: 247, pl. 16. 1905.

Tmeticus affinis Simon. Ar. Fr. 6: 521. 1926.

Male. Length, 2.5 mm. Cephalothorax dull orange, suffused with dusky along the radiating lines; viewed from above broad, evenly rounded on the sides to the cervical groove where there is a broad shallow depression, broadly rounded across the front; viewed from the side gently arched over the back to the eyes, with a very slight depression at the cervical groove, highest back of the eyes. Clypeus gently concave, slanting moderately forward. Sternum short and broad, convex, dark gray over orange. Endites thickened, armed with numerous setigerous tubercles, the one on the outer distal angle distinct. Cheliceræ robust, armed on the inner edge with a large tooth and on the face with numerous setigerous tubercles. Legs orange, abdomen dark gray with a broad pale band on the venter. Posterior eyes in a slightly procurved line, the median slightly smaller than the lateral, separated by the diameter and from the lateral by a little less. Anterior eyes in a straight line, the median slightly smaller than the lateral, equidistant, separated by the radius. Femur of palpus moderately stout, curved inward and downward. Patella slender at base, thickened at tip with a stout triangular tooth below. Ratio of length of femur to that of patella as 26 to 16. Tibia long, slender at base, gradually thickened distally, the dorsal margin nearly straight across, armed dorsolaterally with two small black teeth some distance from the true margin from which they are separated by a shallow excavation. Cymbium small. Paracymbium very broad at base, armed with a row of 6 or 7 short stiff hairs, the distal part strongly curved with deep narrow notch. Tegulum strongly developed with a high bezel. The embolic division is broad and flat with a rounded tail-piece at one end and with the other ending in two points, the lateral one triangular and the other longer and curved; the latter is the embolus.

Described from 2 ♂ from Sussex, England. (A. Randell Jackson.)

Tmeticus ornatus Emerton

(Figures 22–26)

Gongylidium ornatus Emerton. N. Y. Ent. Soc. Jour. 22: 263, pl. 8, fig. 3. 1914.

Male. Length, 3.8 mm. Cephalothorax bright orange, the entire head very dark brown, almost black; viewed from above, sides evenly rounded to the cervical groove, then parallel on the sides of the head, broadly rounded in front; viewed from the side rather flat, gently arched over the back to the eyes. Clypeus straight and vertical.

Posterior eyes in a straight line, equal, separated by the diameter. Anterior eyes in a straight line, median smaller than the lateral, separated from each other and from the lateral by the radius. Clypeus about as wide as median ocular area. Cheliceræ dark brown, swollen, fusiform, divergent, armed with a large tooth on the face, denticulate on the sides, the claw very large, sinuous and strongly curved. Upper margin of the furrow of the chelicera armed with a row of small teeth, three close together at the inner angle, and three more widely separated towards the base of the claw; the lower margin armed with four large teeth, the two nearest the base of the claw near together, the others somewhat separated. Sternum dusky orange, darker at the margin, broad, convex, strongly rounded on the sides and produced in a blunt process between the hind coxæ which are separated by a little more than half the diameter. Labium and endites darker than sternum. Legs and palpi bright orange. Trochanters of first and second legs strongly protuberant ventrally; others less so. Abdomen dark gray, almost black.

Trochanter of palpus strongly protuberant ventrally. Femur long, slender, strongly curved. Patella long, arched above, swollen distally and armed ventrally with a large apophysis. Ratio of length of femur to that of patella as 26 to 13. Tibia a little longer than patella, widened distally. Dorsolateral margin of tibia armed with two short teeth, the outer one rounded, the inner one bluntly pointed. Paracymbium very broad at base, where it is armed with two or three short spines; strongly curved and with a short hook at the tip. Bezel very high. The embolic division is a modification of the Erigone type. The posterior tooth is long and pointed, the median tooth is entirely lacking and the embolus representing the anterior tooth is long and slender. The mesal projection is larger with a rounded margin, the mesal tooth lacking.

Female. Length, 3.5 to 4 mm. Colored as in the male. Cheliceræ large, divergent and finely denticulate on the sides but without a tooth on the face. Upper margin of the furrow of the chelicera armed with three large and one small tooth evenly spaced; lower margin armed with four evenly spaced smaller teeth. Epigynum a broad transverse, slightly convex plate straight behind; the median fovea is semicircular but the middle lobe is truncate wedge-shaped.

Type locality: Ithaca, N. Y.

New York: Ithaca, Mar. 11, 1916, 2 ♂ 3 ♀ on cattail tops. (P. W. Claassen); also in Sept. Crusoe Lake, Wayne Co., May 17, 1919, 1 ♀; Montauk Pt., May 24, 1924, 1 ♀.

NANAVIA Chamberlin and Ivie

Bul. Univ. Utah, 23: 26. 1933.

Type: *Nanavia monticola* Chamberlin and Ivie.

This genus is very closely related to Tmeticus in the form of the embolic division of the genital bulb and in the form and armature of the tibia but differs in lacking a process on the tip of the patella.

In *Erigone* (*Tmeticus*) *tenuipalpis* Emerton, which Chamberlin and Ivie place tentatively in Nanavia, the embolic division has advanced much further towards the typical Erigone form and we, therefore, leave it in that genus as a transitional species.

Nanavia monticola Chamberlin and Ivie
(Figures 27–28)

Nanavia monticola Chamberlin and Ivie, Bul. Univ. Utah 23: 27, pl. 8, f. 75–82. 1933.

Male. Length, 3 mm. Cephalothorax orange yellow suffused with dusky, darker along the radiating lines; viewed from above, evenly and broadly rounded on the sides to the cervical groove where there is a slight constriction then gradually converging to the broadly truncated front; viewed from the side rather low, gently ascending behind to the cervical groove where there is a shallow depression, then broadly and evenly rounded over the head to the posterior eyes; a median row of stiff hairs directed forward. Clypeus nearly straight and slightly protruding. Sternum orange strongly suffused with dusky, darker at the margin, pointed behind. Endites dusky at base, lighter distally.

Legs orange. Abdomen dark gray, light in front with a herring-bone light pattern behind.

Posterior eyes in a straight line, equal, the median separated by the radius and a little farther from the lateral. Anterior eyes in a straight line, the median much smaller than the lateral, separated by less than the radius and from the lateral by the radius.

Femur and palpus rather long and slender, gently curved inward. Patella moderately short, strongly curved. Ratio of length of femur to that of patella as 38 to 17. Tibia long, nearly cylindrical, slender at base, gradually and evenly widened distally. The distal margin nearly straight all way round, dorsolaterally there is a very short, broad, black-edged lobe with a finely serrate margin. Cymbium short, convex dorsally. Paracymbium very broad at base; armed on the margin next to the tibia with a row of nine or ten short stiff hairs; the distal part bent squarely back along the basal part from which it is separated by a narrow fissure. The bulb is rather small. The tail-piece of the embolic division is a thin, nearly flat plate, the central part of which is quadrate with a narrow part that extends to the edge of the cymbium. The embolus is the middle one of three teeth, the one lying mesally from it is shorter and the lateral one longer.

Type locality: Clear Creek, Raft River Mts., Utah.

Utah: Salt Lake City, Sept., 1930, 1 ♂ (Gertsch).

MASO Simon

Ar. Fr. 5: 861. 1884.

Type: *Erigone sundevalli* Westring.

In the type species the female has the tarsi and metatarsi of the first and second legs armed below with two rows of long divergent spines; in the male they are not conspicuously developed. The embolic division has a distinct tail-piece which gives rise, in the interior of the bulb to a long style-like embolus which emerges on the mesal side of the bezel and then curves around to the distal end of the bulb.

Maso alticeps Emerton

(Figures 29–32)

Caseola alticeps Emerton, Conn. Acad. Sci. Trans. 14: 187, pl. 2, f. 2. 1909.

Male. Length, 1.5 mm. Cephalothorax dull yellowish strongly suffused with gray, darker along the radiating lines and with dark patch back of the head, pointed behind. Cephalothorax viewed from above very broad, evenly rounded on the sides behind, very strongly narrowed towards the front, the head carried forward so that the anterior eyes are in profile; viewed from the side moderately ascending behind to the cervical groove, then nearly flat for a short distance, steeply ascending on the back of the head to the posterior eyes, median ocular area slanting forward in a straight line. Clypeus concave and nearly vertical. Sternum dark, broad, convex, smooth and shining. Endites pale. Legs pale dusky orange yellow, somewhat hairy. Abdomen gray.

Posterior eyes in a straight line, equal, the median separated by the diameter and a little farther from the lateral. Anterior eyes in a slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by a little more.

Femur of palpus moderately long, curved inward. Patella short and stout. Ratio of length of femur to that of patella as 17 to 6. Tibia short and stout with a keel-like protuberance below, the dorsal margin broad with a broad, triangular projection in the middle, tip sharply inflexed; the mesal side finely dentate, the lateral angle of the tibia a broad triangular tooth. Paracymbium of moderate size strongly curved, hooked at tip. Tegulum narrow. Tail-piece of the embolic division small, rounded-triangular and lying flush with the edge of the tegulum. It gives rise in the interior of the bulb to a long, slender, style-like embolus which ascends in an open spiral, the tip protected by a large broad, lamellate conductor and by another more slender process which ends in a minute black tooth.

Type locality: Three Mile Island, Lake Winnipesaukee, N. H.

Maine: Winterport, Aug. 29, 1925, 1 ♂.

New Hampshire: Intervale, July 17, 1913, 1 ♂ (Bryant).

Emerton also recorded the species from Waltham, Mass.

Maso sarcocuon Crosby and Bishop

(Text figure 1)

Oedothorax sarcocuon Crosby and Bishop. N. Y. Ent. Soc. Jour. 35: 149, pl. 15, fig. 8–10. 1927.

In the structure of the palpal organ this species is closely related to *alticeps*. The male may be easily recognized by the transverse groove below the anterior eyes.

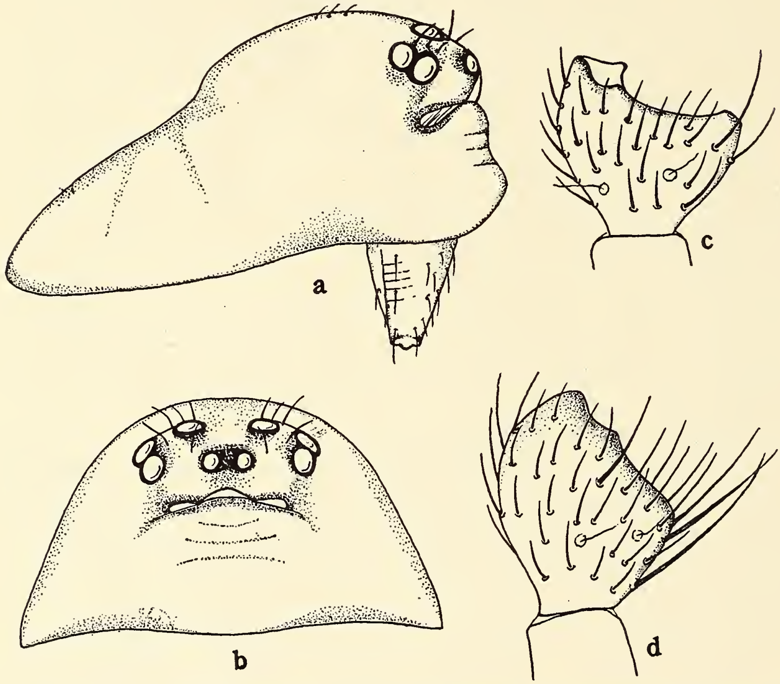


FIGURE 1. *Maso sarcocuon:* a. cephalothorax, lateral view; b. same, anterior view; c. tibia of male palpus, dorsolateral view; d. same, dorsal view.

Maso polita Banks

(Figures 33–34)

Maso polita Banks, Am. Ent. Soc. Trans. 23: 67. 1896.

Male. Length 1.8 mm. Cephalothorax brown, lighter on the front. Viewed from the side the cephalothorax ascends in a nearly straight line to the cervical groove where there is a slight depression. The clypeus is very wide, slightly convex and strongly retreating. The head is very broad and square, the lateral eyes occupying the angles. The posterior eyes in a procurved line, the median being smaller and farther from the lateral than from each other. Anterior eyes in a slightly procurved line, the median smaller than the lateral, close together and farther from the lateral. The ocular area and the space between and back of the posterior median eyes densely clothed with short, stiff, erect hairs.

Sternum light brown, rounded between the posterior coxæ. Labium dark, endites pale, legs and palpi light brownish yellow. Abdomen yellowish, grayish at tip. Legs bristly, with two rows of spines on the under side of tibiæ and metatarsi.

Tibia of palpus short, bearing a short acute dorsal apophysis and a blunter one on the outer angle. The median apophysis very strongly developed, coiled in a spiral (visible only in expanded preparation) and terminates in a strongly chitinized point at the apex of the palpal organ.

The embolic division consists of a short flat tail-piece only a small part of which is visible in the unexpanded palpus; the embolus arises from the basal part at a right angle. It is slender and simply curved; the tip lies near the end of the median apophysis and is protected by a membraneous conductor.

Female. Similar to male in coloration. The legs are much more spiny, especially the first and second pairs. The head is normal. The posterior eyes are in a straight line, nearly equidistant. Anterior row gently procurved.

Type locality: Washington, District of Columbia.

Described from the type, 2 ♂ and 3 ♀.

Maso sundevalli Westring

(Figures 35–37)

Erigone sundevallii Westring, Götheb. Vet. Vit. Samh. Handl. 2: 44. 1851.

Erigone sundevallii Westring, Ar. Suec. p. 290. 1861.

Microneta sundevallii Menge, Preuss. Spin. p. 232, pl. 45, f. 131. 1869.

Erigone sundevallii Thorell, Rem. Syn. p. 142. 1871.
Erigone sundevallii Cambridge, Linn. Soc. Lond. Trans. 27: 450. 1871.
Erigone westringi Simon, Soc. Zool. Fr. Bul. 6: 258. 1881.
Neriene sundevallii Cambridge, Spid. Dorset p. 125. 1879.
Maso westringi Simon, Ar. Fr. 5: 864, f. 800. 1884.
Phylloeca sundevalli Dahl, Naturw. Ver. Schlesw.-Holst. Schriften 6: 101. 1886.
Ceratinopsis frontata Banks, Phila. Ac. Sci. Proc. 1892, p. 33, pl. 5, f. 63.
Maso sundevalli Chyzer and Kulczynski, Ar. Hung. 2: 133, pl. 5, f. 15. 1894.
Maso sundevalli Simon, Hist. Nat. Ar. 1: 641. 1894.
Maso westringi Müller and Schenkel, Naturf. Ges. Basel Verh. 10: 744. 1895.
Maso frontata Banks, Am. Ent. Soc. Trans. 23: 67. 1896.
Maso sundevallii Bösenberg, Spin. Deutschl. p. 154, pl. 13, f. 207. 1903.
Maso sundevalli de Lessert, Rev. Suisse Zool. 12: 332. 1904.
Maso frontata Crosby, Phila. Ac. Sci. Proc. 1905, p. 341.
Maso sundevalli de Lessert, Rev. Suisse Zool. 15: 96, 111. 1907.
Caseola herbicola Emerton, Conn. Ac. Sci. Trans. 14: 186, pl. 2, f. 1. 1909.
Maso sundevalli de Lessert, Cat. Ar. Suisse p. 207. 1910.
Maso frontata Banks, Phila. Acad. Sci. Proc. 1911, p. 447, pl. 35, f. 17.
Maso sundevalli Falconer, Naturalist, June 1910, p. 229, f. 2, 3.
Maso sundevalli Simon, Ar. Fr. 6: 328, f. 548–549. 1926.

Male. Length, 1.5 mm. Cephalothorax light brown, darker on the head, viewed from above evenly rounded on the sides with a very slight constriction at the cervical groove and with the eyes in profile; viewed from the side, rather steeply ascending behind to the cervical groove, then more gradually ascending and broadly rounded over the head to the posterior median eyes. Clypeus nearly straight and slightly protruding. Sternum light gray over dull yellow, darker at the margin, moderately broad and convex, produced behind between the hind coxæ, which are separated by the diameter. Labium and endites dusky yellow.

Legs orange-yellow. A double row of stiff hairs on the underside of the first and second legs.

Posterior eyes in a straight line, the median slightly smaller than the lateral, separated by the diameter and a little farther from the lateral. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by the diameter and from the lateral by nearly twice the diameter.

Femur of palpus moderately long and slender, nearly straight, armed laterally with a row of 4 hairs increasing in length distally. Patella short and thick. Ratio of length of femur to that of patella as 20 to 7. Tibia obconic, the dorsal margin thin, evenly and broadly rounded, just back of the margin, a transverse, curved, ridge with a very finely serrated margin. Lateral angle of tibia evenly and broadly rounded without any excavation. Paracymbium rather stout, strongly curved, only slightly hooked at tip. Tegulum strongly developed, protuberant ventrally, the bezel high, whitish. Tail-piece of the embolic division rather small, bulb-like, lying over the edge of the tegulum, it gives rise immediately to a long, black, whip-like embolus which first passes into the interior of the bulb, emerges from beneath the edge of the bezel and curves distally along the mesal side of the bulb, the tip protected by a membranous conductor and lies near the median apophysis which appears as a stout, black process.

Female. Length, 1.7 mm. Similar to the male in form and color. The abdomen pale, often with a dusky area on the front. The spines on the under side of the first and second legs are larger than in the male. The epigynum has the middle lobe broad and quadrate, in front of which there are two strong, curved ridges. The receptacles show through the integument as black spots.

Our supposition that this American spider is identical with *Maso sundevalli* of Europe has been confirmed by Doctor A. Randell Jackson, to whom we submitted specimens for comparison.

Type locality: Götheborg, Sweden.

Massachusetts: Chester, May 14, 1933, 1 ♀.

Minnesota: Lake Minnetonka, June 22, 1926, 1 ♀ (Fletcher).

New York: Ceres, Sept. 16, 1925, 1 ♀; Deruyter Lake, July 4, 1922, 1 ♂ 1 ♀; Enfield Glen, Oct. 12, 1924, 1 ♀; Guyanoga, June 24, 1923, 2 ♂ 1 ♀; Interlaken, July 1904, 5 ♀; Ithaca, Oct. 8, 1922, 2 ♀; May 23, 1911, 1 ♀ (Banks); July, 2 ♀; Labrador Pond, June 7, 1921, 1 ♀; Letchworth Park, July 9, 1922, 2 ♀; Long Pond, Suffolk Co., June 29, 1924, 1 ♀; McLean, July 1904, 1 ♀; July 4, 1924, 1 ♀; Mendon, Oct. 14, 1924, 2 ♀; Olcott, Sept. 1922, 1 ♀ (Dietrich); Potter Swamp, Yates Co., July 16, 1926, 1 ♀; Presho, Oct. 29, 1924, 1 ♀; Rock City, Sept. 16, 1925, 1 ♀; Slaterville, May 10, 1925, 1 ♀; Snyder Lake, June 18, 1930, 2 ♂ 2 ♀; Stamford, May 30, 1921, 2 ♀ (Chrisp); Oct. 21, 1924, 2 ♀; Sylvan Beach, July 1904, 1 ♀; West Kilns, June 28, 1931, 1 ♂; Wilmington Notch, Aug. 21, 1916, 4 ♀; Aug. 26, 1921, 2 ♀.

North Carolina: Aquone, Oct. 16, 1926, 1 ♀; Black Mt., several ♂ and ♀; Blowing Rock, Oct. 10, 1923, 1 ♀; Junalaska Gap, Oct. 17, 1926, 1 ♀; Minehole Gap, Buncombe Co., Oct. 12, 1923, 1 ♀; Mt. Pisgah, Oct. 19, 1923, 5 ♀; Nantahala Gap, Oct. 16, 1926, 1 ♀.

Tennessee: Laurel Creek, Sevier Co., Oct. 8, 1926, 2 ♀.

Vermont: Pittsford, May 8, 1929, 1 ♀; South Newfane, July 4, 1931, 1 ♂ (Bryant); June 1929, 1 ♀.

England: Surrey, 2 ♂ 3 ♀ (Hancock).

Hungary: 1 ♂ 2 ♀ (Kulczynski).

France, 1 ♂ 1 ♀ (Simon).

UTOPIELLUM Strand

Arch. Math. Naturv. 24 (2): 31. 1901.

Type: *Erigone mirabilis* L. Koch.

This genus is characterized by having the anterior metatarsi distinctly sinuous and armed with numerous spines. The embolic division has the duct opening near the base of the tail-piece beyond which there is a very long, curved, sharp-pointed process. The epigynum is protuberant and is reminiscent of Hilaira.

Utopiellum mirabile L. Koch

(Figures 38–41)

Erigone mirabilis L. Koch, Kong. Sv. Vet-Akad. Handl. 15: 49, pl. 2, f. 4. 1879.

Utopiellum mirabile Strand, Arch. Math. Naturv. 24 (2) : 31. 1901.

Utopiellum mirabile Strand, Fauna Arctica 4 (3) : 449. 1916.

Gongylidium curvitarsis Emerton, Can. Ent. 49: 262, fig. 14. 1917.

Hilaira curvitarsis Emerton, Royal Can. Inst. Trans. 12: 316. 1919.

Utopiellum curvitarsis Chamberlin, N. Y. Ent. Soc. Jour. 29: 40. 1921.

Utopiellum mirabile Holm, Kongl. Sven. Vetensk. Skrift. Natursk. No. 19: 5. 1931.

Male. Length, 3.3 mm. Cephalothorax dusky orange with lighter radiating lines; viewed from above rather broad, sides evenly rounded, convergent toward the front, broadly rounded in front; viewed from the side gradually ascending to the dorsal groove, nearly flat on top and then descending steeply through the eye region. The head is distinctly depressed in the eye region. Clypeus slightly convex and nearly vertical. Posterior eyes in a strongly procurved line, equal and equidistant, separated by a little more than the diameter. Anterior eyes in a very slightly recurved line, the median smaller than the lateral, separated from each other by the diameter and twice as far from the lateral. Clypeus about half as wide as the median ocular area.

Sternum and labium grayish over yellowish orange. Sternum broad and rounded on the sides, narrowly produced between the hind coxæ. Hind coxæ separated by less than half the diameter. Endites grayish yellow, lighter than the sternum. Legs and palpi yellowish. Anterior metatarsi distinctly sinuous, armed ventro-mesally with numerous black spines. No tooth on the face of the chelicera. Abdomen grayish with indistinct light areas, the middle ones in pairs; underside with the usual longitudinal light lines.

Femur of palpus rather short and stout, somewhat curved and widened distally. Patella short, stout, strongly curved ventrally. Ratio of length of femur to that of patella as 23 to 8. Tibia longer than patella, broad, with three long slender hairs near the ventro-lateral margin, the dorso-lateral apophysis triangular, broad at base, with a sharp black incurved tip. Base of cymbium below tibial apophysis with a double row of short, stiff, black spines. Paracymbius large, triangular, armed on the outer angle with two very long slender spines and at the base with 11 short stiff hairs; the tip bluntly pointed and with a deep notch on the inner side. Subtegulum well developed, tegulum narrow. The embolic division consists of a large flattened sock-shaped tail-piece and a very large, curved, long and pointed terminal part. At the base the tail-piece on a large irregular protuberance lies the minute embolus. Near it there is another small pointed process.

Female. Length, 3.5 mm. Similar to the male in color. The head is not depressed in the eye region as in the male and the anterior metatarsi are normal. Epigynum strongly convex, protuberant, semitubular, tapering, truncate; the end is broadly and shallowly emarginate and the middle lobe shows as a broadly triangular truncate plate.

Type locality: Werschininskoj (lat. 68° 45′) Jenissej River, Siberia.

New York: Mt. Whiteface, 4000 ft. Aug. 28, 1916, 1 ♂ 1 ♀, in moss in spruce forest (from the same lot as the type); Sept. 13, 1931, 1 ♂ 1 ♀ (Hammer); Artist's Brook, Chapel Pond, Essex Co., Aug. 24, 1930, 1 ♂ 4 ♀; Sept. 7, 1931, 5 ♂ 7 ♀, sifted from moss on the rocks where the temperature remains low all summer from the ice beneath the talus slope. Mt. Marcy, Aug. 27, 1930, 2 ♀. Mature specimens are abundant late in the season. On Oct. 20, 1934, we collected 5 ♀s at Chapel Pond and on Oct. 21, 9 ♂s and 29 ♀s near the summit of Mt. Whiteface, N. Y.

We have compared specimens from New York with a male from Abisko National Park, Sweden, kindly sent us by Mr. A. Holm, and find them to be identical.

This species has also been recorded by Emerton from Alberta: Sulfur Mt., Banff, April on snow.

DIPLOCEPHALUS Bertkau

Naturh. Ver. Preuss. Rheinl. 40: 228. 1883.

Type: *Erigone foraminifer* Cambridge.

We have not been able to study specimens of the type species, *foraminifer,* but there is very little doubt that it is strictly congeneric with *cristatus* described below.

Diplocephalus cristatus Blackwall
(Figures 42–43)

Walckenaera cristata Blackwall, Lond. Edinb. Phil. Mag. ser. 3, 3: 107. 1833.

Theridion bicorne Wider, Reuss, Zool. Misc. Ar. p. 214, pl. 14, f. 12. 1834.

Walckenaera cristata Blackwall, Res. Zool. p. 317, pl. 2, f. 7–10. 1834.

Micryphantes caespitum C. L. Koch, Uebers. Ar. Syst. 1: 12. 1837.

Micryphantes caespitum C. L. Koch, Die Arach. 8: 104, f. 673–674. 1841

Argus bicornis Walckenaer, Ins. Apt. 2: 365. 1841.

Micryphantes caespitum C. L. Koch, Uebers. Ar. Syst. 5: 19. 1850.

Erigone bicornis Westring, Göteb. Vet. Hdl. 2: 41. 1851.

Walckenaera cristata Blackwall, An. Mag. Nat. Hist. ser. 2, 9: 465. 1852.

Erigone bicornis Westring, Ar. Suec., p. 216. 1861.

Walckenaera cristata Blackwall, Spid. Gt. Brit., p. 309, pl. 21, f. 224. 1864.

Melicertus bicornis Simon, Hist. Nat. Ar., p. 196. 1864.

Micryphantes caespitum Ohlert, Ar. Prov. Preuss., pp. 54, 60. 1867.

Lophomma bicorne Menge, Preuss. Spinn. p. 212, pl. 42, f. 111. 1868.

Erigone cristata Thorell, Rem. Syn. p. 108. 1871.

Lophomma cristata Karsch, Naturh. Ver. Rheinl. Verh. 30: 132. 1873.

Erigone bicornis Lebert, Soc. Helv. Sc. Nat. Nouv. Mem. 27 (2): 190. 1877.

Walckenaera cristata Cambridge, Spid. Dorset, p. 152. 1879–81.

Lophomma cristata Emerton, Conn. Acad. Sci. Trans. 6: 44, pl. 10, f. 1. 1882.

Prosoponcus cristatus Simon, Ar. Fr. 5: 570, f. 380–381. 1884.

Walckenaera cristata Dahl, Naturw. Ver. Schles.-Holst. Schriften 6: 84. 1886.

Diplocephalus cristatus Chyzer & Kulczynski, Ar. Hung. 2: 109, pl. 4, f. 22. 1894.

Diplocephalus cristatus Müller & Schenkel, Naturf. Ges. Basel Verh. 10: 733. 1895.

Lophomma cristata Banks, Phila. Ac. Nat. Sci. Proc. p. 35. 1892. (Probably not this species, ♀ only.)

Diplocephalus cristatus de Lessert, Rev. Suisse Zool. 12: 317. 1904.

Diplocephalus cristatus Crosby, Phila. Ac. Nat. Sci. Proc. p. 304. 1905.

Diplocephalus cristatus de Lessert, Cat. Ar. Suisse, p. 148. 1910.

Diplocephalus cristatus Simon, Ar. Fr. 6: 376. 1926.

Male. Length, 2.2 mm. Cephalothorax yellowish brown; viewed from above, rather elongate, rounded on the sides posteriorly, converging toward the front, bluntly pointed in front. Viewed from the side, steeply ascending behind in a straight line, nearly level on the back and then concavely ascending to the posterior median eyes, the head elevated and divided into two small lobes separated by a shallow notch. Clypeus very wide, broadly concave, and somewhat retreating. Sternum dark, nearly black. Endites orange-yellow, lighter at tip. Cheliceræ rather large, slightly divergent. Legs and palpi orange-yellow. Abdomen dark gray.

Posterior eyes in a very slightly recurved line, the median slightly smaller than the lateral, separated by the diameter and from the lateral by twice the diameter. Anterior eyes in a very strongly procurved line, the median much smaller than the lateral, separated by a little less than the diameter and from the lateral by five times the diameter. Femur of palpus rather stout, thicker distally, and armed below with a row of six or seven small hairs. Patella rather long, thicker distally, armed dorsally near the margin, with an erect stiff spine. Ratio of length of femur to that of patella as 16 to 8.

Tibia rather slender at base, then strongly widened and produced forward to broadly cover the basal half of the cymbium. The lateral margin of this lobe is deeply convex toward the tip, in the middle part it is broadly rounded and armed just back of the margin with a row of 6 or 7 stiff hairs. At base it is deeply notched for the reception of the constricted part of the paracymbium. The distal margin of the lobe broadly rounded and armed on the mesal angle with a strong pointed process directed laterally and lying nearly parallel with the distal margin. The mesal margin gently concave. Tibia with a distinct quadrate protuberance below.

The embolic division has the tail-piece long, nearly straight, broader and rounded at tip, which extends to the edge of the cymbium. Attached to its base is a rather stout enlargement which bears apically a long, stout, pointed process. Basally the margin of this enlargement is expanded into a thin, undulating flange in the edge of which the duct opens. The median apophysis is developed into a very long, branched process which curves around on the ventral side of the bulb inside the bezel and outside of the tail-piece and ends in two sharp points. There is also a sharp tooth on the ventral-lateral side.

Female. Length, 1.9. Similar to the male in form and color; head normal. Posterior eyes in a straight line, equal, the median separated by a little less than the diameter and a little nearer to the lateral. Anterior eyes in a straight line, the median smaller than the lateral, separated by the radius and from the lateral by three-fourths the diameter. The epigynum consists of a convex plate, divided medially by a groove narrow in front with the sides parallel and inclined to form a triangular opening behind which is occupied by the middle lobe.

England: Warwickshire, 4 ♂, 1 ♀ (Richard Hancock).

Hungary: 1 ♂, 1 ♀ (Kulczynski).

Ontario: Toronto, April 5, 1934, 2 ♂ (Dymond).

Massachusetts: Allston, Nov. 9, 1905, 1 ♂, 1 ♀ (Bryant).

(*To be continued*)

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF FEBRUARY 6, 1934

A regular meeting of the Society was held on February 6, 1934, in the American Museum of Natural History; President A. L. Melander in the chair with seventeen members and seventeen visitors present.

Mr. Wuster exhibited a specimen of the saturnid moth, *Samia cecropia,* which, on issuing from its cocoon, showed the interesting aberration of a black marginal band about the edges of all wings.

Mr. Davis showed a male cicada, *Platypedia latipennis* Davis, recently sent to him for identification by Prof. George F. Knowlton of the Utah Agricultural College, Logan, Utah. It was collected on a Russian thistle at Vernal, Utah, June 12, 1931, by Prof. Knowlton and is the only one seen since the type, collected at Douglas Spring, Routt County, Colorado, June 20, 1920, by J. W. Frey, was described in the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY, March, 1921. The type, by permission of Prof. T. D. A. Cockerell, is now in the collection of the American Museum of Natural History. After thirteen years, it is gratifying to have the species confirmed by the discovery of a second specimen.

Dr. Melander had an interesting exhibit of one box of insects, containing 750 specimens, which represented part of the collecting he had done during the past two weeks while in Bermuda. Collecting was not at its height but the box represented a considerable addition to the insect fauna of Bermuda.

Dr. Klots, now with the College of the City of New York, expressed pleasure in being able once more to attend the meetings of the Society.

Prof. Albert L. Weber spoke on "Fruit Sprays and the Residue Problem" in place of the announced speaker. The residue problem came into prominence in 1925 when the farmers of southern New Jersey were notified that their apples had excessive amounts of arsenic residue from spraying and were therefore condemned by the Federal authorities. With the aid of slides, Prof. Weber described the various methods of removing residue by polishing, and by washing in dipping tanks. He also explained the use of wetting or degumming agents to remove oil spray and wax from the apples. The New Jersey Agricultural Experiment Station recommended the machine known as the Pedal Washer, and degumming agents for removing spray residue of arsenic and lead.

Prof. Weber's remarks were discussed at some length by the members present.

E. S. ENGELHARDT, *Secretary*

MEETING OF FEBRUARY 20, 1934

A regular meeting of the Society was held on February 20, 1934, in the American Museum of Natural History; President A. L. Melander in the chair with nineteen members and nine visitors present.

A communication was read from the National Association of Audubon Societies inviting the Society to send a representative, for consultation with others, to draft recommendations to be presented to the Park Commissioner for "the preservation and restoration of attractive conditions for wild life in suitable areas of the parks of Greater New York. Dr. Spieth was appointed a delegate to the conference.

Mr. Robert J. Sim read the paper of the evening on "Small Mammals as Predators of Japanese Beetle Grubs." It has been known for some time that starlings feed on the olive-like grubs of the Japanese Beetle. The skunk has also been reported as an active destroyer of insect grubs. Within the last year Mr. Sim has been studying the feeding habits of mice, the mole and the shrew. Little is known of the mouse-like animal, the shrew. These animals are numerous as individuals but not as species. For his experiments, Mr. Sim kept in captivity one mole, three shrews and several different rodents. He offered the same diet to them all: raw meat, earthworms, squash seeds, and Japanese beetle grubs. The mole and the shrews showed a decided preference for the grubs; the house mouse wouldn't eat the grubs at all; but the long-tailed jumping mouse (the kangaroo mouse) ate nothing but the grubs. Mr. Sim showed a series of slides illustrating the gradation of the rodents from those of subterranean habitat to terrestial, and finally to arboreal habitat. The mole is the least developed, with functionless eyes, short hair, and short tail and the kangaroo house shows the greatest development, having a long tail (necessary in jumping) and long fur.

After a general discussion of Mr. Sim's interesting and entertaining paper the meeting was adjourned.

E. S. ENGELHARDT, *Secretary*

MEETING OF MARCH 6, 1934

A regular meeting of the Society was held on March 6, 1934, in the American Museum of Natural History; President A. L. Melander in the chair with eighteen members and seventeen visitors present.

Mr. Davis gave an informal report of the conference of the National Association of Audubon Societies for the protection and preservation of natural habitat for wild life in the area of Greater New York.

The resignation of Miss Louise Joutel was accepted with regret.

Mr. N. L. Fremed of the Sameth Exterminating Company was proposed for membership.

Mr. Mutchler informed the Society of the death of Mr. Beutenmuller, at one time president of the Society. On motion, the secretary was instructed to write a letter of sympathy to Mrs. Beutenmuller.

Mr. Gertsch, the announced speaker for the evening, was ill but the members present were honored in having Dr. Arthur Gibson of Ottawa speak on "The History of Entomology in Canada." Dr. Gibson brought warm greetings to the Society from the entomologists of Canada. He then spoke of the beginnings of applied entomology in Canada when nests of the browntailed moth were first reported in 1909. This discovery resulted in the establishment of Field Laboratories in 1912 in various provinces of the Dominion. At present, the Entomological Branch of the Department of Agriculture maintains a staff of about two hundred persons, twelve permanent laboratories throughout the provinces and many field and temporary laboratories that can be moved as infestation demands. Dr. Gibson showed some slides of the various laboratories, the staff and also some of the corn borer and parasite work being done in Canada.

E. S. ENGELHARDT, *Secretary*

MEETING OF MARCH 20, 1934

A regular meeting of the Society was held on March 20, 1934 in the American Museum of Natural History; President A. L. Melander in the chair with eighteen members and twenty-one visitors present.

Mr. N. L. Fremed was elected a member of the Society.

The speaker of the evening was Mr. W. J. Gertsch: his subject "Habits of Spiders." By way of introduction, President Melander outlined the mythological origin of the spider from the alien maiden who excelled as a weaver and was for that reason converted by Minerva into Arachne—"the word the Greeks had for it"—the spider, and doomed to spin forever.

Mr. Gertsch mentioned several of the many diversified abodes and habits of spiders calling attention to their isolation from all other animals in their extensive use of silk, and of their reliance upon it—and in spinning a web for use as a net or snare—and to the modification of the male palpi and their strange use at the time of mating. The speaker's remarks on tarantulas were followed with keen interest. Attention was called to the poor vision of spiders, and their main reliance upon their sense of touch. All spiders are carnivorous, feeding entirely on living or freshly killed prey, of which only the liquid juices are used. Mr. Gertsch's remarks were illustrated with several slides and specimens of nests, etc., including a reproduction of Madame Merian's plate of the humming bird killed by a large tarantula whose habits, verified by later observers, she described in her books, with colored plates, on the "Metamorphoses of the Insects of Surinam," first published about 1705.

Messrs. Melander, Ruckes, Wurster and others discussed Mr. Gertsch's paper, after which the meeting adjourned.

JOHN D. SHERMAN JR., *Secretary pro tem.*

MEETING OF APRIL 3, 1934

A regular meeting of the Society was held on April 3, 1934, in the American Museum of Natural History; Vice-President Schwarz in the chair with eighteen members and fifteen visitors present.

The treasurer read a report concerning the readjustment of a bond held by the City Bank Farmers Trust Company.

The resignation of H. H. Johnson, Jr., was read and accepted with regret.

The resignation of J. B. Kendall was read and accepted with regret.

The resignation of Harry Stiner was read and accepted with regret.

The members were acquainted with the death of W. M. Savin, a member.

Dr. Claasen of Cornell University expressed his pleasure in being present at a meeting of the Society and said a few words concerning the stone fly fauna of China on which he is now working together with Dr. Wu of the University of Peking.

Dr. Herman Spieth then read his paper on "Some Points Concerning Mayflies." Dr. Spieth described the life history of these ethereal and very interesting insects. He explained the development of the gills in the second instar. The gills are finger-like outpouchings each one double in form; the anterior lamella becomes shield-like in shape and serves as a protection for the posterior lamella which is more delicate and hair-like. This elaborate tracheal system shows that the mayflies came from terrestial stock and have become aquatic. Some authorities have maintained that the gill is homologous with the later development of the wing. Snodgrass, however, has proved that the gill represents the old abdominal leg, thus indicating that the mayflies entered an aquatic habitat before they lost their legs.

In the last hour of the nymphal stage, the mouth parts degenerate and the insect disgorges its intestine, blows it up like a balloon which enables the nymph to be floated to the edge of the water. Here, after 24 hours, the adult emerges from the sub-imago and commences its nuptial flight or dance. After this dance in the air the females deposit their eggs in the water and then die. The appearance of the adult depends on the time of emergence. Spring emergences are large and dark, while those of the late summer are small and white in color.

The meeting was adjourned after some discussion of Dr. Spieth's paper.

E. S. ENGELHARDT, *Secretary*

MEETING OF APRIL 17, 1934

A regular meeting of the Society was held on April 17, 1934, in the American Museum of Natural History; President Melander in the chair with twenty-five members and twenty-two visitors present.

Dr. Creighton spoke on "The Biology of Leaf-Cutting Ants." Dr. Creighton illustrated his remarks with lantern slides, showing the varied habitat of these ants and the formation of the fungus gardens in their nests. No abstract was furnished.

After a general discussion of Dr. Creighton's remarks the meeting was adjourned.

E. S. ENGELHARDT, *Secretary*

MEETING OF MAY 1, 1934

A regular meeting of the Society was held on May 1, 1934, in the American Museum of Natural History; President Melander in the chair with twenty-four members and fifteen visitors present.

Dr. Curran informed the Society of the death of M. C. Van Duzee of Buffalo on April 21 of this year.

Mr. Davis gave a short resumé of his paper on "New Cicadas from North America" appearing in the Journal of the Society for March, 1935. He exhibited many of the types mentioned in this paper. The most beautiful of these was the green cicada, *Okanagodes Gracilis*, var. *viridis,* which appears in broods by itself and which has been collected around Tucson. Arizona.

Dr. Klots then read his paper on "Lower Permian Insects." Dr. Klots spent last June excavating the insect fossil beds near Elmo, Kansas. These beds were discovered about 1900 by an United States Geological Surveyor and have yielded excellent fossil material of the Permian Period. Dr. Klots then contrasted the Comstock-Needham system of venation with the convex-concave system of Lameere. This concavity and convexity theory of Lameere is very valuable in the study of fossils, the wings of some of the Permian insects being strongly ridged and corrugated. Dr. Klots concluded his remarks with a reel of pictures showing the terrain in which the Elmo fossil beds are found. The fossil specimens that he exhibited were most interesting, the wings ranging in length from 4 to 6 inches and marvelously preserved.

E. S. ENGELHARDT, *Secretary*

MEETING OF MAY 15, 1934

A regular meeting of the Society was held on May 15, 1934, in the American Museum of Natural History; President Melander in the chair with twenty members and twenty visitors present.

The treasurer read his semi-annual report as of May 1, 1934.

Mr. Joseph L. Goldberg, of 1057 Boynton Ave., Bronx, New York, was proposed for membership by Dr. Klots. The By-Laws were suspended and Mr. Goldberg was elected a member of the Society.

Dr. Curran announced the sudden death of Mr. C. Wm. Wurster on April 24. Mr. Wurster had been with the Society for many years and was a valuable and popular member. His absence will be felt keenly by all the members at future meetings of the Society. It was resolved that the Secretary convey an expression of the Society's loss and sympathy to Mrs. Wurster.

Dr. Melander gave one of the most interesting discourses of the year. He related his "Collecting Experiences in the Bermuda Islands in January, 1934." Dr. Melander gave a short history of the island since the settlement of the islands beginning in 1609 by voyagers shipwrecked on the treacherous coral reefs of which the islands are formed. With the aid of lantern slides which he had prepared, he described the interesting tropical vegetation of the islands. The members were able to enjoy the full range of colors to be found in this interesting archipelago through Dr. Melander's color photography which he said faithfully represented the fantastic appearance of vegetation and the salt water forms of life.

Dr. and Mrs. Melander stayed at the Marine Biological Station by arrangement with Prof. Conklin of Princeton. Dr. Melander recommended very highly this method of visiting the Bermuda Islands. He concluded his remarks with a reel of moving pictures showing the many activities of the members of the Biological Station.

Dr. Melander then bade his farewell to the Society, saying that he and his wife were leaving in June for a fifteen-month trip through the West.

Vice-President Schwarz expressed the appreciation of the Society to Dr. Melander for all his efforts in the interest of the Society.

E. S. ENGELHARDT, *Secretary*

MEETING OF OCTOBER 2, 1934

A regular meeting of the Society was held on October 2, 1934; Vice-President Schwarz in the chair with twenty-three members and twenty visitors present.

On motion of Mr. Huntington, it was recommended that the amendment to Article XIV of the By-Laws reading, ''and all applications for membership must be accompanied by dues as provided in Article XV'' be rescinded.

That the following amendment to Article XIV be substituted:—''Upon election a candidate for active membership shall be immediately notified of his election and shall be advised that a membership card for the ensuing term will be forwarded to him on receipt of dues as provided in Article XV.''

Upon due notification of all members of the Society this amendment to Article XIV was to be voted upon at the next meeting of the Society.

Mr. Schwarz informed the members of the publication of Dr. Curran's book, ''Families and Genera of North American Diptera,'' on August 25, 1934, saying that Dr. Curran had performed a service of great magnitude and importance in bringing Williston's work of more than twenty years ago down to date. Mr. Schwarz spoke highly of the many illustrations, the well leaded pages and of the excellent work throughout of the Ballou Press.

The resignation of Dr. Bertha C. Cady was accepted with regret.

Mr. Davis spoke of being present at the funeral of Carl Schaeffer, a Life Member of the Society who died during August. Mr. Davis then exhibited some new species of Okanagana and Tibicen from the Northwestern United States.

Mr. Bell gave a short resumé of his trip with Mrs. Bell, Dr. and Mrs. Lutz and others through New Mexico and Arizona, where they spent some time in and around the Grand Canyon of the Colorado during July and August. Later in the summer he did some collecting for the museum and for Dr. Lutz in Northern Vermont.

Mr. Angell described a specimen of *Pseudolucanus placidus* Say collected at Rochester, N. Y., on June 3, 1933, and again at Fair Haven, N. Y., on June 25, 1933.

Miss Dobroscky spoke of her work during the summer with the insecticide, Kryocide, a material found in Greenland and containing a large amount of fluorine. Miss Dobroscky promised to give a paper at some future meeting on the results of her work with this insecticide.

Dr. Hartzell said that he had been working on plant diseases and insecticides. He exhibited a fine photograph of a cicada, first instar, just hatched. The photograph had won first prize at the recent contest of the Biological Photographers' Society.

The Society was happy in having Mr. Johnson among the members present. He spoke of some new Lepidoptera just received from South America.

Dr. Klots spoke of an unusual ascalaphid and also a dragon-fly caught by his students. He had visited Dr. McDunnough in his fine museum in Canada.

Dr. Leonard said a few words concerning his travels through the South and the North of the United States in the interests of Pyrethrum.

Dr. Readio, of Dutch Elm Disease fame, spoke of his work in trying to curb this disease.

Dr. Moore, now returned from a two-year exile in California, gave an interesting account of the unusual weather he had encountered while there and also spoke of some of the results of his experiments in testing the immunity of scale insects to insecticides. The red scale has developed no immunity or tolerance, it is merely a matter of penetration. The citricola scale thrives when the summer season is hot and the winter cold. During a cool summer, however, there was a natural mortality of 97 per cent.

Dr. Ruckes had successful collecting at Wading River, Long Island, where he took the Homopterous insect, Ormenis, in its pinkish form. It is normally a brilliant green. He also exhibited a cicindellid, one of the largest in the East and Northeast, which is easily told by the brilliant orange wings in flight. Dr. Ruckes is studying the evolution of the head sclerites of this cicindellid.

Dr. Sanders exhibited some decaying wood containing an increasing colony of termites showing that the Queen must be present though not yet found in the mass. Dr. Sanders said that in his opinion the ant population in this region is being destroyed by the pavement ants which, however, do not feed on termites.

Mr. Sherman spoke of visiting Mr. H. C. Fall in Tyngsboro, Mass. Mr. Fall had just received the collection of Charles Liebbeck, of Philadelphia. Mr. Fall hoped to find some new species in this large collection of Coleoptera contained in 250 closely packed Schmidt boxes.

Mrs. Engelhardt gave a resumé of a trip to California by motor.

Mr. Schwarz described the very pleasant trip he and his family had had through the West Indies on the S. S. Mauretania.

A letter of Mr. Sherman's was read from Dr. and Mrs. Melander containing greetings to the Society from both of them.

Mr. Schwarz suggested that the society's greetings, with regrets that they are absent from the meetings, be conveyed to the Melanders in Mr. Sherman's reply.

E. S. ENGELHARDT

MEETING OF OCTOBER 16, 1934

A regular meeting of the Society was held on October 16, 1934, at the American Museum of Natural History; Vice-President Schwarz in the chair with seventeen members and thirteen visitors present.

The following were nominated for election as Active Members of the Society: Miss Lucay Clausen, American Museum of Natural History, and Kenneth W. Tompkins, 263 W. 54th St., New York City.

It was moved and seconded that the amendment to Article XIV of the By-Laws reading "and all applications for membership must be accompanied by dues as provided in Article XV" be rescinded. Carried.

It was moved and seconded that the following amendment to Article XIV be substituted: "Upon election a candidate for active membership shall be immediately notified of his election and shall be advised that a membership card for the ensuing term will be forwarded to him on receipt of dues as provided in Article XV." Carried.

Dr. Albert Hartzell, the speaker of the evening, gave a paper on "Greenhouse Fumigation With Naphthalene Solutions." An abstract of this paper follows.

Progress made in naphthalene fumigation was briefly reviewed. A method of fumigating with naphthalene was described which permits the control of the concentration of naphthalene vapor so that the desired concentration will be maintained throughout the fumigation period.

The method involves the continued recirculation of greenhouse air through a saturator containing a solution of naphthalene in an inert solvent. The concentration of naphthalene in the solvent determines the maximum concentration which can be reached in greenhouse air.

The two types of saturators were described, one involving the use of a solid solution of sulphur and naphthalene and another involving the use of naphthalene in oil.

Satisfactory control of red spider mite could be obtained with both these methods without injury to plants usually considered sensitive to naphthalene, by a fumigation period of 15 hours.

Following Dr. Hartzell's paper there was a short discussion of the use of naphthalene as a fumigant by Messrs. Weiss, Moore and Horsfall.

E. S. ENGELHARDT

MEETING OF NOVEMBER 20, 1934

A regular meeting of the New York Entomological Society was held on November 20, 1934, at the American Museum of Natural History; Vice-President Schwarz in the chair with twenty-three members and seventeen visitors present.

The following were elected Active members of the Society: Miss Lucy Clausen, American Museum of Natural History; Mr. Kenneth W. Tompkins, 263 W. 54th St., New York City.

The following were proposed for Active membership in the Society: Mr. James Forbes, 139 Stone Ave., Yonkers, N. Y.; Mr. Charles Ortner, 64 W. 124th St., New York City.

Dr. H. R. Hagan, of the College of the City of New York, gave a paper on the "Viviparity in Insects." A summary of Dr. Hagan's remarks appears herewith.

The embryologist recognizes three types of bigametic reproduction, *i.e.*, oviparity, ovoviviparity, and viviparity. In the field of insect embryology, examples of the first and last groups are well-known and clear-cut, but those of the second category are quite unsatisfactory for observing stages in development from the time of fertilization to the instant of hatching, because developing eggs of different insect species vary a great deal. In certain cases (Orenia, Coleoptera; some Plecoptera) eggs hatch in less than a minute after deposition. My personal opinion is that oviparity refers to laying of eggs in which the chorion is intact while viviparity applies to the bearing of live young that have been freed from the enveloping chorion, if indeed, the latter membrane be present at all. It is wanting, for instance, in all Strepsiptera, all Polyctenidæ, Hemimerus, (Orthoptera) and parthogenetic aphids. Therefore, the term ovoviviparity in this connection is superfluous.

Several attempts have been made to classify the types of insect embryological development. Holmgren's plan has been most widely cited and generally used. Comstock adopted and improved upon it by inferring but not actually using a physical basis of separation. It appears that viviparous insects illustrate four types of viviparity, when physical and physiological adaptations on the part of the parent and her offspring are considered; these are:

1. Ovoviviparity: The eggs are passed into the uterus with an adequate supply of nutriment (yolk) to bring the contained embryos to full growth by hatching time. (Chrysomelidæ, Sarcophagidæ.)
2. Adenotrophic viviparity: In these cases (flies) the eggs are supplied with sufficient yolk to carry them through hatching, but one pair of accessory glands of the parent discharges fluid into the uterus upon which the larvæ feed until full grown. (Glossina and the Pupipara).
3. Exgenital viviparity: The mature ovaries rupture and eggs are dispersed into the hæmocœl, where development proceeds at the expense of the maternal tissues, especially the fat bodies. (Miastor and the Strepsiptera.)
4. Pseudoplacental viviparity: In these cases the egg does not possess a chorion and the embryo soon establishes a physical union with the maternal tissues. (Hemimerus, Polyctenidæ).

Dr. Hagan concluded his remarks with slides illustrating these various types of viviparity.

A discussion of Dr. Hagan's paper followed.

Mr. Davis exhibited specimens of *Ponchlora cubensis*, a viviparous Cockroach, the young of which he had reared in 1929. One lived to be one year and one month old.

Dr. Hagan said that in the case of Pupipara the parent goes so far as to take care of the young after deposition.

ELIZABETH S. ENGELHARDT, *Secretary*

MEETING OF DECEMBER 4, 1934

A regular meeting of the Society was held on December 4, 1934, in the American Museum of Natural History; Vice-President Schwarz in the chair with twenty-three members and thirteen visitors present; and also those members and visitors of the Linnean Society attending the Ornithological Seminar in the adjoining room.

The following were elected active members of the Society: Mr. Charles Ortner, 64 West 124th St., New York City; Mr. James Forbes, 139 Stone Ave., Yonkers, N. Y.

Mr. Roland F. Hussey, of 19 West 16th St., New York City, was proposed for membership.

Dr. Herman Spieth read his paper on ''Present Problems of Species Concept,'' the first in a series of two papers on this subject. An abstract of Dr. Spieth's paper follows:

Part I.—Historical Aspects and Genetical Approach.

One of the best ways of approaching an understanding of any problem is from a historical standpoint. The early part of the eighteenth century forms a good starting point for a discussion of modern methods in taxonomy and the species question. Due to a variety of causes, taxonomy was in a chaotic state at that time. To a great extent this was cleared up by the masterful work of Linnaeus and his students. Of particular importance was his introduction of the binomial nomenclature. It is important to note, however, that Linnaeus considered the species a *static* unit.

During the following hundred years or so, taxonomists followed closely the precepts of Linnaeus. In 1859 Darwin published his ''Origin of Species'' and changed the conception of species from a static unit to a *dynamic* one. Thus, the taxonomists must now show relationships as well as cataloguing and naming species.

At the beginning of the present century the rediscovery of Mendel's laws and the subsequent rise of genetics showed that the taxonomists had been using phenotypic and not genotypic characters to determine relationships between various species. Consequently the geneticists began to question the work of taxonomists. In turn the taxonomists questioned the work of the geneticists.

It is interesting to note that the early genetical work was mainly concerned with the genetics of individuals and not the genetics of species of ''natural groups.'' Lately, however, there has been done some genetical work which has definitely concerned itself with the genetics of ''natural groups.'' Outstanding has been the work of Goldschmidt on *Lymantria dispar*, the gypsy moth, and Sumner on *Peromyscus*. Their conclusions are not in entire agreement with each other and most certainly Goldschmidt's conclusion that subspecies do not give rise to new species would not be accepted by the majority of taxonomists. The present indications are that more work of a similar nature should be undertaken. It is obvious, however, that it will be impossible to work out the genetics of all groups. The most that can be hoped for is that the genetics of certain groups which are amenable to study of this type shall be worked and that the findings can be employed as a yardstick for other groups.

Following Dr. Spieth's paper there was a general discussion of the material it contained by Messrs. Ruckes, Curran, Bird and Klots.

Dr. Mayr, of the Ornithological Seminar, discussed Dr. Spieth's paper at some length saying that his main disagreement with geneticists was their loose definition of mutations. Fisher in his ''Genetic Theory of Natural Selection'' defines mutations as ''any initiation of any heritable novelty.'' Dr. Mayr disagrees with Sumner and Goldschmidt because they make every effort to agree with the orthodox theory of genetics.

E. S. ENGELHARDT, *Secretary*

Lac and the Indian Lac Research Institute. By Dorothy Norris, P. M. Glover, and R. W. Aldis, Indian Lac Research Institute, Calcutta, October, 1934. 53 p. illus. Rs 2/8 (91¢).

To entomologists, whose knowledge of the lac insect has been derived from the brief notices in standard texts on entomology, this report of the Indian Lac Research Institute will be a distinct enlightenment. The lac industry of India was adversely affected by the war and a commission was appointed to study it and make recommendations. The commission did this in 1921 and in 1925 the Indian Lac Research Institute was born. Its present report is a summary of its activities during the first nine years of its existence.

These activities included studies of the host trees of the lac insect, chemical and physio-chemical work in the problems of shellac manufacture, research into methods and practice of lac cultivation, the insect that produces it, a study of the insect enemies of the lac insect and their control, investigations of insects associated with lac and the insect pests of the trees on which lac is grown.

Some of the aims of the Institute are the improvement of cultural practices and the maintenance of healthy lac producing strains of *Laccifer lacca* Kerr.

The report is much more than an entomological one. It surveys the early history of the lac industry, the entomological history of the lac insect, the areas of importance in lac cultivation in India, the uses of shellac and synthetic substitutes, and the diverse work of the Institute, all concisely and briefly. In addition, there are tables on lac production, exports, etc., and an appendix listing 80 publications of the Institute.

Although the phonograph, electrical and varnish industries are the most important users of shellac, there are many other manufacturing activities in which it is used. However, in spite of a wide range of usefulness, natural lac products have to meet competition from an increasing number of synthetic substitutes. So far, an actual synthetic shellac has not been produced. Against the inroads of synthetic resins, the Indian Lac Research Institute has to battle in order that the Indian lac industry may not disappear, as did the cochineal trade by the discovery of aniline dyes. It is to be hoped, as the report suggests, that the shellac research interests in America, India, and the United Kingdom will combine for their own interest and protection.

The authors are to be congratulated for their concise, readable and scientific report. Mrs. Dorothy Norris is the director and biochemist of the Institute; Mr. P. M. Glover is the entomologist and Dr. R. W. Aldis is the physio-chemist.—H. B. W.

The
New York Entomological Society

Organized June 29, 1892—Incorporated June 7, 1893
Certificate of Incorporation expires June 7, 1943.

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Columbus Avenue.

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Members of the Society will please remit their annual dues, payable in January, to the treasurer.

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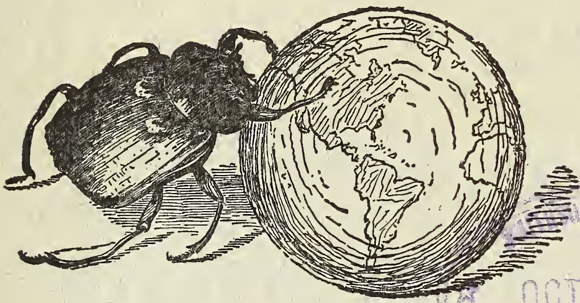

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OF THE

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Vol. XLIII September, 1935 No. 3

STUDIES IN AMERICAN SPIDERS: MISCELLANEOUS GENERA OF ERIGONEÆ

Part I

By S. C. Bishop and C. R. Crosby

(*Continued from page 241*)

GONATIUM Menge

Preuss, Spinnen, p. 180. 1868.

Type: *Gonatium cheliferum* Menge, which equals *Neriene rubens* Blackwall.

The characteristic form of the male palpus and the epigynum distinguish this genus from all other American genera.

Gonatium rubens Blackwall

(Figures 44–47)

Neriene rubens Blackwall, Lond. Edinb. Phil. Mag. (3) 3: 189. 1833.

Theridion cheliferum Wider, Reuss Zool. Miscel. Ar., p. 231, pl. 16, f. 4. 1834.

Argus cheliferus Walckenaer, Ins. Apt. 2: 364. 1837 (1841).

Micryphantes isabellinus Menge, Neueste Schr. Naturf. Ges. Danzig 4 (3) : 71. 1850.

Erigone chelifera Westring, Göteb. Vet. Handl. 2: 44. 1851.

Erigone chelifera Westring, Ar. Suec. 264. 1861.

Neriene bifida Cambridge, Zoologist 21: 8587. 1863.

Erigone chelifera Nordmann, Bidrag Finl. Ntk. Etnogr. Statist, 8: 1863.

Micryphantes cheliferus Six, Tijds. Ent. 6: 126. 1863.
Neriene rubens Blackwall, Spid. Gt. Britain, p. 270, pl. 18, f. 184. 1864.
Melicertus chelyfer Simon, Hist. Nat. Ar., p. 195. 1864.
Micryphantes isabellinus Ohlert, Ar. Prov. Preussen, pp. 57, 80. 1867.
Gonatium cheliferum Menge, Preuss. Spinn., p. 180, pl. 34, tab. 82. 1868.
Erigone rubens Thorell, Rem. Syn., p. 129. 1871.
Neriene bifida Cambridge, Linn. Soc. Trans. 28: 449, pl. 34, f. 14. 1873.
Neriene rubens Cambridge, Spid. Dorset, p. 111. 1879–81.
Gonatium rubens Emerton, Conn. Acad. Sci. Trans. 6: 60, pl. 23, f. 6. 1882.
Gonatium rubens Simon, Ar. Fr. 5: 554, ff. 357–359. 1884.
Gonatium rubens Dahl, Schrift. naturw. Ver. Schl.-Holstein 6: 100. 1886.
Gonatium rubens Chyzer & Kulczynski, Ar. Hung. 2: 99, pl. 4, f. 9. 1894.
Gonatium rubens Becker, Ar. Belg. 3: 106, pl. 10, f. 9. 1896.
Gonatium rubens Bösenberg, Spinn. Deutschl., p. 160, pl. 14, f. 214. 1903.
Gonatium rubens Holm, K. Svenska Vet.-Akad. Skrift. Natursk. No. 19: 6. 1931.

Male. Length 2 mm. Cephalothorax orange-red with darker radiating lines and a lanceolate spot in front of the dorsal furrow connected by three dark lines with posterior eyes. Cephalothorax viewed from above very broad, rounded on the sides, rapidly narrowed toward the front; the eyes in profile, in a group much narrower than the head; viewed from the side gently arched and ascending behind to cervical groove where there is a broad depression, then steeply ascending to the posterior eyes. Clypeus wide, concave immediately below the eyes and then broadly convex below, somewhat protruding. Sternum orange suffused with reddish gray, broad, triangular, the sides crenulate, broadly produced behind between the coxæ. Labium same color as sternum. Endites yellow. Legs yellow. First leg has the femur armed below with numerous stiff hairs, the tibia gently curved downward and thickened below on the distal third, armed below with numerous stiff hairs, denser on the thickened part. Metatarsus gently curved and armed below with a double row of short curved spines stouter towards the base of the segment. The second leg similar to the first but the characters not so pronounced. Abdomen light gray.

Posterior eyes in a straight line, equal, the median separated by the diameter and from the lateral by three-fourths the diameter. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by less than the radius and from the lateral by the radius.

Femur of palpus yellow, very large, gradually thickened distally, squarely truncate at tip, the dorso-lateral angle produced into a short nipple-like process, armed below with a few short scattered hairs, armed towards the tip, above and on the sides with numerous short, very stout dark spines. The patella borne on the ventral angle of the end of the femur, short and broad, gently arched above, bearing the tibia on the ventro lateral angle. Ratio of length of femur to that of patella as 20 to 10. Tibia constricted at base and then widened, dorsally produced into a very long process that is closely applied to the back of the cymbium and reaches almost to its tip; the lateral side of this process is smooth, thin, without hairs, and is produced basally into an acute angle; the mesal part is raised in a narrow ridge and clothed with hairs. At the base of the dorsal process the tibia is hollowed out, the cavity covered from the caudal and mesal sides by a large, diagonal, black-edged tooth. On the lateral side of the tibia there is an erect, stout, black, pointed tooth which touches the angle of the base of the dorsal process. Cymbium rather short with a broad shallow groove over the back in which lies the dorsal tibial process. Paracymbium thin, smooth, evenly curved, pointed at tip. Tail-piece of the embolic division, bluntly pointed at tip, lying over the tegulum to the edge of the cymbium. Basally it gives rise, first, to the very long slender styliform embolus, second, to a shorter but similar process which seems to support the conductor and third, to a conspicuous brush-like appendage which may serve as a conductor. The embolus arises on the dorsal side of the tail-piece, curves around back of the bulb and emerges near the base of the bulb from beneath the corner of the bezel. It then curves across the base of the bulb, the tip lying near the tip of the conductor. It is accompanied by a thin membrane which is supported by the black process previously mentioned.

Female. Length 2.5 mm. Similar to the male in color. Palpi yellow. Abdomen varies from grayish white to black. The epigynum has the middle lobe quadrate behind, abruptly narrowed in front with two round openings in front.

Type locality: Trafford Park, near Manchester, England.

Maine: Long Island, Sept. 10, 1904, 1 ♀ (Bryant); Sept. 14, 1909, 1 ♂ (Bryant); Winterport, Aug. 29, 1925, 1 ♂ 2 ♀; Falmouth, Aug. 30, 1925, 1 ♀; Sebasticook Lake, Aug. 24, 1925, 1 ♂; Presque Isle, Aug. 26, 1925, 2 ♀.

Vermont: South Newfane, Sept., 1926, 2 ♀ (Bryant).

Rhode Island: Kingston, May, 1905, 1 ♂ (Barlow), June, 1905, 1 ♀ (Barlow); without date 1 ♂ (Bryant).

Massachusetts: Concord, Oct. 29, 1932, 2 ♀; Blue Hills, Indian Pool, Nov. 28, 1914, 1 ♂ (Bryant); Hammonds Pond, April 6, 1904, several ♂ ♀ (Bryant); Clarendon Hills, Nov. 3, 1904, 1 ♀ (Bryant); Duxbury, Aug. 1916, 3 ♂ 1 ♀ (W. F. Clapp); Holden, Sept. 1926, 1 ♀ (Forbes); Holliston, Sept. 15, 1928 (Banks); Lexington, Sept. 8, 1902, 1 ♀ (Bryant); Lynn, Oak Id., Aug. 27, 1878, 1 ♂ (Emerton); Readville, Nov. 1913, 1 ♂ 4 ♀ (Emerton).

New York: Saranac Lake, Sept. 6, 1931, 1 ♀; Sea Cliff, 1 ♂ 1 ♀ (Banks); Mt. Whiteface, 2300 ft., Aug. 25, 1 ♂; Summit of Mt. MacIntyre, Aug. 30, 1922, 1 ♀; Wilmington Notch, Aug. 26, 1921, 1 ♂; Malone, Oct. 1918, 1 ♂; Whetstone Gulf, Lewis Co., Sept. 2, 1926, 1 ♂, lacking a molt; Ithaca, Aug. 27, 1922, 1 ♀, Oct. 1 ♀; Taughannock Falls, Oct. 15, 1902, 1 ♀; Painted Post, Sept. 26, 1925, 1 ♂; Olcott, Oct. 1924, 2 ♂ (Dietrich); Juanita Island, Lake George, Sept. 1, 1920, 1 ♂, Aug. 4, 1920, 1 ♂; Larchmont, Sept. 26, 1925, 1 ♂ (Augusta Wolf).

Maryland: Cabin John, Sept. 25, 1911, 1 ♂, Oct. 13, 1912, 1 ♀ (Shoemaker).

Virginia: Falls Church, 1 ♂ (Banks); opposite Plummers Id., Sept. 28, 1912, 1 ♂ 1 ♀ (Shoemaker).

North Carolina: Nantahala Gorge, Aug. 27, 1930, 1 ♂ 1 ♀ (Banks); Summit of Mt. Mitchell, Oct. 22, 1923, 1 ♀; Frying Pan Gap, Mt. Pisgah, Oct. 13, 1926, 1 ♂.

Iowa: Ames, Fall of 1932, 1 ♂ (H. B. Mills).

District of Columbia: Washington, May, 1 ♀ (Fox).

Tennessee: Rough Creek, Sevier Co., Oct. 8, 1926, 1 ♂; Mill Creek below the falls, Mt. Leconte, Oct. 10, 1926, 1 ♂ 3 ♀.

Colorado: Pingree Park, Aug. 20, 1924, 1 ♀.

Goneatara new genus

Type: *Oedothorax platyrhinus* Crosby and Bishop.

This genus is characterized by the peculiar development of the head in the male. The tegulum is prominent. The embolic division has an elongate tail-piece, the embolus is short and accompanied by a process of about the same length.

Goneatara platyrhinus Crosby and Bishop

Oedothorax platyrhinus Crosby and Bishop, N. Y. Ent. Soc. Jour. 35: 147, pl. 15, fig. 1–5. 1927.

Goneatara plausibilis n. sp.

(Figures 48–51)

Male. Length, 1.5 mm. Cephalothorax dull yellowish orange, strongly suffused with dark gray in radiating lines; viewed from above broadly rounded on the sides in the posterior half, sides convergent towards the front, clypeus projecting, evenly rounded, the anterior eyes in profile; cephalothorax viewed from the side ascending in a nearly straight line to the cervical groove, then nearly level to the base of the cephalic lobe, which is rounded over the top, steeper behind than in front; the front of the lobe, the ocular area and the clypeus slanting steeply forward in a nearly straight line. Clypeus projecting strongly forward in a broad rounded snout. Clypeus, ocular area and front and top of cephalic lobe clothed with many erect, stiff hairs.

Posterior eyes in a straight line, the median separated by the diameter and a little nearer to the lateral. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by the diameter.

Sternum dusky over straw yellow, punctate with very many small yellowish dots. Endites honey yellow, slightly dusky. Legs and palpi pale straw-yellow, anterior femora and tibiæ armed beneath with a double row of short, stiff, black hairs. Femur of second leg with a few longer stiff hairs below. Abdomen dark gray with indication of a light pattern.

Femur of palpus rather short and thick; patella relatively long. Ratio of length of femur to that of patella as 17 to 11. Tibia very short, the dorsal margin armed with a rather long, erect process; lateral margin concave, armed with six or seven stiff hairs; mesal margin smooth and rounded. Paracymbium strongly curved with a rounded notch before tip. Bezel high. Tailpiece of the embolic division rather long, smooth, rounded at tip. The embolus with the tip black, ending in two points, the one near the tip of the palpus more slender and pointed, the proximal one shorter, thicker at base, minutely spirally curved, pointed at tip.

Holotype male, Tallulah, Louisiana, Nov. 11, 1933. Collected by J. W. Folsom in a Berlese funnel from material from a swamp.

Louisiana: Tallulah, Dec. 4, 1933, 2 ♂.

Goneatara eranistes Crosby and Bishop

Oedothorax eranistes Crosby and Bishop, N. Y. Ent. Soc. Jour. 35: 148, pl. 15, fig. 6–7. 1927.

This species is evidently related to *platyrhinus* and *plausibilis* by the structure of the genital bulb. The clypeus is very wide but not developed to such a remarkable degree as in those species.

Cheniseo new genus

Type: *Cheniseo fabulosa* new species.

In this genus we place four species which are rather closely related in the form of the head of the male and in the structure of the genital bulb. The tegulum is prominent and roughened. The embolic division has an elongate tail-piece; the embolus is short; *recurvata* is a little less closely related to the other species than they are to each other.

Cheniseo fabulosa n. sp.

(Figures 52–56)

Male. Length, .6 mm. Cephalothorax chestnut-brown strongly marked with dusky at the margin, along the radiating lines and in a patch back of the cephalic lobe; viewed from above broadly rounded on the sides with the margin slightly crenulate, rather abruptly narrowed forward to the bluntly pointed front; viewed from the side, steeply ascending behind in an almost straight line, then nearly level to the base of the cephalic lobe which is very high and overhangs the thorax behind. The lobe is rounded over the top and slants steeply downward in front. Clypeus nearly straight, slanting steeply forward and projecting beyond the base of the cheliceræ. Sternum dark gray, broad, convex, smooth and shining. Labium and endites dark gray. Legs yellow, suffused with dusky, coxæ gray. Abdomen dark gray, almost black.

Posterior eyes in a straight line, equal, the median separated by three times the radius and from the lateral by twice the diameter. Anterior eyes in a moderately procurved line, the median only slightly smaller than the lateral, separated by a little less than the radius and from the lateral by a little more than the radius.

Femur of palpus rather short and stout. Patella short and thick. Ratio of length of femur to that of patella as 12 to 6. Tibia much as in *C. faceta* but the dorsal process is blunter and the tip less curved, and the tooth in the lateral excavation is lacking. Paracymbium as in *faceta.* The tegulum much as in that species and the embolic division of the same type but the embolus is more pointed and is accompanied by another pointed black process of about the same length.

Female. Length 1 mm. Similar to male in form and color, head normal. Posterior eyes in a straight line, equal, the median separated by three times the radius and from the lateral by a little less than the diameter. Anterior eyes in a straight line, the median smaller than the lateral, subcontiguous, separated from the lateral by the diameter. The epigynum has the median fovea entirely occupied by the quadrate middle lobe.

Holotype, male; allotype, female. Big Moose, N. Y., June 10, 1930. Sifted from moss.

New York: Montauk Point, May 24, 1924, 4 ♂ 1 ♀.

Cheniseo faceta n. sp.

(Figures 57–60)

Male. Length, 1.1 mm. Cephalothorax gray over yellow with darker radiating lines and a dark patch back of the head; viewed from above squarely truncate behind, evenly rounded on the sides, no constriction at the cervical groove, the sides very slightly converging to the broadly rounded front; viewed from the side, rather steeply ascending in a straight line to the dorsal groove, then nearly flat to the base of the cephalic lobe which is nearly perpendicularly elevated. Lobe very high, rounded over the top to the anterior median eyes. Clypeus very broad, convex, extending forward far beyond the base of cheliceræ, densely clothed with stiff hairs directed upward. Sternum dark gray, broad and convex. Labium and endites a little lighter. Legs dusky yellow, coxæ darker. Abdomen dark gray, almost black.

Posterior eyes in a straight line, equal, separated by twice the diameter and from the lateral by three times the diameter. Anterior eyes in a very strongly procurved line, the median slightly smaller than the lateral, separated by the diameter and from the lateral by a little more than twice the diameter.

Femur of palpus rather short and thick, strongly curved inward. Patella as thick as femur. Ratio of length of femur to that of patella as 16 to 7. Tibia obconic, the dorso-mesal margin thin and closely applied to the base of the cymbium, the dorsal margin produced into a rather stout process which is curved downward toward the cymbium, the tip curved laterally and pointed; the lateral side of this process broadly and evenly concave with a small, thin, triangular tooth in the middle. Paracymbium very small and strongly curved. Tegulum strongly developed and protuberant ventrally. The embolic division lies diagonally across the tip of the bulb. The tail-piece is thin and flat, strongly constricted near the middle; the distal part elongate, the tip lying over the edge of the tegulum; the basal part rounded, bearing on the mesal distal side the minute, squarish black embolus.

Holotype, male. Highlands, N. C., April 5, 1929.

Cheniseo recurvata Banks

(Figures 61–63)

Cornicularia recurvata Banks, Wash. Acad. Sci. Proc. 2: 479, pl. 29, f. 9. 1900.

Walckenaera recurvata Strand, Fauna Arctica, 4: 443. 1906.

Male. Length, 1.5 mm. Cephalothorax dark gray over dull yellowish; viewed from above, elongate, evenly rounded on the sides with a slight constriction at the cervical groove, narrowed and bluntly rounded in front; viewed from the side, evenly and rather steeply ascending behind to the cervical groove, then slanting downward to the posterior eyes, the head in front of the posterior median eyes elevated into a stout recurved horn, concave behind, convex in front, clothed with rather long hairs directed upward and backward and bearing the anterior median eyes at its base in front. Clypeus convex, retreating. Sternum dark gray over dull yellow, convex, smooth. Endites dull orange-yellow lightly suffused with dusky. Legs yellow-orange. Abdomen nearly black.

Posterior eyes in a very slightly procurved line, the median slightly smaller than the lateral, equidistant, separated by a little more than the diameter. Anterior eyes in a very strongly procurved line, the median separated by the radius and from the lateral by three times the diameter.

Femur of the palpus moderately long, cylindrical, slightly curved mesally. Patella moderately long, stout, somewhat widened distally. Ratio of length of femur to that of patella as 17 to 12. Tibia shorter than patella and rather broad, dorsal margin produced into a broad, triangular tooth, the tip of which is briefly incurved; mesally from this tooth there is a deep, rounded excavation and a shorter tooth; lateral margin of tibia a rounded lobe, separated from the median tooth by a rounded excavation. Paracymbium armed at base with a row of 4 fine, stiff spines, rather small, strongly curved, without a very distinct notch. Tegulum strongly developed and protuberant ventrally. Tail-piece of the embolic division rather long, nearly flat, the sides nearly parallel, the tip rounded and lying over the edge of the tegulum. At the base it gives rise directly to a short, black, curved embolus, ending in a sharp point.

Type locality: Muir Glacier, Alaska.

Alaska: Admiralty Id., June 1933, 1 ♂ (Sheppard).

Cheniseo sphagnicultor n. sp.

(Figures 64–69)

Male. Length, 1.4 mm. Cephalothorax dusky yellowish, marked with blackish near the margin and along the radiating lines; viewed from above broadly and evenly rounded on the sides to the cervical groove where there is a slight constriction, broadly rounded across the front; viewed from the side rather steeply ascending behind, then nearly flat to the base of the cephalic lobe. Head strongly and abruptly elevated behind, rounded over the top to the posterior eyes. The median ocular area convex. Clypeus broad, convex, protruding, densely clothed with hairs directed upward. Cephalic lobe viewed from above rounded on the sides and behind. Cephalic pit represented by a shallow depression.

Posterior eyes in a straight line, equal, the median separated by a little more than the diameter and a little farther from the lateral. Anterior eyes in a slightly procurved line, the median slightly smaller than the lateral, separated by about the radius and from the lateral by a little more than the diameter.

Sternum broad and scalloped at the margin, yellow strongly suffused with gray, darker at the margin. Labium and endites grayish, lighter basally. Coxæ and trochanters gray with light mottlings. Legs yellowish with a tinge of orange. Abdomen dark gray.

Femur of palpus moderately long and stout, slightly thicker distally. Patella short and thick. Ratio of length of femur to that of patella as 12 to 5. Tibia, viewed from above, broadened distally, the distal quarter turned downward at a steep angle. This part is thin, smooth and semitrans-parent, its anterior margin straight, right-angled mesally and laterally produced into a narrow, rather long process, the lateral angle of which ends in a sharp, black, recurved point. Back of this thinner distal area, the tibia is swollen, rounded and extends laterally into a rounded lobe. The paracymbium small and strongly curved. The bezel is enormously developed, its surface rugose. The embolic division consists of a rather long, flat, rounded tail-piece which reaches to the edge of the tegulum. The embolus is a short, sharp, black point connected with the tail-piece by a short, spiral band and protected by a thin, flat, rounded, transparent conductor.

Holotype, male. McLean, N. Y., May 30, 1919. Collected by sifting moss in a sphagnum bog.

OEDOTHORAX Bertkau

Naturh. Ver. Rheinl. Vehr. 40: 236. 1883.

Type: *Neriene gibbosa* Blackwall (designated by the author, p. 238).

We give a description with figures of the type species. *O. montiferus* has the same peculiar transverse furrow on the cephalothorax and the same type of embolic division; *trilobata* more closely approaches the type in the form of the embolus, but the cephalic lobe is divided into three parts in front.

Oedothorax gibbosus Blackwall

(Figures 70–73)

Neriene gibbosa Blackwall, Linn. Soc. Lond. Trans. 18: 653. 1841.

Argus gibbosus Walckenaer, Ins. Apt. 4: 513. 1847.

Neriene gibbosa Blackwall, Ann. Mag. Nat. Hist. (ser. 2) 9: 270. 1852.

Nerieneus gibbosus Simon, Hist. Nat. Ar. p. 196. 1864.

Neriene gibbosa Blackwall, Spid. Gt. Britain, p. 278. 1864.

Erigone gibbosa Thorell, Rem. Syn. p. 446. 1873.

Neriene gibbosa Cambridge, Linn. Soc. Lond. Trans. 28: 445, pl. 34, f. 20. 1873.

Neriene gibbosa Cambridge, Spid. Dorset, p. 117. 1879–1881.

Oedothorax gibbosa Bertkau, Naturh. Ver. Preuss. Rheinl. Verh. 40: 236. 1883.

Gongylidiuum gibbosum Simon, Ar. Fr. 5: 489, f. 270–272. 1884.

Kulczynskiellum gibbosum Cambridge, Guernsey Soc. Sci. Trans. 1895.

Oedothorax gibbosus Bösenberg, Spinn. Deutschl. p. 213, pl. 19, f. 300. 1903.

Stylothorax gibbosa Reimoser, Zool.-bot. Ges. Wien Abh. 10 (2): 72. 1919.

Oedothorax gibbosus Simon, Ar. Fr. 6: 451, f. 785. 1926.

Male. Length, 2.1 mm. Cephalothorax dull orange-yellow, strongly suffused with dusky especially along the radiating lines; viewed from above rather broad, rounded on the sides in the posterior half, the sides moderately converging towards the front, evenly rounded across the front; in the middle of the back there is a very large lobe bounded in front by a very deep transverse cavity, the edges of which are guarded by numerous long hairs. Cephalothorax viewed from the side, steeply ascending and slightly concave back of the dorsal lobe which is very high, rounded above and deeply excavated in front. In front of the excavation the head is gently convex and slants downward through the median ocular area to the anterior median eyes. The eyes are borne on the front of the head, separated from the dorsal excavation by more than the length of the median ocular area. Clypeus nearly vertical, distinctly concave. Cheliceræ rather robust, armed on the face with a distinct tooth. Sternum nearly black, broad, the hind coxæ separated by less than the diameter. Endites dark gray, pale at tip. Legs pale orange-yellow. Abdomen nearly black.

Posterior eyes in a slightly procurved line, the median very slightly smaller than the lateral, separated by a little more than the diameter and from the lateral by two-thirds the diameter. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, equidistant, separated by about the radius. Femur of palpus rather stout, gently curved inward. Patella rather long, curved downward at base, thicker distally. Ratio of length of femur to that of patella as 16 to 10. Tibia viewed from above, the sides appear nearly straight, converging posteriorly; viewed from the lateral side, the lower side is much shorter than the dorsal, gently sinuate; the upper side slants strongly upward with the tip curved slightly forward towards the cymbium. Viewed from the mesal side, the margin has a smooth, semicircular excavation bounded below by a distinct tooth. The margin viewed from above appears to be armed by two teeth at different levels, the upper one broad, diagonally truncate at tip and the lower one narrower and rounded. Paracymbium rather thick at base, slender and strongly bent and with a short hook at tip. Tail-piece of the embolic division rather broad, flat, the tip narrower and rounded. At the base there are two processes, the ventral one ends in a short curved style-like point, the other, which is the style-like embolus, arises on the back, curves ventrally and laterally so that the tip lies against the other process.

France: one ♂, Simon collection.

Oedothorax montiferus Emerton

(Figures 74–78)

Lophocarenum montiferum Emerton, Conn. Acad. Sci. Trans. 6: 47, pl. 13, fig. 2. 1882.

Lophocarenum montiferum Banks, Phila. Acad. Nat. Sci. Proc. 1892, p. 36.

Neriene montifera Simon, Hist. Nat. Ar. 1: 633, 1894.

Oedothorax montiferus Crosby, Phila. Acad. Nat. Sci. Proc. 1905, pp. 312, 335.

Diplocephalus montiferum Banks, Phila. Acad. Nat. Sci. Proc. 1916, p. 73.

Male. Length, 1.8 mm. Cephalothorax dark gray over yellow, dusky orange-yellow on the cephalic lobe; viewed from above, long, evenly rounded on the sides, slightly constricted opposite the lateral eyes and truncate in front, the anterior eyes slightly projecting on a common tubercle. The cephalic lobe whitish in front, viewed from above nearly as wide as the cephalothorax, broadly rounded behind, the sides straight, convergent towards the front, front squarely truncate. Cephalothorax viewed from the side steeply ascending in a straight line to the cephalic lobe. The posterior lobe is high and long, steeply ascending behind, rounded over the top and more gradually descending in front, somewhat depressed on the anterior declivity. In front it is separated from the anterior lobe by a transverse suture. At each end of the suture the lobes do not come together, thus leaving a pear-shaped opening, pointed above. Anterior lobe bluntly rounded in front, almost flat on top. The eyes are all borne on the anterior lobe.

Posterior eyes in a strongly procurved line, the median slightly larger than the lateral, separated by the width of the anterior lobe and nearly touching the lateral. Anterior eyes in a strongly procurved line, the median smaller than the lateral, separated by about the radius and from the lateral by three times the diameter. Sternum dark brown almost black, smooth and shining, convex, broad as long, roundly tapering behind and produced in a truncate point between the hind coxæ which are separated by a little less than the diameter. Endites dusky orange. Legs and palpi dusky orange-yellow. Abdomen dark gray, almost black.

Femur of palpus cylindrical, strongly curved, armed dorsally with a row of 6 hairs curved forward. Patella rather long, widened distally, almost straight above. Ratio of length of femur to that of patella as 13 to 8. Tibia shorter than patella; the dorsolateral apophysis a short, broad, truncate tooth, mesad of which there is a rounded emargination with a short, sharp tooth at its mesal edge. The paracymbium is fairly slender, very strongly curved and hooked at the tip, at the base next to the cymbium armed with a row of short stiff hairs. The tegulum with a distinct protuberance ventrally. Bezel very high, rounded. Tail-piece of the embolic division broad, widened toward the tip which is bluntly rounded and lies over the edge of the tegulum. The apical portion which arises directly from the tail-piece, is a black, curved, spine-like process which lies inside the greatly widened bezel. Near the tip of the embolus is a sharp black tooth, which is the tip of the median apophysis. The median apophysis armed near the base with a quadrate tooth on the tip of which is a small triangular tooth. The conductor is curved down over the tip of the embolus.

Female. Length, 2.1 mm. Colored like the male, cephalothorax normal. Posterior eyes in a procurved line, equal, the median separated by three times the diameter and from the lateral by the diameter. Anterior eyes in a procurved line, the median smaller than the lateral, separated by two-thirds the diameter and from the lateral by a little more than the diameter. Epigynum a transverse convex plate. The middle lobe is wedge-shaped, narrow in front, hind margin straight, bluntly pointed in front. In front of the middle lobe there is a narrow transverse plate.

Type localities: Brookline and Salem, Mass.

New York: Shurgers Gorge, near Ithaca, Nov. 24, 1918, 1 ♂ 5 ♀; Ithaca, Oct. 12, 1927, 2 ♂; Dec. 1 ♂; April 1 ♂ 1 ♀; Mar. 29, 1910, 2 ♂ (in one specimen both palpi are fully expanded).

Massachusetts: Brookline, Apr. 6, 1904 ♂ (Bryant).

District of Columbia: Washington, Feb. 1888, 1 ♂ (Fox).

Oedothorax trilobatus Banks

(Figures 79–84)

Dicyphus trilobatus Banks, Can. Ent. 28: 64, 1896.

Hypomma trilobata Crosby, Phila. Acad. Nat. Sci. Proc. 1905, p. 310.

Lophocarenum trilobatum Emerton, Conn. Acad. Sci. Trans. 14: 191, pl. 3, fig. 1. 1909.

Male. Length, 2 mm. Cephalothorax dull orange strongly suffused with dusky, darker at the margin and along the radiating furrows, viewed from above evenly and broadly rounded on the sides with scarcely any constriction at the cervical groove, then the sides gradually converge toward the front, nearly straight across the front. The cephalic lobe pale yellow, suffused with dusky on the sides behind, the surface finely reticulated, viewed from above as broad as long, rounded and a little pointed in the middle behind, the anterior angles smoothly rounded, the front margin nearly straight across except for the lower part of the lobe which protrudes forward close to the head in a rounded projection just behind the posterior median eyes. Cephalothorax viewed from the side steeply ascending behind but in outline first concave and then rounding over to the base of the cephalic lobe. Cephalic lobe moderately high, evenly and broadly rounded over the top to the transverse groove just back of the eyes. This groove is very deep, extending back of the posterior lateral eyes, following in side view a sinuous course. The lobe is closely appressed to the cephalothorax. No true cephalic pit present but just back of the end of the groove there is a whorl of short hairs. Median ocular area convex, densely clothed with short, erect hairs. Clypeus slightly convex and slightly protruding.

Posterior eyes in a very slightly recurved line, the median slightly smaller than the lateral, separated by a little more than twice the diameter and from the lateral by less than the diameter. Anterior eyes in a straight line, the median slightly smaller than the lateral, separated by the radius and from the lateral by a little more. Sternum and labium dark gray over yellow. Endites a little lighter. Legs orange-yellow, coxæ suffused with dusky below, edge black. Abdomen dark gray.

Femur of palpus rather stout, gently curved inward, armed with three rows of short, stiff hairs. Patella long, slightly curved downward, slightly widened distally, armed with rows of hairs a little longer than on femur. Ratio of length of femur to that of patella as 20 to 11. Tibia rather long, not widened distally as much as usual. The dorsal margin produced into a long, triangular process which bears on the mesal margin a short, slender branch. The tibia on the dorso-lateral side clothed with a bunch of long, stiff hairs. Paracymbium flat, strongly curved, a short hook at the tip. Tegulum narrow but has the bezel extending into a very long, triangular, membranous process that functions as a conductor. Tail-piece of the embolic division broad, convex, rounded at apex. The tail-piece gives rise on the lateral side of the bulb to a long, slender, black, pointed process. The embolus arises from a bulb-like base on the inner or dorsal side of the tail-piece and extends as a long, slender style first to the tip of the cymbium and then curves ventrally and transversely across the base of the tail-piece. The tip curves forward and lies between the tip of the bezel and the lateral process of the embolic division. In a palpus expanded naturally the base of the embolus lies in the angle formed between the mesal branch and tip of the tibial apophysis. The lateral process of the embolic division lies across the lateral edge of the tibial apophysis (fig. 82). The bezel touches the outer side of the paracymbium, the tip of the latter lies near the base of the lateral process of the embolic division.

Female. Length, 2 mm. Similar to male but head normal. Posterior eyes in a straight line, the median slightly larger than the lateral, separated by the diameter and from the lateral by the radius. Anterior eyes in a slightly procurved line, the median a little smaller than the lateral, equidistant, separated by the radius. The epigynum consists of a strongly convex, dark gray plate in the posterior margin of which there is a transverse oval fovea with a point in front directed backward.

Type locality: Ithaca, N. Y.

New York. McLean, May 14, 1919, 11 ♂ 7 ♀; May 8, 1919, 2 ♂; June 17, 1923, 1 ♀; May 30, 1919, 2 ♀. Collected in the moss hanging loose on tussocks over water. Ringwood, Tompkins Co., May 20, 1919, 1 ♂ (Dietrich), from deep swamp; Labrador Pond, Cortland Co., May 14, 1921, 1 ♂ (Tarris), from deep swamp; Suffern, May 26, 1924, 2 ♂. (In moss by small pond on Ramapo Mt.); Freeville, April 27, 1921, 2 ♀; Fresh Pond, Suffolk Co., April 20, 1935, 1 ♂.

British Columbia, Terrace, June 10, 1931, 1 ♂ (Hippisley).

Emerton also records this species from Clarendon Hills, Mass.

PLATE XVII

1. *Coreorgonal bicornis,* ♂, cephalothorax, lateral view.
2. *Coreorgonal bicornis,* ♂, cephalothorax, dorsal view.
3. *Coreorgonal bicornis,* ♂, right palpus, mesoventral view.
4. *Coreorgonal bicornis,* ♂, right palpus, mesal view.
5. *Coreorgonal monoceros,* ♂, cephalothorax, lateral view.
6. *Coreorgonal monoceros,* ♂, cephalothorax, dorsal view.
7. *Coreorgonal monoceros,* ♂, right palpus, mesoventral view.
8. *Coreorgonal monoceros,* ♂, right palpus, mesal view.
9. *Gnathonargus unicorn,* ♂, cephalothorax, lateral view.
10. *Gnathonargus unicorn,* ♂, cephalothorax, dorsal view.
11. *Gnathonargus unicorn,* ♂, right palpus, mesal view.
12. *Gnathonargus unicorn,* ♂, right palpus, dorsomesal view.
13. *Gnathonargus unicorn,* ♀, epigynum.

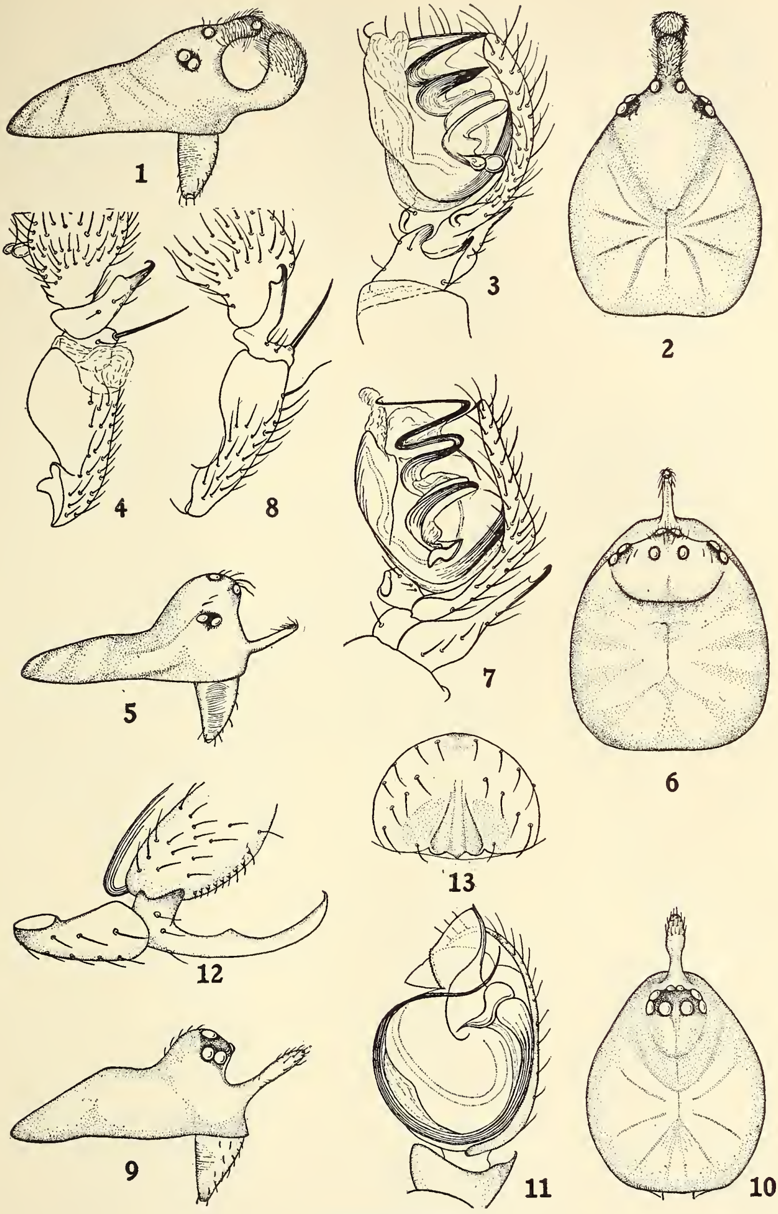

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PLATE XVIII

14. *Gnathonarium dentatum,* ♂, right palpus, mesal view.
15. *Gnathonarium dentatum,* ♂, right palpus, tibia, mesal view.
16. *Gnathonarium dentatum,* ♀, epigynum.
17. *Gnathonarium famelicum,* ♂, right palpus, mesal view.
18. *Gnathonarium famelicum,* ♂, right palpus, tibia, mesal view.
19. *Tmeticus affinis,* ♂, right palpus, mesal view.
20. *Tmeticus affinis,* ♂, right palpus, tibia, dorsolateral view.
21. *Tmeticus affinis,* ♂, right palpus, lateral view.
22. *Tmeticus ornatus,* ♂, right palpus, mesal view.
23. *Tmeticus ornatus,* ♂, right palpus, lateral view.
24. *Tmeticus ornatus,* ♂, embolic division.
25. *Tmeticus ornatus,* ♂, right palpus, tibia, dorsal view.
26. *Tmeticus ornatus,* ♀, epigynum.

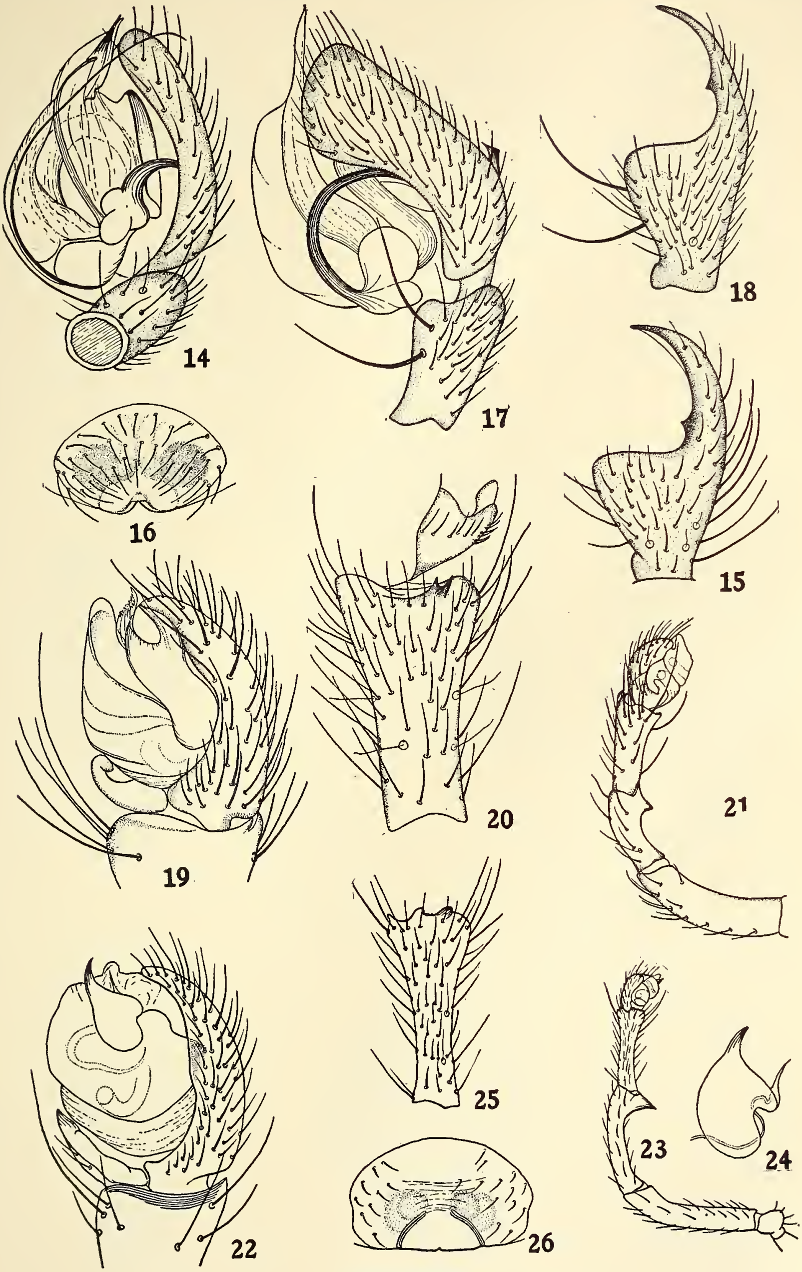

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PLATE XIX

27. *Nanavia monticola,* ♂, right palpus, mesal view.
28. *Nanavia monticola,* ♂, right palpus, tibia, dorsal view.
29. *Maso alticeps,* ♂, right palpus, ventral view.
30. *Maso alticeps,* ♂, right palpus, mesal view.
31. *Maso alticeps,* ♂, right palpus, tibia, dorsal view.
32. *Maso alticeps,* ♂, right palpus, tibia, lateral view.
33. *Maso polita,* ♂, left palpus, mesoventral view.
34. *Maso polita,* ♂, left palpus, tibia, dorsal view.
35. *Maso sundevalli,* ♂, right palpus, mesoventral view.
36. *Maso sundevalli,* ♂, right palpus, tibia, dorsal view.
37. *Maso sundevalli,* ♀, epigynum.

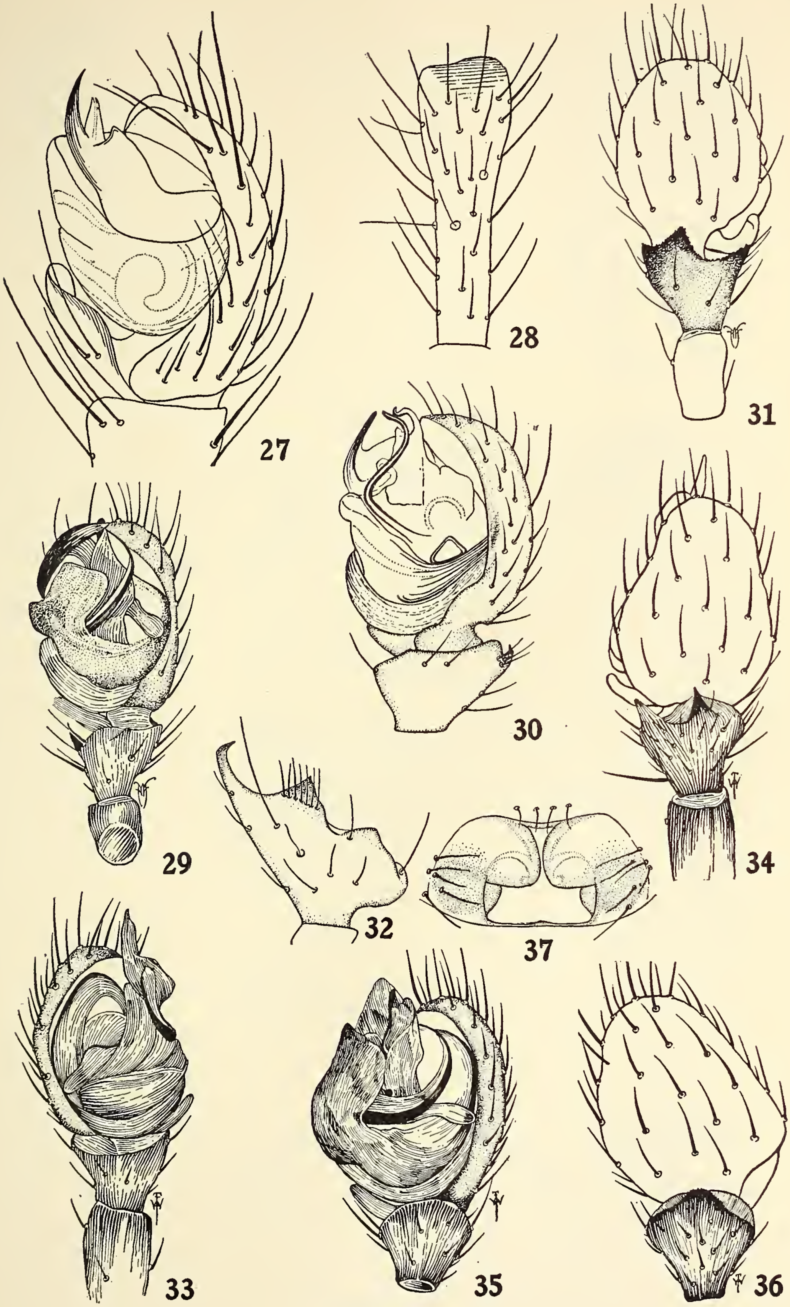

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PLATE XX

38. *Utopiellum mirabile,* ♂, right palpus, lateral view.
39. *Utopiellum mirabile,* ♂, right palpus, mesoventral view.
40. *Utopiellum mirabile,* ♂, right palpus, tibia, mesal view.
41. *Utopiellum mirabile,* ♀, epigynum.
42. *Diplocephalus cristatus,* ♂, right palpus, mesoventral view.
43. *Diplocephalus cristatus,* ♀, epigynum.
44. *Gonatium rubens,* ♂, right palpus, lateral view.
45. *Gonatium rubens,* ♂, right palpus, dorsal view.
46. *Gonatium rubens,* ♂, right palpus, ventral view.
47. *Gonatium rubens,* ♀, epigynum.
48. *Goneatara plausibilis,* ♂, cephalothorax, lateral view.
49. *Goneatara plausibilis,* ♂, cephalothorax, front view.
50. *Goneatara plausibilis,* ♂, right palpus, mesoventral view.
51. *Goneatara plausibilis,* ♂, right palpus, tibia, dorsal view.

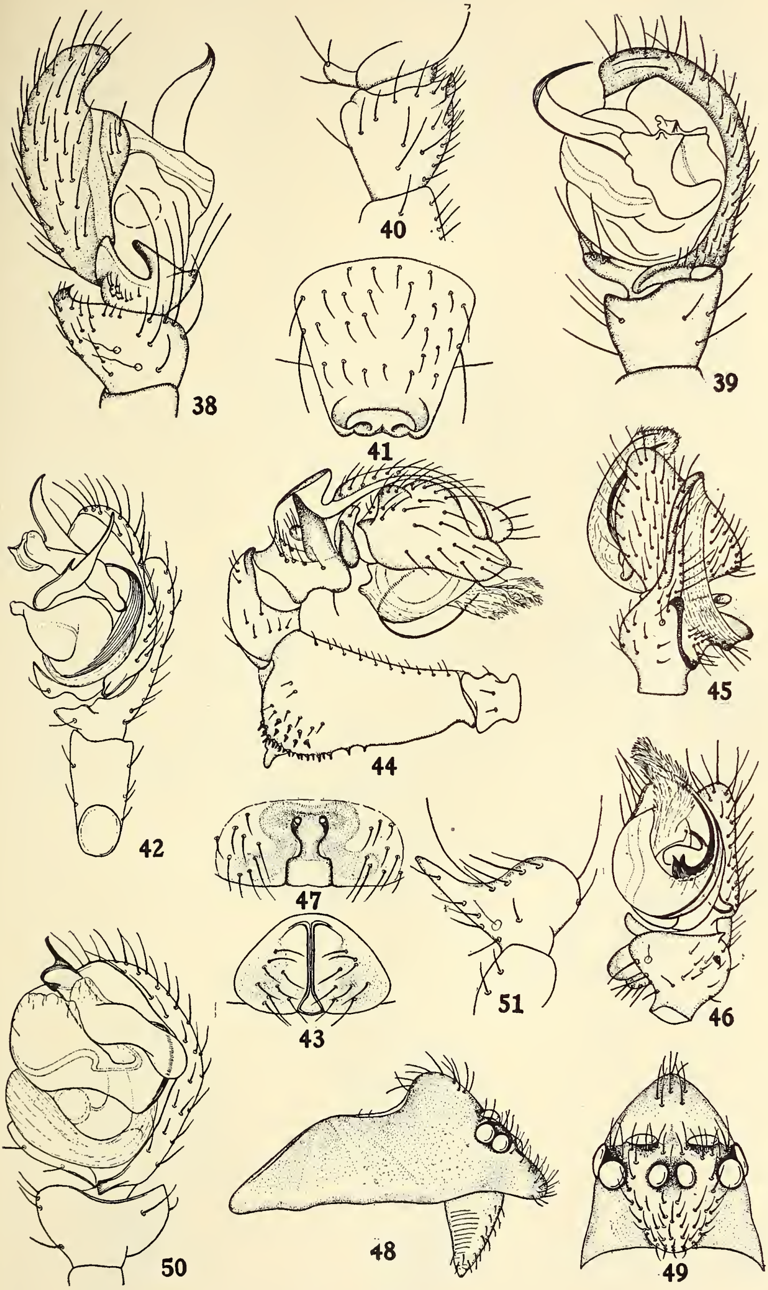

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PLATE XXI

52. *Cheniseo fabulosa*, ♂, cephalothorax, lateral view.
53. *Cheniseo fabulosa*, ♂, cephalothorax, dorsal view.
54. *Cheniseo fabulosa*, ♂, right palpus, mesal view.
55. *Cheniseo fabulosa*, ♂, right palpus, tibia, dorsolateral view.
56. *Cheniseo fabulosa*, ♀, epigynum.
57. *Cheniseo faceta*, ♂, cephalothorax, lateral view.
58. *Cheniseo faceta*, ♂, cephalothorax, dorsal view.
59. *Cheniseo faceta*, ♂, right palpus, mesal view.
60. *Cheniseo faceta*, ♂, right palpus, tibia, dorsolateral view.
61. *Cheniseo recurvata*, ♂, cephalothorax, lateral view.
62. *Cheniseo recurvata*, ♂, right palpus, mesoventral view.
63. *Cheniseo recurvata*, ♂, right palpus, tibia, dorsal view.
64. *Cheniseo sphagnicultor*, ♂, cephalothorax, lateral view.
65. *Cheniseo sphagnicultor*, ♂, cephalothorax, dorsal view.
66. *Cheniseo sphagnicultor*, ♂, right palpus, tibia, dorsal view.
67. *Cheniseo sphagnicultor*, ♂, right palpus, mesoventral view.
68. *Cheniseo sphagnicultor*, ♂, right palpus, mesal view.
69. *Cheniseo sphagnicultor*, ♂, right palpus, lateral view.

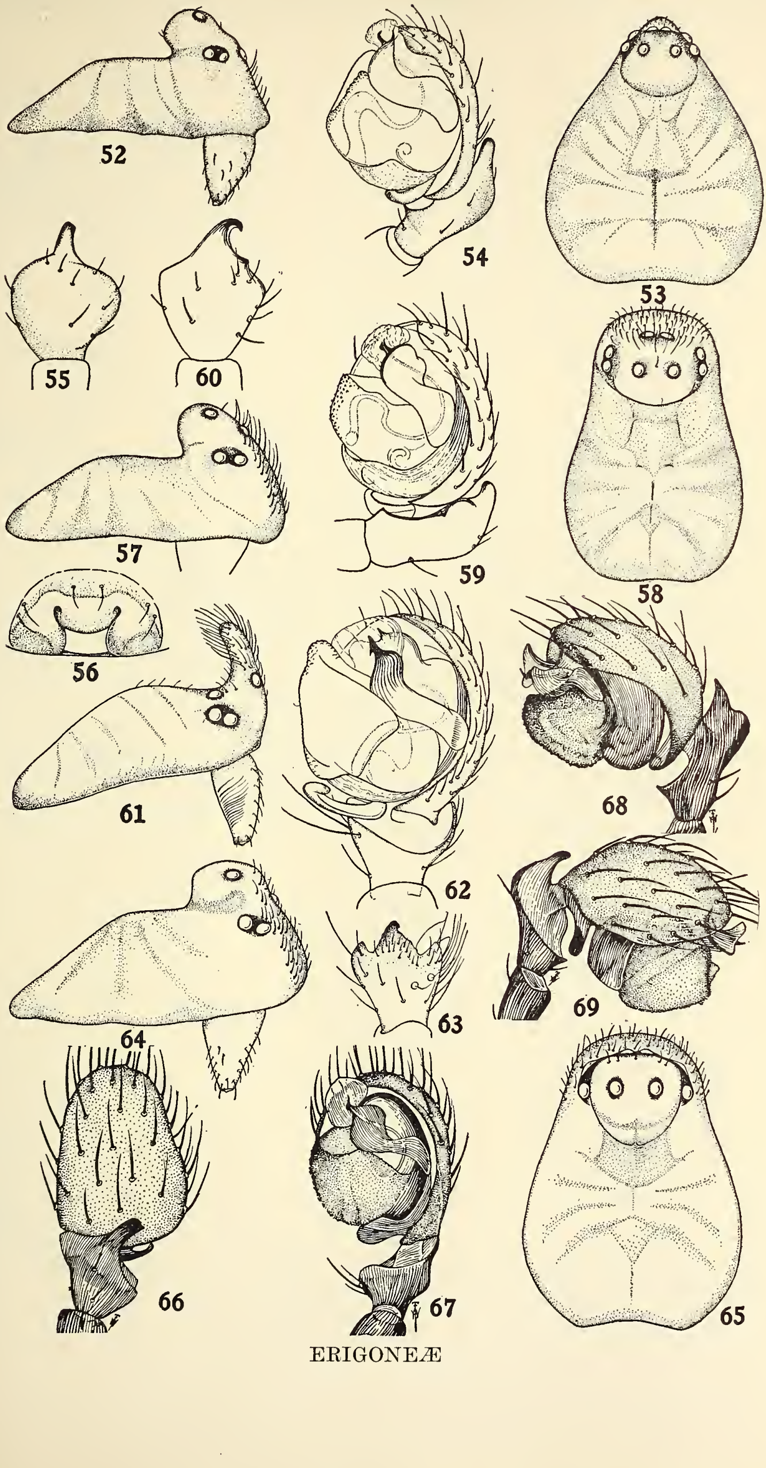

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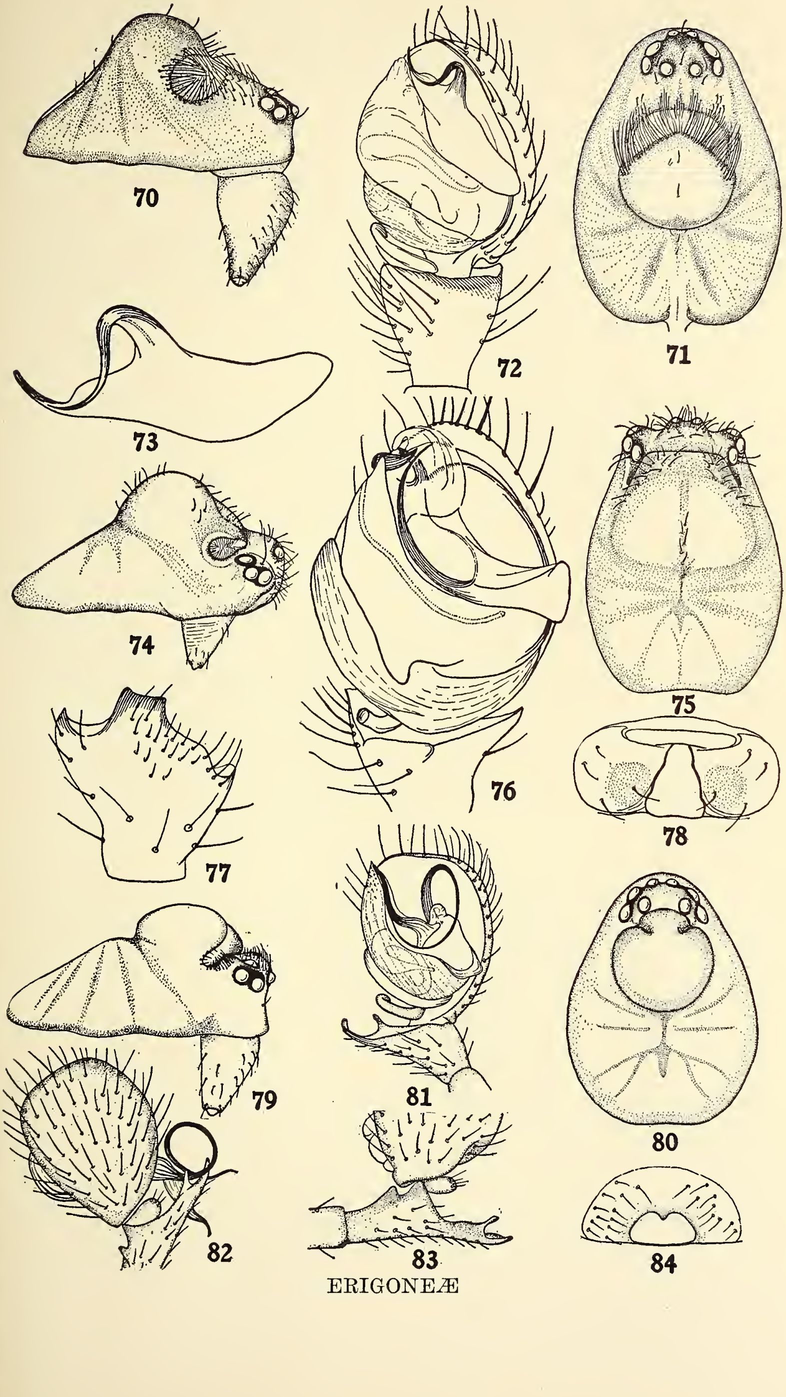
PLATE XXII

70. *Oedothorax gibbosus,* ♂, cephalothorax, lateral view.
71. *Oedothorax gibbosus,* ♂, cephalothorax, dorsal view.
72. *Oedothorax gibbosus,* ♂, right palpus, ventral view.
73. *Oedothorax gibbosus,* ♂, embolic division.
74. *Oedothorax montiferus,* ♂, cephalothorax, lateral view.
75. *Oedothorax montiferus,* ♂, cephalothorax, dorsal view.
76. *Oedothorax montiferus,* ♂, right palpus, ventral view.
77. *Oedothorax montiferus,* ♂, right palpus, tibia, dorsolateral view.
78. *Oedothorax montiferus,* ♀, epigynum.
79. *Oedothorax trilobatus,* ♂, cephalothorax, side view.
80. *Oedothorax trilobatus,* ♂, cephalothorax, dorsal view.
81. *Oedothorax trilobatus,* ♂, right palpus, ventral view.
82. *Oedothorax trilobatus,* ♂, right palpus, dorsal view, bulb expanded.
83. *Oedothorax trilobatus,* ♂, right palpus, tibia, mesal view.
84. *Oedothorax trilobatus,* ♀, epigynum.



ERIGONEÆ

NEW SPECIES OF NEW YORK STATE CERATOPOGONIDÆ

BY LILLIAN THOMSEN

In a study of the biology of some Ceratopogonidæ a number of species were encountered which appear to be new. These, together with the males of some others, of which only females have thus far been discovered, are therefore herewith described.

KEY TO SPECIES OF DASYHELEA OF NORTHEASTERN UNITED STATES

Females

1. Posterior margin of abdominal segments light yellow 2
   Posterior margin of abdominal segments not light yellow 3
2. Halteres yellow; mesonotum gray pruinose; scutellum yellow ...... *grisea* Coq.
   Halteres light brown to black; mesonotum, metanotum, and mesosternum blue pruinose; scutellum yellow with a black central patch; last antennal segment with stylet .... *subcœrulea* n. sp.
3. Halteres yellow 4
   Halteres black 5
4. Last antennal segment with no stylet; spermatheca spherical with posterior extension curved and sclerotized (Fig. 26) .... *mutabilis* Coq.
   Last antennal segment with stylet; spermatheca nearly pyriform, posterior extension about a third its length (Fig. 23) .... *oppressa* n. sp.
   Small species, 1.5 mm. in length; mesonotum without vitta; apices of knobs black; last antennal segment with stylet .... *traveræ* n. sp.
   Larger species, 2 mm. in length; mesonotum with four brownish vittae; apices of knobs white .... *major* Malloch

Males

1. Ninth sternite with a central posterior extension (Fig. 1) 2
   Ninth sternite without a central posterior extension (Fig. 3) 3
2. Central posterior extension narrow, highly sclerotized; distal portion of harpes cleaver-shaped; no processes at base of cerci (Fig. 1) .... *mutabilis Coq.*
   Central posterior extension broad; distal portion of harpes needle-like (Fig. 6) .... N. sp. ?
3. A sclerotized process at base of cerci 4
   No process at base of cerci; distal portion of harpes broadening just above aedeagus and tapering toward apex; lateral part of aedeagus double (Fig. 3) .... *traveræ* n. sp.
4. Ninth sternite with a distinct central posterior depression; distal portion of harpes broad; basal process of cerci nearly as long as cerci (Fig. 2) .... *oppressa* n. sp

No depression in ninth sternite; distal portion of harpes narrow, apex pointed; basal process of cerci scarcely half as long as cerci (Fig. 5) .... *subcœrulea* n. sp.

Dasyhelea subcærulea new species

Female. Length 1.5 mm. Wing length 1 mm. Head black, dark blue pruinose; eyes contiguous; proboscis brown, palpi light brown; antennæ black with short black hairs, last segment tapering into a style; basal segment oval, others slightly increasing in length to fourteenth segment, fourteenth segment nearly twice as long as wide. Thorax black, mesonotum, mesosternum, and metonotum blue pruinose, in some specimens a central black vitta distinct on mesonotum; scutellum yellow with black central patch and eight marginal bristles. Halteres light brown to black. Legs light yellow to brown with apices of segments black; hind tarsal proportions are 23–9–6–4–5; claws simple. Wings hairy, bare spaces on both sides of veins; radial branches fused except small space where they join the costa, producing a very narrow second radial cell a third the length of the fused portion; cubitus forking opposite to center of fused radial veins; base of media indistinct. Abdomen velvety black with posterior margins of each segment light yellow, segments seven and eight have the light yellow a third the width of the segment; spermatheca oval, posterior extension about a third its length, curved and sclerotized.

Male. Similar to female in coloring except the light yellow margins of the abdominal segments are not always as well defined as in females. Antennæ black, the plume reaching to last segment; segments 2–9 are 0.8 as long as 10–14 combined; segments 10–14 are in proportions of 7–16–16–12–20 (Fig. 34). Wing less hairy than female; cubitus forking opposite to where anterior branch of radius joins costa, second radial cell more distinct than in female and a fourth the length of the fused portion.

Terminalia: Tergite rounded at its posterior extremity, covered with short hairs; cerci highly sclerotized with a short bristle at apex, at the base of each cercus is a highly sclerotized process half its length; sternite broad with a small posterior medial depression and covered with short hairs; side pieces short and thick covered with hairs and a few bristles; claspers slightly longer than side pieces and densely covered with hairs; harpes asymmetrical, the basal portions are slender curved rods extending from side pieces to center of ninth segment, the distal portion is a long rod curved at the apex and as long as the ninth tergite, which arises from the left side of insect at anterior end of basal portion; the basal portion of the aedeagus broad, extending laterally to the side pieces, two medial distal portions curved at apex and about half the length of side pieces (Fig. 5).

Holotype and allotype in the Cornell University collection. Ithaca, N. Y.

Dasyhelea oppressa new species

Female. Length 1.2 mm. Head black; eyes broadly contiguous dorsally; proboscis and palpi brown; antennae black, hairs black, lighter at tips; last segment bears a style; basal segments oval, increasing in length to thirteenth segment, which is a third longer than broad; fourteenth segment twice as long as thirteenth. Thorax black; mesonotum with bluish pruinescence making an indefinite pattern, anterior lateral angles yellow; yellow spot at base of wings; a narrow longitudinal yellow streak on the lateral edge of the prescutellar depression, a medium double row of hairs on the mesonotum, with scattered hairs on the sides; six long bristles near the posterior margin of mesonotum; scutellum yellowish brown the medium area darker, with a row of six marginal bristles and three to six short medium hairs; metanotum black with bluish pruinescence. Stem of halteres black, knob white. Legs yellowish brown, apices of femora and tibia black, apices of tarsi slightly darker, claws simple; hind tarsal proportions, 21: 8: 6: 4: 5. Wings 1 mm. in length. Surface thickly covered with hairs, somewhat denser at anterior margin; radial branches fused except a small space where they join the costa, producing a second radial cell a third the length of the fused portion; cubitus forking just beyond the crossvein. Abdomen dull black, eighth and ninth segments lighter. Spermatheca nearly pyriform, posterior extension about a third its length (Fig. 23).

Male. Similar to female in coloring. Antennal segments 2–9 a sixth shorter than 10–14 combined; eleventh to fourteenth are in the proportions of 8: 6: 7: 8. Wing less hairy, cubitus forking opposite to where anterior branch of radius joins costa, second radial cell not as distinct as in female. Abdomen velvety black with black hairs.

Terminalia. Tergite of ninth segment reaching to end of side pieces, dorsally sparsely long haired; cerci highly sclerotized ending with a long hair; at base of each cercus with a process covered with hairs and nearly as long as cerci. Sternite with posterior medial depression; side pieces of forceps with many long hairs denser towards the tergite; claspers covered with short hairs except inner side of distal third where there are two to three long hairs; harpes asymmetrical, the distal portion a broad rod, arising from the basal part which is on the left side of the insect; the basal portion of aedeagus broad, extending laterally to the side pieces, two medial distal portions hooked at apex and about half the length of side pieces (Fig. 2).

Holotype and allotype in the Cornell University collection. Reared from larvæ taken from the wound of an elm tree on Cornell campus. Ithaca, N. Y., July to September, 1934.

Dasyhelea traveræ new species

Female. Length 1.5 mm. Head black. Eyes contiguous dorsally; proboscis and palpi black; antennae black with black hairs, last segment tapering into a style; basal segments oval, slightly increasing in length to fourteenth segment; fourteenth segment nearly twice as long as wide. Thorax black; mesonotum with bluish gray pruinescence, anterior lateral angles brown, a brown spot at base of wings; scutellum with eight marginal bristles. Halteres black. Legs black except tarsi which are yellowish brown with black apices; claws simple; hind tarsal proportions are 24: 4: 6: 4: 5. Wings 1.2 mm. in length; hairy; bare lines along the veins, hairs denser along anterior margin. Radial branches fused except small space where they join the costa, producing a very narrow second radial cell a third the length to the posterior end of second radial cell; base of media indistinct. Abdomen velvety black; spermatheca ovoid covered with irregular projections; duct membranous (Fig. 21).

Male. Similar to female in coloring. Hair of antennae black with light tips; segments 2–10 transversely oval, about an eighth longer than 10–14 combined; eleventh to fourteenth are in the proportions of 7: 5: 5: 7. Wing length 1.4 mm., less hairy than female; cubitus forking opposite to where anterior branch of radius joins costa, second radial cell more distinct than in female.

Terminalia. Ninth tergite rounded at its posterior extremity, covered with short hairs and a scattering of long stout hairs. Cerci prominent, highly sclerotized having a long bristle at apex and covered with short hairs. Sternite broad, covered with short hairs; side pieces slightly longer than claspers covered with hairs and a few bristles. Claspers with pointed tips each bearing a stout spine near apex; the basal two-thirds with stout hairs. Harpes highly sclerotized, basal portion nearly symmetrical, broad near medium line and curving laterally, the distal portion reaching nearly to cerci, broadening beyond aedeagus and tapering toward apex. Aedeagus with two lateral projections as figured, the outer projections reaching to middle of side pieces (Fig. 3).

Holotype and allotype in the Cornell University collection. Reared from larvæ taken from floating algæ in ponds in May and September. Ithaca, New York.

Forcipomyia johannseni new species

Female. Length 1 mm. Wing length 0.6, width 0.3. Head black, proboscis and palpi brown; eyes contiguous; antenna dark brown with short black hairs, segments 2–9 are 1.3 times as long as segments 10–14 combined, last segment twice as long as 13th, with stylet. Thorax dark brown, mesonotum, scutellum, and metanotum glossy, black; mesonotum covered with black hairs, those in presutellar depression twice as long as others; five long hairs along margin of scutellum. Stem of halteres light brown, knob white. Legs light brown, tarsi paler; hind tarsal proportions are 15: 7: 6: 5: 5, claws as long as last tarsal segment with a very short spur at base, empodium as long as claws. Wings densely covered with macrotrichia; posterior branch of radius ends in the middle of wing as measured from the arculus to the tip; first radial cell almost obliterated, second radial cell slightly longer than first and nearly half as wide as long; posterior branch of media very faint; cubitus forking in line with the end of first radial cell. Abdomen brown covered with black hairs; one spermatheca, oval and highly sclerotized, duct membranous.

Male. Length 1.5 mm. Wing length 0.9 mm., width 0.3. In coloring as with the female but differs from female in having thorax, wings, and abdomen less hairy. The last five segments of antennæ as long as 2–9 combined, the last five bearing the ratio of 5: 15: 11: 7: 9; the fourteenth with stylet; antennal plume reaching to middle of last segment. Hind tarsal proportions are 25: 11: 10: 6: 4.

Terminalia: Ninth segment dark brown with a scattering of long hairs and dense covering of short hairs, posterior border of sternite depressed in the middle, tergite with a membranous posterior extension and a small process with a hair on each side; side pieces ovoid, covered with short hairs and scattered long ones, claspers about as long as side pieces, lightly sclerotized, basal third covered with short hairs, distal portion slightly spatulate; harpes long, narrow straight rods, arising at base of side pieces and crossing caudad of aedeagus, highly sclerotized, no basal connection between the two rods; aedeagus a broad membranous plate with highly sclerotized lateral processes and two slender rods extending anteriorly from posterior edge of mid portion of membranous plate (Fig. 15).

Holotype and allotype in Cornell University collection. Reared from larvæ taken from bark from wound of elm tree on Cornell campus, Ithaca, New York, July 17, 1934. This species will fall in with *F. specularis* in Malloch's key (Malloch, 1915). It differs in having an elongate hind hasitarsus. From *F. fuscicornis* Coq. it differs in being smaller, in having the hind basitarsus shorter than the combined three following segments and in the glossy black scutellum.

Alluaudomyia (Neoceratopogon) needhami new species

Female. Length 2 mm. Wing 1.7 mm. Eyes narrowly separated; vertex covered with dense white pruinescence; occiput and postgenæ black; clypeus and palpi dark brown; proboscis light brown; antennae as long as thorax; basal joints white gradually becoming light brown toward apex, antennal hairs brown. Mesonotum dark brown covered with grayish-brown pruinescence except the anterior portion and the lateral margins which are white; discal hairs black and those located in the grayish brown part have a black spot at the base of each hair (Fig. 18). Scutellum white, a black streak in the center; metanotum black, anterior lateral angles covered with white pruinescence; pleura dark brown except dorsal border which is white; sternum dark brown. Halteres white. Legs black, marked with white as follows: fore coxæ, narrow part at base of femora, a narrow band before apices of femora, a narrow band near base of fore and hind tibia, a broad band near base of mid tibia, a narrow band near apices of each tibia; tarsi except hind metatarsi, and apices of all segments of tarsi. Wings white, densely covered with white hairs except basal portion; veins white. Ten black spots as follows: On crossvein, below and proximad of crossvein, at apex of posterior branch of radius, near base of posterior branch of media, near base of anterior branch of cubitus, near apices of anterior and posterior branches of media and cubitus, at apex of anal vein. Spots on apices of media and cubitus are long narrow lines on veins. First radial cell nearly obliterated by fusion of radial branches for one-half the length of the anterior branch of radius; posterior branch of radius ends six-tenths of entire wing as measured from arculus; cubitus forks in line with anterior end of second radial cell (Fig. 25). First and second tergite of abdomen, anterior portion of third and fourth, black, remaining segments white. Pleura white, sternum black.

Male. Length 1.5 mm. Wing 1.1 mm. Similar to female in coloring. Antennæ golden, last three segments dark brown, the plume dense and reaching to last segment; hairs at base light brown and white at tips; segments 2–9 eight-tenths as long as segments 10–14 combined; segments 10–14 are in the proportion of 5: 10: 13: 15: 15; last segment bears a style (Fig. 33). Mesonotal pattern not as definite as in the female. Wings clear, veins light colored, a few macrotrichia at distal anterior margin; spots on wing same as with the female except that those at apices or media and cubitus are reduced to a faint line on the veins; posterior branch of radius ends at slightly over half of wing-length as measured from arculus; cubitus forks in line with the basal end of the second radial cell.

Terminalia: Ninth segment as long as seventh and eighth combined; posterior portion of tergite a white membranous structure ending in two small cerci each with a long spine; sternite with anterior end sclerotized forming a central depression posteriorly. Side piece of forceps black, 3.5 times as long as lateral margin of ninth sternite, entirely covered with short hairs and with many bristles; claspers light brown, half as long as side pieces, bases with thick hairs. Harpes entirely separate, basal part highly sclerotized, attached to anterior basal part of side pieces, distal portion a long rod as long as side pieces, inner sides covered with short hairs, each rod bearing a slender curved rod longer than the claspers. Aedeagus a triangular structure with sides heavily sclerotized, the tip curving into a short point (Fig. 7).

Holotype and allotype in the Cornell University collection. Reared from eggs taken from floating pond algae. June, 1933. Ithaca, New York.

Alluaudomyia (Neoceratopogon) splendidus Winnertz

(*Ceratopogon bellus* Coq.)

Female. Differs from *needhami* in the number of spots on the wings and in the thoracic marking of which there are several color variations. The macrotrichia on wings are more definitely arranged along the veins and not so dense.

Male. The terminalia exhibit the striking differences. Ninth segment three times as long as eighth segment; anterior margin of tergite black, posterior portion white ending in two sharp pointed cerci and two short processes on ventral surface covered with short hairs; anterior and lateral margins of sternite black and heavily sclerotized forming a deep central depression. Side pieces of forceps black, twice as long as lateral margin on ninth sternite, densely covered with hairs and scattered bristles; claspers not quite half as long as side pieces, bases covered with short hairs. Harpes entirely separate, basal portion attached to anterior basal portion of side pieces, distal part forming a rod half as long as side pieces with enlarged rounded tips. Aedeagus with two highly sclerotized internal arms, which extend posteriorly, each ending in a flap (Fig. 9).

Stilobezzia bulla new species

Female. Length 1 mm. Wing 0.8 mm. Vertex of the head, proboscis, and palpi light gray; antennae almost white, long, reaching to the first abdominal segment. Thorax dark gray, covered with gray pruinescence; mesonotum with prominent brown mesonotal pits and few short hairs; scutellum yellowish with four marginal bristles; metanotum black. Halteres white with two short bristles on knob. Legs nearly white with apices of each of the segments light brown; fore leg as long as body, mid and hind legs half again as long; hind metatarsal segment with a double row of very closely set spines; hind tarsal segments are in the proportion of 30: 12: 6: 5: 7; claws unequal, one as long as last segment, the other one half as long. Wings clear, no macrotrichia, veins very light in color; second radial cell nearly twice as long as the fused first; stem of media twice as long as the cross vein; cubital fork nearly on line with medial fork. Abdomen black, with few stout hairs. Two spermatheca oval with duct sclerotized a very short distance.

Male. Similar to female in color. Antennæ light brown, last three segments dark brown and with a dark brown, thick plume; the last five antennal segments are in the proportion of 5: 7: 14: 15: 19. Claws of legs simple, equal and half as long as last segment.

Terminalia: Posterior portion of ninth tergite ends in well developed cerci and a central bilobed process, both structures thickly covered with bristles; sternite a very narrow sclerotized band and transparent membranous structure extending nearly to the aedeagus. Side pieces of forceps long and narrow, on the distal half, mesad, are heavily sclerotized knobs articulating with the aedeagus. Claspers half as long as side pieces, tips rather blunt, both with a few short bristles and many short hairs. The pair of harpes are not fused; the basal portion of each is a narrow curved structure one end of which is attached to side pieces; the distal portion is a long slender needle-like structure. The aedeagus has a broad basal part with lateral arms attached to knobs on side pieces (Fig. 13).

Holotype and allotype are in the Cornell University collection. Reared from larvæ taken from algæ from McLean Bogs in June 1933. Ithaca, N. Y.

This species will fall in with *Hartomyia arctica* and *H. diversa* in Malloch's Key (Malloch 1915); differing from the first in wing venation, from the second in the color of the abdomen.

Plapomyia pruinescens new species

Female. Length 3.8 mm. Head brown; eyes well separated; vertex, occiput, and palpi covered with dense pruinescence; antennæ brown, two basal segments light brown, segments 2–9 half as long as 10–14 combined, each of the latter eight times as long as wide; tips of antennæ reaching to scutellum. Thorax entirely covered with gray pruinescence; mesonotum black with median longitudinal grayish vitta divided by a fine line, the vitta ending in a pair of elongate seal brown spots laterad of which are two similar but smaller spots (Fig. 19). Scutellum dark brown having six long marginal spines; mesanotum black. Stems of halteres light brown, knob black. Legs brownish yellow, the coxæ, trochanters, extreme tips of all tibia, the tips of middle and apical half of hind femora, the basal third of middle and the basal half of hind tibia, and the last two tarsal segments largely, on all feet, dark brown. Fore femora with 10–14, middle from 1–4, hind femora with 2–4 short black spines on lower side near apex; fourth segment cordiform; underside of fifth tarsal segments with a few bristly hairs, no spines; hind tarsal segments are in the proportions of 13: 5: 2: 2: 5; claws subequal, toothed near base. Wings 3.5 mm. in length. Clear, veins light brown; costa extending four-fifths of wing length as measured from arculus; second radial cell twice as long as first; posterior branch of radius as long as media from arculus to cross vein; media forking at cross vein; cubitus forking beyond cross vein. Abdomen light brown; two spermatheca, oval with small part of duct sclerotized. Segments six and seven have each a pair of eversible glands on anterior margins of tergite; segments five, six, and seven have each a pair of gland rods (Fig. 27).

Male. Length 2.4 mm. Wing 2.2 mm. Differs from female in the following points: Antennæ black, segments 10–14 in proportion of 8: 12: 9: 8: 18. Vitta on thorax very faint in most cases. Hind femora, mid and hind tibia, entirely dark brown; eight spines on fore, one on mid, and none on hind femora.

Terminalia. Tergite of ninth segment has a row of ten long bristles near median transverse line, the posterior part ends in two well developed cerci and one ventral lobe covered with short hairs (Fig. 11). The sternite has a few short bristles at lateral posterior part and a large central depression. Sides pieces of forceps have on the margin near the ædeagus a short projection ending in a short bristle, the claspers slightly longer than side pieces, blunt, both side pieces and clasper having a few stout bristles and covered with short hairs. Harpes heavily sclerotized, fused into a single structure, the basal part extending to side pieces and the distal part forming an elongated rod rounded at tip (Fig. 4). The ædeagus forms a flat triangular structure with the margins highly sclerotized with a small cap-like structure on tip (Fig. 11).

Holotype and allotype in Cornell University collection. Reared from larvæ taken from blanket algæ, June–September, Ithaca, New York. 1934.

This species will find a place in Malloch's Key (1915) near *P. illinoensis,* differing in the thoracic markings.

Palpomyia tibialis Meigen

Male. Length 2.5 mm., wing 2.2. Similar to female in coloring. Antennal segments 10–14 are in the proportion of 4 : 6 : 13 : 17 : 19.

Terminalia. Ninth segment black; basal part of tergite sclerotized; posterior part ends in two well developed cerci with sclerotized margins, and one ventral lobe. The sternite has a large central depression, a transparent membrane with short hairs is between the depression and the ædeagus. Side pieces of forceps extend nearly to cerci each with a large rounded projection at the base, the claspers are half the length of side pieces and narrow towards the apex into a point. Harpes heavily sclerotized, basal part extending to side pieces and the distal part forming a short rod ending in two comma-like structures (Fig. 16). Aedeagus heavily sclerotized, triangular in shape with two lateral arms extending anteriorly to base of side pieces and posteriorly forming a cordiform knob (Fig. 16).

Male and female reared from larvæ taken from mud from edge of ponds from May to September, 1933. Ithaca, New York.

Bezzia varicolor Coquillett

Male. Length 2 mm. Wing 1.6 mm. Head black covered with gray pruinescence; proboscis and palpi dark brown; antennæ dark brown, pedicel nearly black, bases of all segments lighter, plume light brown; segments 2–9 are 0.6 as long as 10–14 combined; segments 10–14 are in the proportion of 10 : 13 : 22 : 37 : 32. Thorax including scutellum brown; metanotum darker; mesonotum with three dark brown vittæ, the laterals abbreviated anteriorly; the humeri, space between vittæ, and anterior part of pleura gray pruinose; in some lights with a brown spot on humeri. A few short black hairs above the base of the wing and one on postero-lateral angle; scutellum with about six short setæ. Halteres yellowish. Legs as described by Coquillett for the female but with colors less contrasting especially in mature specimens. Fourth segment cordate; hind tarsal segments are in the proportion of 38 : 22 : 12 : 8 : 16. Claws simple and half as long as last segment. Wings clear, veins pale; posterior branch of radius ends at eight tenths the wing length as measured from the arculus, and twice as long as anterior branch; media forking just in front of the cross vein. Abdomen dark brown.

Terminalia. Posterior part of ninth tergite is membranous ending with short cerci which are covered with hairs and numerous stout bristles; the sternite has a posterior medial depression which is a thin membranous structure covered with short hairs. Side pieces of forceps and claspers equal in length and both covered with hairs and numerous bristles. Harpes highly sclerotized, the basal portion not fused, the lateral arms extending to side pieces, distal portion merged into a long rod, rounded at tip and reaching to cerci. Aedeagus a triangular structure with the lateral sides heavily sclerotized, the base and tip are covered with short hairs (Fig. 12).

Reared from larvæ taken from floating algæ every month of the year. Ithaca, New York.

This sex will find a place in Malloch's key with *pruinosa* because of its dark abdomen, but it differs in leg markings. In mature female specimens the abdomen is brownish rather than yellow.

Probezzia copiosa new species

Female. Length 2 mm. Wing 1.8 mm. Vertex of head, fronto-clypeus, black with gray pruinescence; proboscis dark brown; palpi light brown; eyes widely separated; antennæ brown, last five segments darker, short, reaching to anterior third of mesonotum.

Thorax black covered with gray pruinescence and short hairs. Anterior lateral portion of mesonotum black, graying pruinose, dark brown central vitta extending from head to edge of prescutellar depression, a dark brown vitta on each side from center of central vitta to posterior margin of mesonotum; prescutellar depression dark brown; three bristles at base of wing, one bristle at posterior lateral angle of mesonotum; scutellum dark brown with many short hairs and four short weak marginal bristles; metanotum black, anterior half gray pruinose. Halteres whitish. Coxæ black, gray pruinose; legs yellow except following parts; a band at apex of each femora, base and apex of each tibia and two-thirds of base of hind femora; fourth tarsal segment cordate; claws simple, about half length of last segment. Wings clear, veins pale, posterior branch of the radius ends at three-fourths the wing length as measured from the arculus, and twice as long as anterior branch; media forking at cross vein; cubutus forking distad of cross vein. Tergites of abdomen light brown, sternites dark brown with the posterior margins nearly black; internally on the anterior margin of seventh tergite is a pair of rod glands twice as long as width of segment and beside each rod is an eversible gland as long as the rod; on the posterior margin is a pair of eversible glands four times as long as width of segment.

Male. Length 1.7 mm. Wing 1.2 mm. Head black; palpi dark brown; antennæ dark brown, two basal segments black, plume lighter, segments 2–9 are 0.63 as long as 10–14 combined; segments 10–14 are in the proportion of 6 : 7 : 9 : 8 : 11. Thorax black without pruinescence; halteres cream colored. Legs dark brown, black band at apices of fore and mid femora, hind femora black except a light band near apex, black band at base and apex of each tibia with a central band in fore femora, apices of all tarsal joints black. Wings similar to female. Abdomen black.

Terminalia. Basal part of ninth tergite heavily sclerotized, posterior section ending in well developed cerci and a central process, both with a few bristles and covered with short hairs; sternite highly sclerotized, except a posterior medial depression. Side pieces of forceps short and thick, claspers slightly longer than side piece, with blunt tips, both covered with short hairs and a few bristles. Harpes fused into one piece, the basal part broad with short lateral arms extending to side pieces, the distal part forming a thick rod extending to base of claspers and rounded at tip; ædeagus a triangular heavily sclerotized plate (Fig. 10).

Holotype and allotype in Cornell University collection. Reared from larvæ taken from algæ from Ringwood ponds in May, 1933. Ithaca, New York.

This species will find a place in Malloch's key (1915) with *P. opaca* Lw. It differs in being darker, the thorax opaque with three vittæ, and in coloration of the legs.

Probezzia glaber Coquillett

Male. Length 2 mm. Wing 1.5 mm. Head black; palpi brown; antennæ light brown, pedicel dark brown, plume light brown; segments 2–9 are five-sixths of the length of 10–14 combined;

segments 10–14 are in the proportions of 9:11:12:13:19. Thorax dark brown thinly covered with gray pruinescence; the median vittæ less pruinose, but not very sharply differentiated; scutellum golden brown; metanotum black; halteres cream colored. Legs similar to those of the female except that they are brown rather than pale yellow. Wings clear; veins dark; posterior branch of radius ends at seven-tenths the wing length as measured from the arculus, and slightly more than twice as long as the anterior branch. Abdomen black.

Teminalia. Posterior part of tergite of ninth segment ends in two well developed cerci and a membranous central process, both covered with short hairs and several bristles; sternite heavily sclerotized except a narrow medial depression. Side pieces, claspers, and harpes, as in *copiosa*. Aedeagus a thick triangular structure the apex being double hooked (Fig. 17).

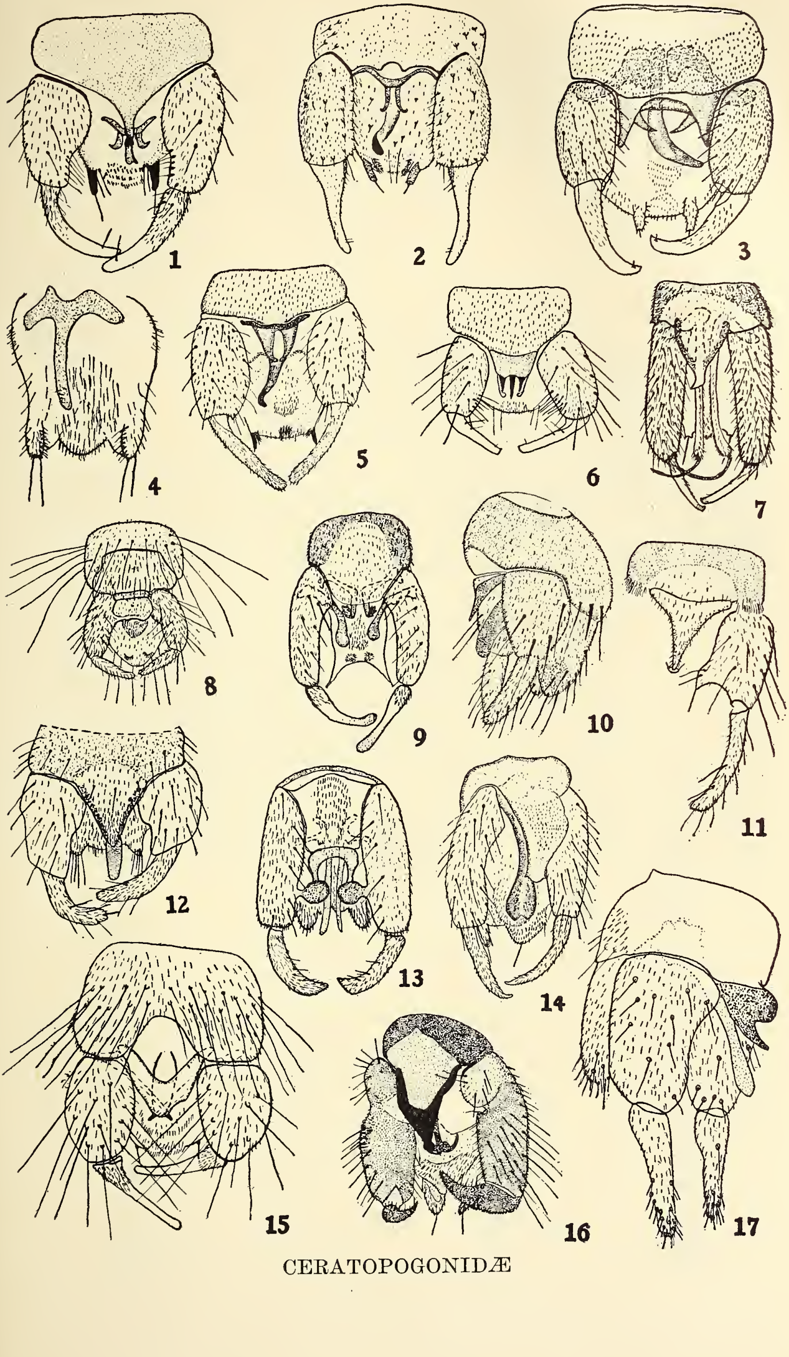
The female of this species was described by Coquillet from a specimen from Florida.

Reared from larvæ taken from floating algæ. Ithaca, New York, 1934.

This sex will find a place in Malloch's key (1915) with the female of *P. opaca* Lw.; differing in being darker. From *P. copiosa* it differs in leg markings.

PLATE XXIII

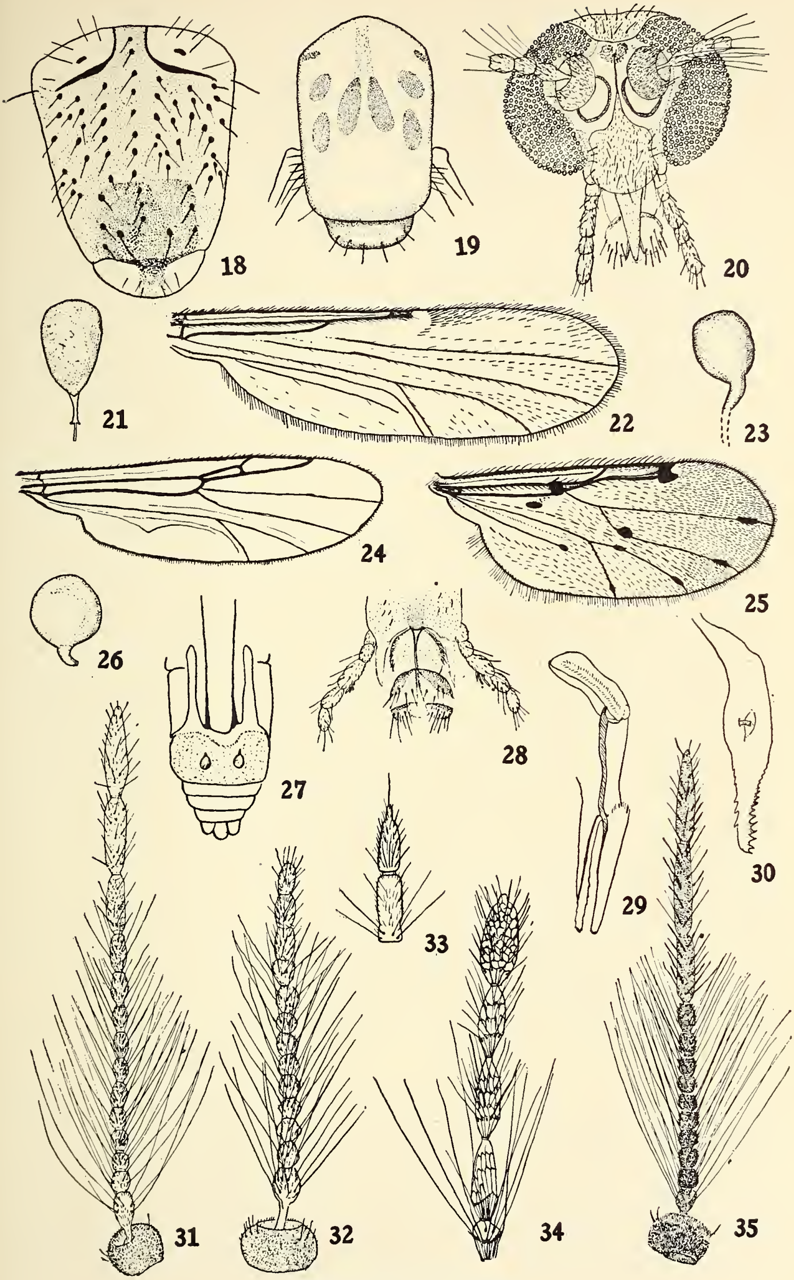
Figure 1. *Dasyhelea mutabilis* Coquillett. Terminalia. Ventral aspect.
Figure 2. *Dasyhelea oppressa* n. sp. Terminalia. Ventral aspect.
Figure 3. *Dasyhelea traverae* n. sp. Terminalia. Ventral aspect.
Figure 4. *Palpomyia pruinescens* n. sp. Ninth tergite and harpes.
Figure 5. *Dasyhelea subcaerulea* n. sp. Terminalia. Ventral aspect.
Figure 6. *Dasyhelea* sp. ?. Terminalia. Ventral aspect.
Figure 7. *Alluaudomyia needhami* n. sp. Terminalia. Ventral aspect.
Figure 8. *Atrichopogon websteri* Coquillett. Terminalia. Ventral aspect.
Figure 9. *Alluaudomyia splendidus* Winnertz. Terminalia. Ventral aspect.
Figure 10. *Probezzia copiosa* n. sp. Lateral aspect.
Figure 11. *Palpomyia pruinescens* n. sp. Ninth sternite, forceps, and aedeagus.
Figure 12. *Bezzia varicolor* Coquillett. Terminalia. Ventral aspect.
Figure 13. *Stilobezzia bulla* n. sp. Terminalia. Ventral aspect.
Figure 14. *Palpomyia longipennis* Loew. Terminalia. Ventral aspect.
Figure 15. *Forcipomyia johannseni* n. sp. Terminalia. Ventral aspect.
Figure 16. *Palpomyia tibialis* Meigen. Terminalia. Ventral aspect.
Figure 17. *Probezzia glaber* Coquillett. Terminalia. Lateral aspect.



CERATOPOGONIDÆ

PLATE XXIV

Figure 18. *Alluaudomyia needhami* n. sp. Mesonotum.
Figure 19. *Palpomyia pruinescens* n. sp. Mesonotum.
Figure 20. *Probezzia copiosa* n. sp. Head of male.
Figure 21. *Dasyhelea traveræ* n. sp. Spermatheca.
Figure 22. *Dasyhelea traveræ* n. sp. Wing of male.
Figure 23. *Dasyhealea oppressa* n. sp. Spermatheca.
Figure 24. *Palpomyia tibialis* Meigen. Wing of female.
Figure 25. *Alluaudomyia needhami* n. sp. Wing of female.
Figure 26. *Dashelea mutabilis* Coquillett. Spermatheca.
Figure 27. *Palpomyia pruinescens* n. sp. Glands and rods of female.
Figure 28. *Probezzia copiosa* n. sp. Labium of female.
Figure 29. *Bezzia varicolor* Coquillett. Labrum-epipharynx of female.
Figure 30. *Bezzia varicolor* Coquillett. Mandible of female.
Figure 31. *Bezzia varicolor* Coquillett. Antenna of male.
Figure 32. *Probezzia copiosa* n. sp. Antenna of male.
Figure 33. *Alluaudomyia needhami* n. sp. Apex of male antenna.
Figure 34. *Dasyhelea subcaerulea* n. sp. Apex of male antenna.
Figure 35. *Palpomyia tibialis* Meigen. Antenna of male.



CERATOPOGONIDÆ

SIX NEW CICADAS FROM THE WESTERN UNITED STATES

BY WILLIAM T. DAVIS
STATEN ISLAND, N. Y.

It was pointed out by the writer in this JOURNAL for March, 1930, page 55, that the cicadas of North America fall naturally into two great groups, namely those in which the males can protrude the uncus from, or withdraw it into, the abdomen, and those of the genera *Okanagana, Tibicenoides, Okanagodes, Clidophleps, Platypedia* and *Neoplatypedia* in which the uncus cannot be withdrawn to a like extent by the males, and is protected by being dropped into the valve or hypandrum. All our male cicadas can be placed readily and almost at a glance in one or the other of these groups. While there are species of the old world, such as *Tibicina haematodes,* that closely resemble in structure our species of *Okanagana,* it appears to be true that the characters found in the six genera mentioned above are chiefly confined to the many cicadas of Western North America.

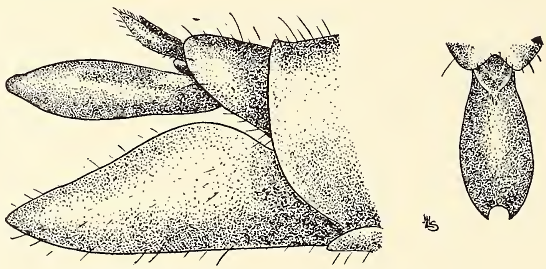
There are at present about 75 recognized species and varieties in the United States belonging to the first of these groups, while in the second there are about 90, for during the past few years the richness of the cicada fauna of Western North America has become more and more apparent. As the distribution of some of the species has been found to be quite limited it may safely be assumed that it will still take a long time to become intimately acquainted with the numerous species.

In the preparation of this paper I am indebted to Hans L. Stecher for the text figures, and to several friends for sending me numerous specimens.

Okanagana venusta new species (Plate XXV, Fig. 1)

Type male and allotype female from Greenhorn Mountain, Kern County, California, June 12, 1935 (Franklin T. Scott).

Allied to *Okanagana cruentifera, O. formosa* and *O. magnifica,* and of the same wing expanse as the two first named, but with the head broader and the front not nearly as prominent. (See Journal, N. Y. Ento. Soc., June 1926, Plate XXII). From *magnifica* it may be separated by the differently shaped fore wings and in having the venation surrounding the marginal areas fine as in *cruentifera* and not heavily clouded as in the larger *magnifica*. Uncus as figured and remarkable for the shape of the apical notch when viewed from above. It is about the same length as the valve, as in *cruentifera* and *formosa*, whereas in *magnifica* the valve is much longer than the uncus. Head as broad across eyes as the pronotum at anterior angles; front not prominent, feebly produced and with the median sulcus well defined about as in *formosa* and not as narrowed above as in *cruentifera*. Last ventral segment with the end rounded. Uncus is black and shaped as figured. The last ventral segment of the allotype is deeply notched centrally. Fore wings shaped as in *formosa* and *cruentifera* and many of the smaller species of the genus. Basal cell of the fore wings black, the margin bright orange-yellow to the end of the radial area, darker beyond; the remaining veins fuscous and of the same color throughout. Both pairs of wings at base as well as the anal membranes, orange, but not orange-red as in *cruentifera* and *formosa*.



OKANAGANA VENUSTA

Head black. Pronotum black, rather broadly pale orange on the hind margin and with the sides very narrowly edged with orange for about half the distance toward the head. Mesonotum black; hind margin pale. Metanotum margined posteriorly with orange. Tergum black, the 9th and 10th segments narrowly margined posteriorly with orange. Beneath black the legs variegated with orange, and each abdominal segment orange along the pos-

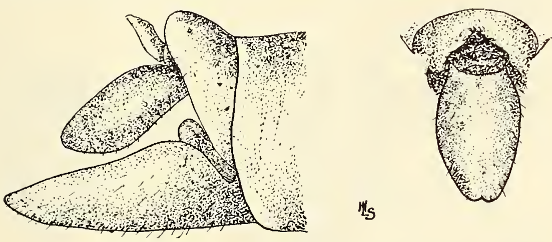
MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	26	25
Width of head across eyes	8	8
Expanse of fore wings	73	75
Greatest width of fore wing	11	11.5
Length of valve	4	

terior margin; more broadly so on the 2nd and 8th segments. Valve pale blackened along the sides at the upper margin. In the female the space about the notch and ovipositor is pale.

In addition to the type and allotype, I have received three males and two females collected at the same place and time, and a female from Kettleman City, Kings County, California, June 13, 1935. Mr. Scott states that he found them very abundant in Greenhorn Mountain, but shy and hard to catch.

Okanagana fratercula (Plate XXV, Fig. 4) was described from Utah in the JOURNAL, NEW YORK ENTOMOLOGICAL SOCIETY, Vol. XXIII, March 1915, and was named as the little brother of *Okanagana schaefferi* because of its close resemblance except in size, *schaefferi* being a large cicada and *fratercula* a very small one. Since 1915 several species resembling *schaefferi,* and also occurring in Utah, such as *O. fumipennis* and *O. tanneri* have been described. *Okanagana gibbera,* which also belongs to this group was described in this Journal, December, 1927.



OKANAGANA FRATERCULA

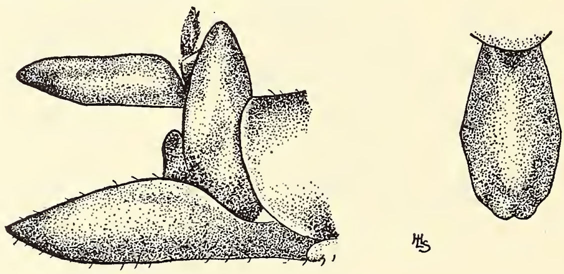
It has become evident as the writer's collection has grown that two other species likewise occurring in Utah, have been confused with *fratercula.* These are here described as new, and comparisons made with related forms, all of which have been described in this Journal. The specimens of *fratercula* lately reexamined are from southwestern Utah. They are the male type, Bucksk Valley, Iron County, 1904; male, Beaver, Beaver County (J. E. Blazzard), and male, Kolob Mountains, Washington County, 8,500 feet., June 30, 1917 (George P. Engelhardt).

Okanagana luteobasalis new species (Plate XXV, Fig. 2).

Type male and allotype female from near Hatch, Davis County, Utah, June 5, 1931 (Dr. John W. Sugden). Davis collection.

Luteobasalis has the dorsum of the rather slim abdomen black, the hind margin of the segments very narrowly edged with orange at the sides only, and the eyes prominent. In the smaller *fratercula* each abdominal segment is plainly edged posteriorly with orange; the head is small and the eyes less prominent. Both species are black beneath, more so than the larger *schaefferi;* or than in *annulata.* In having the pronotum bordered with orange (narrowly on the anterior margin) and the tergum black, this species somewhat resembles *Okanagana bella,* but the anal membranes of all of the wings are vermilion in *bella* and orange in *luteobasalis.*

Head not quite as broad as the front margin of the pronotum; front considerably produced, sulcus of front narrow, wider below. Pronotum with the humeral angles rounded; sides sinuate toward the anterior angles which are prominent. Opercula oblique with the ends turned inward. Last ventral segment with the base about as long as the sides that gradually converge to the extremity which is not quite as rounded as in *fratercula.* The notch in the last ventral segment of the allotype is single. Uncus as figured. Wings transparent with veins of fore wings generally fuscous; those of hind wings paler. Costa of the fore wings yellowish, darker beyond the radial area. All of the wings fuscous and orange at base; the anal membranes orange and the basal area clouded or black.



OKANAGANA LUTEOBASALIS

Head above black with an orange spot above each antenna. In the allotype and some of the paratypes there is an orange spot on the front. Pronotum black narrowly bordered with orange on the front margin and more broadly on the hind margin and sides. In some of the paratypes the anterior portion of the median groove is pale. Mesonotum black with hind margin irregularly bordered with orange; the elevated × orange-black centrally, and with a black band across each anterior ridge followed by orange. Two small orange spots beyond. The dorsal orange spots taken together are arranged in a semicircle. An orange spot near the base of each of the wings, both in the fore and hind pair. Metanotum with hind margin orange. Tergum shining black; segments narrowly margined with orange posteriorly at the sides only; uncus black, rarely with a dorsal pale line in some of the lighter colored paratypes. Beneath nearly as black as in *fratercula.* Head black beneath, orange on sides of median sulcus and about each antenna; rostrum black, orange at base. Fore femora black with orange on sides and at tips; middle and hind femora black, orange beneath and at tips; segments of the abdomen black both centrally and at the sides, margined with orange posteriorly; valve black orange along the upper margins.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	24	24
Width of head across eyes	6.5	6.5
Expanse of fore wings	58	58
Greatest width of fore wing	10	10
Length of valve	5	

In addition to the type and allotype the following specimens of *luteobasalis* have been examined.

Utah.—Nephi, June 25, 1912; Callao, Juab Co., June, 1922 (Tom Spalding); Ft. Duchesne, July 7, 1932 (Lowell Cutler); 5 males, 1 female Parowan, July 24–25, 1921 (Knaus, Nininger and Hoover); male and 2 females Red Canyon (near Brice Canyon) June 9, 1924 (Dr. John W. Sugden) and 16 males and 7 females from near Hatch June 5, 1931 (Dr. John W. Sugden).

Idaho.—Male, Pocatello, May 25, 1889; 5 males 6 females, Rogerson May 20, 1926, on sagebrush (R. W. Haegele).

North Dakota.—Male, Marmarth, July 4, 1918 (O. A. Stevens).

Montana.—Male, Enid, July 12, 1912.

Oregon.—Five males, 2 females, Blitzen River, Harney Co., June 25, 1933 (G. P. Engelhardt); male and female, Coleman Lake, S. Oregon, June 24, 1933 (G. P. Engelhardt); male, Burns, June 1, 1915.

Alberta.—Male and female, Medicine Hat, June 29, 1923 (F. S. Carr), and male and female without date. Five males, Cypress Hills, (F. S. Carr).

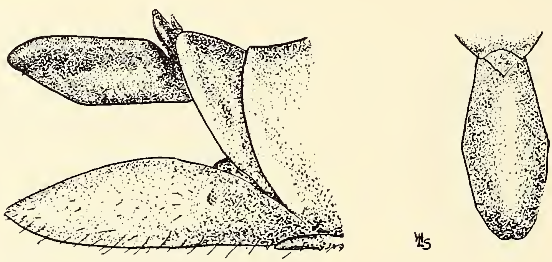
Okanagana annulata new species (Plate XXV, Fig. 3)

Type male, Promontory, Box Elder Co., Utah, June 27, 1920.

Allotype female, Hardup, Tooele Co., Utah, June 17, 1931 (G. F. Knowlton and M. J. Jones).

Larger than *Okanagana fratercula,* and lighter colored both above and below, with the posterior margin of each abdominal segment rather conspicuously orange. The body is not as elongate as in *luteobasalis,* it being a more robust species. In having the abdomen humped at segments seven and eight, especially in the female, this species resembles the larger and more brilliantly colored *Okanagana gibbera.*

Head not quite as broad as the front margin of the pronotum; front moderately produced, but not as much so as in *luteobasalis;* front sulcus narrow; eyes not as prominent as in *luteobasalis.* Pronotum with the humeral angles rounded; sides sinuate toward the anterior angles which are prominent. Opercula oblique with the rounded extremities turned inward. Last ventral segment with the base about as long as the sides which gradually converge to the broadly rounded extremity which is sometimes slightly truncate. Uncus as figured. Wings transparent with the veins of the anterior pair pale in the basal half and dark about the marginal areas. Costa of the fore wings yellowish, darker beyond the radial area. All of the wings fuscous and orange at base; the basal area clouded and the anal membranes orange.



OKANAGANA ANNULATA

Head above black, with an orange spot above each antenna, and a narrow orange colored line in front of the celli. Front black in the types and in all of the paratypes. Pronotum black, narrowly bordered with orange on the front margin and more broadly on the hind margin and sides. Anterior portion of the median groove is pale. Mesontum black the hind margin irregularly bordered with orange; the elevated × orange, black centrally, and with a black band across each anterior ridge, followed by orange. Two small orange spots beyond. The dorsal orange spots taken together are arranged in a semicircle. An orange spot near the base of each of the wings, both in the fore and hind pair. Metanotum with posterior margin orange. Tergum shining black; segments plainly margined with orange posteriorly; uncus black. Beneath paler than in *luteobasalis.* Head black; not orange at sides of median sulcus; rostrum black orange at base. All of the femora orange striped with black; segments of the abdomen largely pale centrally; black at base margined posteriorly with orange, less black at sides. Valve pale in type and in all of the paratypes.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	25	22
Width of head across eyes	7	7
Expanse of fore wings	63	63
Greatest width of fore wing	11	11
Length of valve	5	

In addition to the type and allotype the following specimens of **Okanagana annulata** have been examined.

Utah.—Male, Trout Creek, Juab Co., July 14, 1922 and male, same locality, July 14, 1925 (Tom Spalding). Male, Hardup, Tooele Co., June 9, 1930, and male, Cedar Creek, June 9, 1930 (G. F. Knowlton). Male 3 m. w. of Snowville, Boxelder Co., June 24, 1932.

Idaho.—Male, Twin Falls, 3,700 feet, June 6, 1919; and female same locality, June 24, 1932 (E. Turner). Male, Blackfoot, 22 June, 1924. Two males, Shoshone Basin, June 11, 1926 (R. W. Haegele).

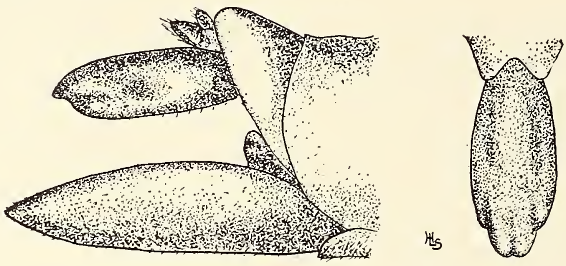
Nevada.—Male, Gardnerville, July 11, 1930 (E. W. Davis).

Okanagana wymorei new species (Plate XXV, Fig. 5)

Type male, Lebec, Kern County, California, June, 1918 (A. C. Davis). Wm. T. Davis collection.

Resembles both *Okanagana oregona* and *Okanagana triangulata* in size and general appearance, but the head is sunk into the pronotum to a greater degree and the eyes are less prominent. The fore wings are proportionally shorter and broader than in *oregona;* and in shape are like those of *triangulata.* As in *oregona* the venation is darker than in *triangulata* and in addition the basal cell of the fore wing is opaque and includes a dark area at its anterior margin; in *oregona* and *triangulata* the basal area is clear or nearly so. Uncus as figured.

Head black with the supra-antennal plates, a spot each side before the front ocellus, and the median groove leading from the ocellus to the hind margin, yellowish. Pronotum black margined all around, but very narrowly in front with yellowish; also the grooves pale. Mesonotum black; two spots each side near the wings; a spot at the forward extremity of each limb of the elevated ×, and the posterior margin pale. Metanotum with the posterior margin narrowly pale. Dorsum of the abdomen black, the segments edged posteriorly with orange. Uncus pale at base, terminal part black. Abdomen pale beneath, including the valve, with the legs striped with black, particularly the femora. Each abdominal segment irregularly blackened along the base, particularly near the sides.



OKANAGANA WYMOREI

MEASUREMENTS IN MILLIMETERS

	Male Type
Length of body	19
Width of head across eyes	5.5
Expanse of fore wings	46
Greatest width of fore wing	8
Length of valve	4

In addition to the type there are two male paratypes in the writer's collection collected at the same place and time.

F. H. Wymore has sent me a number of cicadas from California.

Platypedia

In the JOURNAL, NEW YORK ENTOMOLOGICAL SOCIETY for June, 1920, a table was given for the determination of the then known species of *Platypedia*, and *P. similis* was described from Sonoma County, California. Additional specimens of *similis* were mentioned from San Mateo, Santa Cruz and Santa Clara counties. A single female from Kern County was included, but with the accumulation of specimens this is now transferred to *P. mari-*

posa, which, with *P. scotti,* also here described as new, appear to be more inland species.

In *P. mariposa* and *P. scotti* the fore wings are narrow, about as in *P. aperta* and *P. laticapitata,* but the uncus is not broad as in both of those species, and as figured in this Journal, June, 1920, and March 1921, p. 14.

In *P. areolata* the venation is darker than in *similis,* where only the radial vein and the veins surrounding the marginal areas in the fore wings are dark. This gives *similis* a yellowish appearance when seen in series.

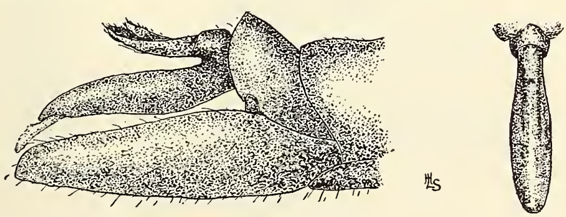
In the narrow winged *P. mariposa* the color of the venation is more as in the much larger *P. areolata.* In *P. scotti* the venation is also darker than in *similis* and the insect has a grey appearance. The six species mentioned above are alike in having the upper part of the fore femora chestnut colored.

Platypedia mariposa new species (Plate XXV, Fig. 6)

Type male and allotype female from Mariposa County, California, June 17, 1914.

Resembles *Platypedia areolata* and *Platypedia similis,* but is generally smaller, and the dorsum of the abdomen is not as humped centrally. It has narrowed wings and the upper line of the terminal portion of the uncus is not as arched. Shape of head as in *areolata* and *similis* but the front more prominent. The frontal sulcus is well defined, and the groove is not interrupted in most of the specimens. The uncus is shaped much as in *similis,* except that it is slimmer and not as arched. The last ventral segment in the male is broadly rounded at the extremity, in the female the notch is V-shaped with the bottom of the V rounded.

Body black with a brassy tinge, and the usual paler marks are yellowish orange as in *areolata* and *similis.* The legs are almost wholly chestnut colored; the membranes at the base of the fore wings are yellowish white, and the dark venation about the marginal areas of the fore wings extends toward the base in many of the veins. The collar or hind margin of the pronotum is pale as in *areolata* and *similis.*



PLATYPEDIA MARIPOSA.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	18	15
Width of head across eyes	5	5
Expanse of fore wings	40	42
Greatest width of fore wing	6.5	7
Length of valve	5	

In the JOURNAL, NEW YORK ENTOMOLOGICAL SOCIETY, June 1920, p. 112, is the statement that "In the writer's collection there are also two males and three females collected in Mariposa Co., June 6 and 17, 1914, that may not be *areolata* as they are very much smaller, expanding from 40 to 46 millimeters." These are the specimens here described, and the female from Kern County has been added as stated above.

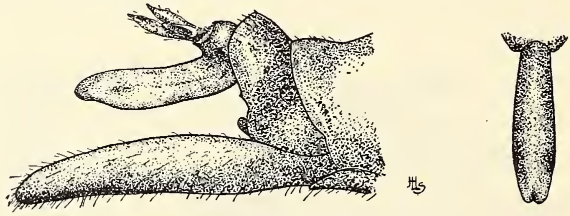
Platypedia scotti new species (Plate XXV, Fig. 7)

Type male and allotype female, Kaweah, Tulare Co., California, May, 1935 (Franklin T. Scott).

This species can easily be separated from known related forms by the shape of the uncus.

Head broad; front about as prominent as in *areolata* and *similis,* but not as hairy. Frontal sulcus owing to less hairs plainer than in either *similis* or *mariposa.* Uncus as figured. Last ventral segment in the male is rounded at the extremity; in the female the notch is V-shaped with the bottom of the V rounded. The valve is slimmer in this species than in either *mariposa* or *similis.*

Body black, with purplish reflections in certain lights. Head black with a pale spot above each antenna. Pronotum black; hind margin or collar and about the anterior two thirds of the median groove pale. Mesonotum



PLATYPEDIA SCOTTI

black with a pale area at the base of each of the fore wings, and in the allotype and some of the paratypes a small bright orange-red spot posterior thereto. Hind margin as well as the posterior half of the × pale. Metanotum black with the hind margin pale. Abdomen, uncus and valve black both above and beneath. The front of the head black; rostrum pale at base. Legs pale striped with black; fore femora chestnut-colored above. Basal membranes of all of the wings yellowish-white and the veins of the fore wings dark, the costal margins yellow.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	17	16
Width of head across eyes	5	5
Expanse of fore wings	38	41
Greatest width of fore wing	7	7
Length of valve	4	

In addition to the type and allotype Mr. Scott has sent to me 3 males and 5 females collected at the same time, and in 1934 he sent a female collected in Sequoia National Park, May 5.

PLATE XXV

Figure 1. *Okanagana venusta* new species. Type.
Figure 2. *Okanagana luteobasalis* new species. Type.
Figure 3. *Okanagana annulata* new species. Type.
Figure 4. *Okanagana fratercula.* Type.
Figure 5. *Okanagana wymorei* new species. Type.
Figure 6. *Platypedia mariposa* new species. Type.
Figure 7. *Platypedia scotti* new species. Type.

CICADIDÆ

FUSCOZETES (*ORIBATOIDEA–ACARINA*) IN THE NORTHEASTERN UNITED STATES

BY ARTHUR PAUL JACOT

The genus Fuscozetes (4, p. 11) belongs to the Achipteriinæ (5, p. 184) because the lamellæ are fused to each other at some point on the median line. It is more primitive than Tectoribates or Joelia because the lamellæ are fused to each other for a short distance only and because they are much more slender towards the distal half, and the lamellar bristles are not so much reduced.

Only two species are found in the northeastern states: the genotype *Oribates fuscipes* (2, fasc. 38/9) and *Oribatella bidentata* (1, p. 8). As neither of them are described or figured with enough detail to be at all recognizable, this is done below, placing the more primitive species (with its less developed lamellæ) first.

Fuscozetes bidentatus *comb. nov.*

Figures 3–5, 7–11

Diagnostic characters: Notogastral bristles twenty (there are twenty-four in *F. setosus* (2, fasc. 30/19); distal end of lamellæ slender, untoothed (as in *F. setosus*); distal cusp of tectopedia I so short as not to extend over insertion of rostral bristles (figure 7); pseudostigmatic organs shorter than free portion of lamellæ (compare figures 6 and 7); ventrodistal bristle of femora II proximad of center of length of flange (compare figures 5 and 1).

Description: Shape in dorsoventral view bluntly oval, with distinct, triangular cephaloprothorax, in lateral view ovate, with free, projecting lamellæ, size averaging 0.54 by 0.3 mm. and 0.77 mm. high; color tan (thus being lighter in color and smaller in size than the next); cephaloprothorax (in dorsal aspect) visible as a short, broad triangle between bases of lamellæ, and as a narrow band between them; rostrum broad, somewhat distinct in lateral aspect; lamellæ broad at base, joined on median plane by a distinct but short bridge which is also attached to the cephaloprothorax along posterior edge; distal half of lamellæ tapering to a blunt apex, the whole making the cephaloprothorax appear covered by a bidentate roof; tectopedia I curved near middle so as to extend beyond edge of cephaloprothorax (figure 8), the free cusp short, the ventral brace weakly developed (figure 7); rostral bristles inserted at base of rostrum, ciliate along lateral edge, not strongly arched (figures 7 and 8); lamellar bristles nearly as long as rostral, barbed; interlamellar bristles quite long (figure 7), burred; inserted close to edge of notogaster and to lamellæ; pseudostigmata projecting conspicuously beyond notogaster, edges rounded, median edge the longer; pseudostigmatic organs (figures 7 and 9) erect, with a few barbs, somewhat blunt; exopseudostigmatic bristles quite long, dorsally curved (figure 7); tectopedia II large, trough-like, almost completely covering the femora, lower edge incised (figure 8); lower edge of camerostome with a spur-like spine running forward from near insertion of legs I (figure 7).

Notogaster with surface appearing smooth; bristles and porose areas as in figures 7 and 8; bristles not fine, rather abruptly tapered, burred along distal half, medium long; porose areas not large, one third to one fourth distance between bristles; a porose area between each bristle pair, thus: a3, b2 p.a. b3, c2 p.a. c3, d2 p.a. d3, e2 p.a. e3, a3 is actually on the ptermorphæ (figure 7).

Ventral plate produced anteriorly as a slight shoulder about side of camerostome, and anterolaterad as tectopedia II, bristle of tectopedia II inserted opposite insertion of legs I, curving ventrad, burred; tectopedia III mammiform; tectopedia IV long, slender, a bristle springs from dorsad of the ridge between these two tectopedia (dotted in figure 7); apodemata I straight, with ental prolongation directed posteriad; apodemata III straight, directed anteriad of genital aperture; apodemata IV sigmoid; bristle of parasterna I about midway between anterior edge of ventral plate and apodemata I; the three pairs of sternal bristles present, posterior pair quite approximate, middle pair most remote; other parasternal bristles normal (figure 8); genital aperture with strongly arched anterior edge, strongly converging sides and undulate posterior edge; cover bristles 4 nearer posterior than median edge, bristles 3 more remote, halfway between lateral and median edges, close to bristles 4, bristles 2 distant from bristles 3, about as approximate; bristles 1 more remote than bristles 2; marginal bristles inconstant in position, the mesal tending to move away from edge; genitothoracic suture distinct, extending posterolaterad towards insertion of legs IV; paramesal bristles more remote than diameter of genital aperture, distant from aperture as smallest diameter of a genital cover; anal aperture with anterior edge very narrow, sides strongly converging, posterior edge rounded, the angle unusually anteriad; pseudofissuræ long, curved, slender, slightly anterior to middle of sides, paranal bristles as near anterior corner as to end of pseudofissuræ; postanal bristles distant from aperture, fairly long, inserted in pairs, the lateral pair more approximate than greatest diameter of aperture; anterior cover bristles close to lateral edge and slightly further from anterior edge, posterior pair slightly more remote than anterior pair, close to posterior edge of covers.

Labium short, with anterior cusp to fit about palps (figure 8).

Legs with triheterohamate ungues, the lateral hooks very slender. Legs I (figure 4) with tarsi short, the bristles as in figure 1, thus showing a concentration on dorsodistal half, where the bristles are reduced to three, and another concentration on dorsoproximal half where the bristles are also reduced to three, one of them quite long; ventral face bristles fairly smooth, the second moderately barbed. A mesal face bristle, corresponding to proximolateral not figured. Tibiæ with very long major bristle inserted close to distal edge of segment, premajor on very rim of segment; lateral bristle somewhat spinelike; the ventral bristles also somewhat spinelike, shorter, burred, ventromesal (not figured) short, barbed. Genuals as figured, the lateral bristle spine-like, shorter than the tibial, the long dorsal somewhat laterally inserted and curving laterad. Femora oval, with very slight keel or flange on ventral edge, two bristles on dorsal edge, a dorsolateral near dorsodistal, two on ventral edge, the distal one more proximally inserted than the dorsodistal.

Legs II (figure 5) similar but tarsi with more dorsal face bristles, second bristle of ventral face with three strong pectiniform spurs. Tibiæ with shorter major bristles; no premajor. Genuals similar but shorter; dorsal face bristle not long; ventral face bristle long and fine. Femora with large flange which has a small tooth not far below genual (figure 5), dorsodistal bristle burred; ventroproximal bristle inserted almost on pedicel; ventrodistal bristle inserted proximad of center of segment. One specimen from Maine has another bristle distad of this ventrodistal.

Legs IV (figure 3) quite slender; tarsi with ventral face bristles smooth; tibiæ with ventrodistal bristle inserted on extreme distal edge, somewhat spinelike; lateral bristle shorter. Genuals well developed, as long as genuals I; the bristles fine. Femora broadly oval, dorsodistal edge straight, diagonal, flange long, equally broad throughout; bristles fine. Trochanter as in figure 3, the flange extending well back of body of segment; there is a small, very fine bristle on distal corner of flange.

Legs III (figure 10) quite similar but tarsal bristles more numerous; tibiæ with bristles inserted nearer distal edge of segment; major bristle somewhat shorter, inserted on distal edge. Genuals short, the bristles longer. Femora with narrower flange; the bristles much longer, the dorso-lateral well developed. Trochanters with much narrower flange, and a well developed bristle on each side.

Material examined: Cliff Id., Casco Bay., Me.: 39 specimens from epigeous moss, evergreen woods; taken August 15, 1919 by Lydia Jacot, slide 1933o1. Twenty-two specimens from spruce needles; taken August 8, 1920,* slide 2023o1. Three specimens from sphagnum moss, cranberry bog; taken September 17, 1925, slides 2543o1, 2544o1.

Upland swamp, East Village, Monroe, Conn.: Ten specimens from epigeous, prostrate, mat-like moss with foliose lichens; taken March 23, 1919, slide 1914o1. Seventeen specimens from epigeous, open cushion moss; taken May 31, 1919, slide 1931o5. One specimen from short moss on rock, May 30th 1920, slide 2014o1. Seven specimens from club moss under snow; taken February 18, 1922, slide 22ao1. Thirteen specimens from sphagnum clump; taken August 18, 1925, slides 2520n2, 2521.2, 2522o1. Two specimens from stump moss; August 24, 1925, slide 2530o1. Seven specimens from grey-green cushion moss on boulder; taken August 25, 1925, slide 2531o1.

* When no collector is mentioned it is understood to be me.

Hemlock gorge, Sandy Hook, Conn.: Nine specimens from hemlock leaf mould; taken June 24, 1926, slide 2613o1. Four specimens from moss on old log; taken June 25, 1926, slides 2614o2 and 2614o3.

Sea Cliff, Long Island, N. Y.: Six specimens; slides 26B10 (Cotypes) and 26B107e.

Dolson (Clarksville), Ill.: Three specimens from moss, near Big Creek; taken January 5, 1933, by Frison and Ross, slide 33IS1/5♯34–6b.

Habitat: This species is therefore common in epigeous moss, rare on such elevated moss as found on stumps and boulders. Also in spruce, and hemlock leaf mould of moist microclimates.

Forty-five specimens from moss from New Found Gap, Tenn.; taken September 1, 1930 by Nathan Banks are *F. bidentatus* but have the femora II of *F. fuscipes*. The lamellæ tend to be broader at the apex than in typical *F. bidentatus*.

Fuscozetes bidentatus floridæ *subsp. nov.*

Lamellæ slightly broader, the sinus almost closed at proximal end, the distal end emarginate; lamellar bristles about as long as length of sinus; tectopedia I much as in *F. fuscipes;* flange of femora II as in *F. bidentatus* but bristle inserted distad of center of segment.

One specimen from dead leaves of Holly-Bay-Hop, dense hammock (Sugar-foot), Gainesville, Florida; taken September 16, 1929 by J. R. Watson. One specimen from moss on clay bank, Hog Twin Creek, southwest of Gainesville, Fla.; taken June 23, 1929 by J. R. Watson, slide 29W6/23–3. One specimen from fallen longleaf pine needles, south shore of Newman's Lake, near Gainesville; taken March 25, 1928 by E. F. Grossmann, slide G55–1. One specimen from fallen oak leaves, upper edge of Devil's Mill Hopper, Gainesville; taken April 24, 1928 by Grossman, slide G76–1. All cotypes.

Fuscozetes fuscipes (2, fasc. 38/9)

Figures 1, 2, 6

DIAGNOSTIC CHARACTERS: Notogastral bristles twenty; distal end of lamellæ truncate, each corner produced as a slender tooth, making the end of the lamellæ appear dog-eared; distal cusp of tectopedia I so long as to extend well beyond insertion of rostral bristles (figure 6); pseudostigmatic organs longer than free portion of lamellæ; ventrodistal bristle of femora II distad of center of length of flange.

DESCRIPTION: Differing from preceding species in the following characters: Size larger, averaging 0.7 by 0.44 mm.; color deeper, more reddish; free half of lamellæ tends to be divergent (not parallel); cephaloprothoracic bristles burred; rostrum produced as a blunt keel (figure 2); buttress of tectopedia I well developed (figure 6); rostral bristles inserted more posteriad than incision on camerostone edge; pseudostigmatic organs more pointed; porose areas larger; notogastral bristles stouter, not longer; porose area of bristles d2 and d3 anterior to d2; apodemata stouter, with swollen, anteriorly bent mesal ends; mesal marginal bristle of genital cover often crowded posteromesad to lacking (giving an indication of method of loss of these bristles); anal aperture broader anteriorly with sides more parallel; anal cover bristles more distant from edges; inner edge of anal aperture broadly underlying covers anterolaterally. In one specimen I find two paranal bristles on one side only and no lateral postanal,—another example of a regressional mutation, recapitulating the path of migration of this bristle.

Legs (from American individuals) quite similar but mesal bristle of genuals I quite long. In one specimen femur I has three bristles along ventral edge. Legs II (figure 1) with second ventral bristle of tarsus four to five pectinate (major bristle foreshortened in figure); femoral keel drawn out to a prominently projecting cusp, the ventro-distal bristle not far from distal end of body of segment; ventroproximal bristle more distad than in *F. bidentatus*.

Armature of legs III, and IV more developed; major bristle of tibiæ longer; spine of tibiæ long and stout, prominent; ventral bristle of femora III inserted near center of segment, quite long.

MATERIAL EXAMINED: Ottawa, Canada (Harrington), two specimens, slide 26B114a.

Cliff Id., Casco Bay, Me.: Three specimens from sphagnum moss, cranberry bog; taken September 17, 1925, slide 2544o1.

East Village, Monroe, Conn.: from *Carex stricta* clump of upland swamp: drooping leaves, on south side, seventeen specimens, August 5, 1925, slides 2511o1 and o3; dead, drooping leaves on east side, eight specimens, August 10, 1925, slide 2514n2; another clump, drooping leaves, twelve specimens, August 15, 1925, slide 2517o1; sides of root mass, ten specimens, August 7, 1925, slides 2512o1, 2513o2. From *C. stricta* clump of marsh: drooping leaves, one specimen, August 28, 1925, slide 2532o1; root mass, three specimens, September 5, 1925, slide 2537o1a and b. Upland swamp, sphagnum clump, seventeen specimens, August 18, 1925, slides 2520h, 2520n2b, 2521o2, 2522o1.

Ithaca, N. Y. and vicinity: Sixteen specimens from under stones, boards, and/or bark of twigs, Six Mile Creek; taken April 14, 1927, slides 176o4 and 176o5. One specimen from Buttermilk Creek; taken May 21, by Nathan Banks, slide 26B81e. One specimen from under bark of logs or twigs or lower face of stone, Michigan Hollow, Danby, April 8, 1917, slide 175o1. Two specimens from marsh, Freeville, taken May 20, by N. Banks, slide 26B75c.

Habitat: From the above it is evident that this species prefers a more moist substratum than the smaller species, and, judging from the difference in numbers between those of the open marsh and of the swamp, shade.

I also have one hundred and two specimens from moss from sides of ditch draining Pürkelgut meadows, barely a mile southeast of Regensburg, Bavaria, slides 3115o2, 3115o3, 3115n4, 3117o2.

On slide 3115o2 I find a well eaten out specimen without labium and mouth parts, containing three well grown larvae. On slide 2514n2 is another individual with four well grown larvae with erect pseudostigmatic organs.

Koch describes *O. fuscipes* accurately and in detail, the bent, erect pseudostigmata are characteristic. The description of the lamellæ and tectopedia is good. Pteromorphae merging into posterior curve of abdomen is truer of Fuscozetes than of Trichoribates. As to the reidentity of *O. setosus* (2, fasc. 30/19), Koch says that the notogaster bristles of *O. fuscipes* are somewhat blunt, those of *O. setosus* are long (Latin) linearly arranged (German). The extra four bristles near the median line would help to give this effect. Further the lamellæ of *O. fuscipes* are described as tapering to the bristle, those of *O. setosus* as thick. All these things considered I am perfectly satisfied that these two species are correctly reidentified as per Willmann (6, p. 168).

Zetes morticinus of Koch (2, fasc. 31/14) is more like Michael's plate 7, figure 2 than what Michael suggests (3, p. 241).

LITERATURE CITED

1. BANKS, NATHAN, 1895 (Jan.), On the Oribatoidea of the United States, Trans. Am. Ent. Soc., vol. 22, pp. 1–16.
2. KOCH, CARL LUDWIG, 1835–49, Deutschlands Crustaceen, Myriapoden und Arachniden, Regensburg.
3. MICHAEL, ALBERT DAVIDSON, 1884, British Oribatidæ, vol. 1, pp. XI + 336, pls. 24 + A–G.
4. SELLNICK, MAX, 1929, Hornmilben, Oribatei, in: Tierwelt Mitteleuropas, vol. 3, lief. 3, sect. 9, 42 pp., 91 figs.
5. THOR, SIG, 1929 (May), Ueber die Phylogenie und Systematik der *Acarina*, mit beiträgen zur ersten Entwicklungsgeschichte einzelner Gruppen, Nyt Mag. f. Naturv., vol. 67 (1928), pp. 145–210, 10 tables.
6. WILLMANN, CARL, 1931, Spinnentiere oder Arachnoidea V: Moosmilben oder Oribatiden (Oribatei), in: Dahl, Die Tierwelt Deutschlands, pp. 79–200, 364 txt. figs.

PLATE XXVI

Fuscozetes fuscipes (Koch), adult

Figure 1. Legs II; ratio x150.

Figure 2. Dorso/ventral aspects; legs and mouth parts omitted; ratio x120.

Figure 6. Cephaloprothorax, lateral aspect, legs I and mouth parts omitted; ratio x120.

Fuscozetes bidentatus (Banks), adult

Figure 3. Legs IV; ratio x150.

Figure 4. Legs I (femur omitted); ratio x150.

Figure 5. Legs II; ratio x200.

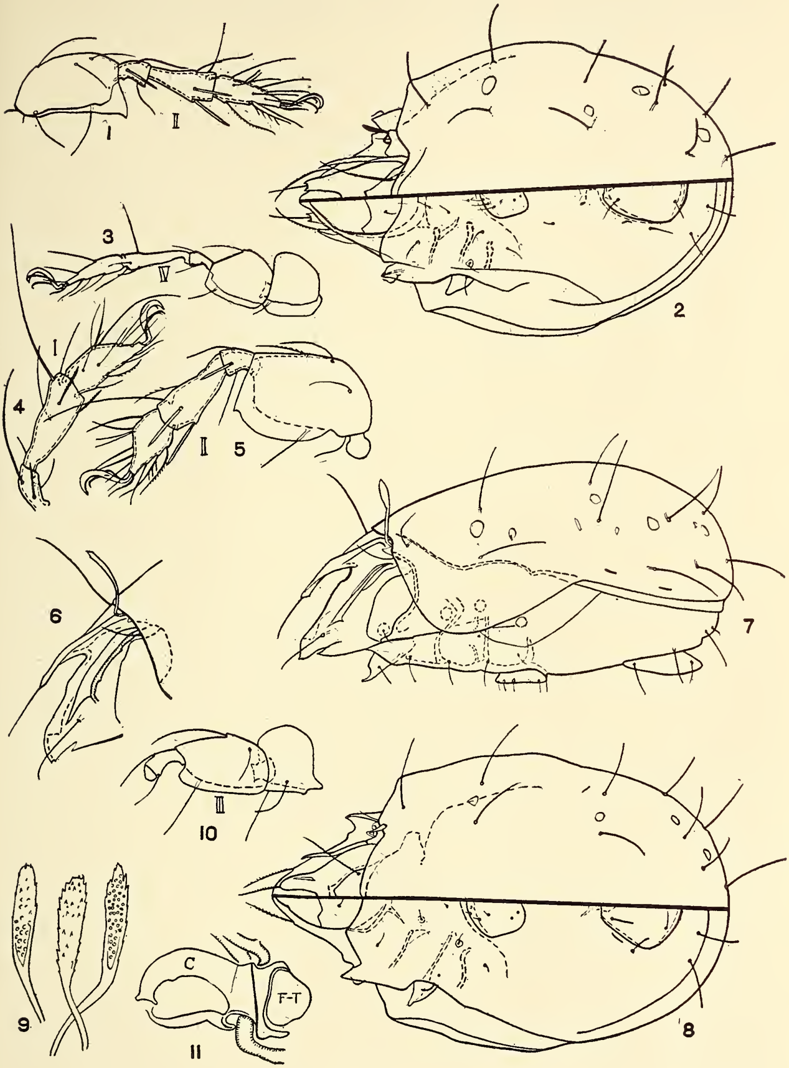
Figure 7. Lateral aspect, legs and mouth parts omitted; ratio x120.

Figure 8. Dorso/ventral aspects, legs and mouth parts omitted; ratio x120.

Figure 9. Pseudostigmatic organs; ratio x440.

Figure 10. Trochanter, femur and genual III, ratio x200.

Figure 11. Coxæ I, with articulations of its trochanter with femoral trochanter, and body wall (shaded lines); ratio x440.



FUSCOZETES

ANTS OF THE GENUS ACROPYGA ROGER, WITH DESCRIPTION OF A NEW SPECIES

BY WILLIAM MORTON WHEELER

Within recent years Acropyga, which seemed to be a rather insignificant genus of tropical Formicine ants, has been acquiring a reputation as a serious though indirect pest in certain South American countries. The receipt of an undescribed species of this genus together with its very interesting symbiotic coccids from Mr. E. J. H. Berwick of the Imperial College of Tropical Agriculture in Trinidad, B. W. I., has led me therefore to review briefly some of the published accounts of these insects.

Emery, in the "Genera Insectorum" (1925), has divided the genus Acropyga into four subgenera: Acropyga *s. str.* (5 species), Rhizomyrma Forel (18 species), Atopodon Forel (5 species) and Malacomyrma Emery, with a single species. Acropyga and Atopodon are confined to the Indomalayan and Papuo-Australian regions. Rhizomyrma has a similar distribution in the Old World but is also represented and by an even greater number of species in Middle and South America and in the Antilles. The single species of Malacomyrma (*M. silvestrii* Emery) is known only from Eritrea. At first sight the workers of all four subgenera closely resemble those of our North American species of Lasius of the subgenus Acanthomyops Mayr in their small size, smooth, yellow integument and small or vestigial eyes, but closer examination shows that they are peculiar in having a reduced and variable number of antennal joints in all three castes. Moreover, like the species of Acanthomyops, all the Acropygae are exquisitely hypogaeic, or subterranean ants devoted to fostering and disseminating root-coccids. Since the ants and their cherished coccids may be locally very numerous, especially in plantations, it is easy to see how certain economic plants may suffer serious injury through loss of sap or more indirectly, as will be shown in the sequel, by infection with pathogenic organisms transmitted by the coccids, after they have been transported to healthy plants by their hosts. The following accounts, with one exception, refer to species of Rhizomyrma and their coccids.

Professor E. A. Goeldi, in 1892, while studying extensive injury to coffee in the state of Rio de Janeiro, Brazil, observed that the roots of the plants were infested with coccids, which he referred to the genus Dactylopius but which in all probability belonged to the species since called *Rhizoecus coffeae* by Laing, and that these insects were attended by small yellow ants. The latter were identified by Mayr as *Acropyga decedens* Mayr (described in 1887 as *Brachymyrmex decedens*) but were recognized by Forel in 1893 as a different species and named *Rhizomyrma goeldii.*

More recently, Rev. D. Pickel (1927) and Da Costa Lima (1928) have investigated similar and wide-spread injury to coffee plants in the states of Parahyba and Pernambuco, Brazil, and have attributed it to the same coccids and accompanying ants. These, however, were found by Rev. T. Borgmeier (1927) to differ specifically from *R. goeldii* and were therefore described as *R. pickeli.*[1]

Much additional light has been cast on the activities of Rhizomyrma and its coccids by Dr. G. H. Bünzli's investigations of 1932. I am unable to find that these have been published and therefore quote two paragraphs from his letters of March 12th and July 2nd of that year. In the former he writes: "During the past year I have been actively investigating anew the sieve-tube disease of coffee in collaboration with Prof. Stahel, director of the Agricultural Experiment Station at Paramaribo and have been assigned to the field work and study of practical control measures. After Prof. Stahel had demonstrated the presence of a flagellate (*Phytomonas leptovasorum*) in coffee plants and was able to ob-

[1]Da Costa Lima (1931) claims that "*decedens, goeldii* and *pickeli* are perfectly similar forms of the very same species, *Acropyga* (*Rhizomyrma*) *decedens* (Mayr 1887)," but Emery's figure (1905) of *decedens* shows important differences from all the other known species of Rhizomyrma in the shape of the head and mandibles, and all of Emery's published drawings are remarkably accurate. Furthermore, cotypes of *goeldii* in my collection and cotype specimens of *pickeli* received from Father Borgmeier show that the two species are distinct. The fact that all three ants cultivate the same species of coccid on the roots of the same plant does not, of course, imply that they are cospecific. In Surinam Bünzli has found that another very different subterranean ant, *Tranopelta gilva* Mayr, cultivates the same coccid on the roots of coffee plants.

tain, by means of root-grafting, proof of its hitherto overlooked infectivity, it seemed very probable that the disease was carried by root-infesting Hemiptera. Because Dr. H. Rheijne had begun entomological investigations of this problem in Surinam as early as the year 1895 I took up the work anew and am at present engaged with the coccids *Rhizoecus coffeae, Geococcus radicum* and *Orthesiopoda rheijnei.* Since *R. coffeae,* as Van Dijk here and Pickel, Da Costa Lima and Borgmeier in Brazil have already shown, lives in symbiosis with ants [erroneously regarded as *Acropyga pickeli,* but since described as *A. paramaribensis* by Borgmeier], the injury, even if it should prove not to be transmitted by the coccid, is due in great measure to this symbiosis, as control experiments in Brazil have shown during 1927 and 1928. I have devoted some attention to the ants occurring in coccid-infested coffee-plantations and send you a small collection with a request for identification." In the second letter Bünzli writes as follows: "In the meantime I have succeeded in demonstrating that the females of the Acropyga during their nuptial flight disseminated the coccids in great numbers and thus cause the infectious phloëmnecrosis on which Prof. Stahel has been working since 1917 (he discovered the infective agent, Phytomonas, in 1930). The epidemic occurrence of the disease is thus completely explained, and I shall be glad to inform you of my results on the practical control measures as soon as possible. The same sieve-tube disease seems to have broken out in Brazil (Pernambuco) and has been traced to *Rhizoecus coffeae* and *Acropyga pickeli,* although its true cause was not known. Rhizococcus is the vector of the infection!"

The material received from Dr. Bünzli comprised besides the Rhizomyrma and its coccids several mites and Clavigerid and Staphylinid beetles that live in their labyrinthine nests about the coffee roots and a series of ants that prey on the Rhizomyrma and its wards. These enemies belong to the following species: *Paratrechina longicornis* Latr., *Pheidole fallax jelskii* Mayr, *Pheidole subarmata* Mayr, *Solenopsis* (*Diplorhoptrum*) *hermione* Wheeler and *S.* (*D.*) *minutissima* Emery. There were also numerous workers of *Tranopelta gilva* Mayr which were attending Rhizoecus and two species of small fungus-growing ants of the genera Trachymyrmex and Myrmicocrypta (*T. relictus* Borgmeier and *M. buenzlii* Borgmeier) which were common in areas infested by *R. paramaribensis* and its coccids.

According to Crawley (1921), the workers from which he described *Rhizomyrma marshalli,* a species characterized by its very short, broad head and partially subdivided second funicular joint, were taken in Barbados by J. R. Bovell "in soil round a sugar-cane-root." It is probable, therefore, that this ant also cultivates coccids on the roots of an important food-plant and under certain circumstances might acquire some economic importance. Santschi (1929) mentions that his *R. bruchi* from the Argentine is "coccidophile."

The habits of the Old World Acropygas are very similar to those of the Neotropical region but, with the exception of the new species described below, the associated coccids seem to be very different. In 1924 Silvestri described a singular coccid, *Xenococcus annandalei,* taken by Dr. N. Annandale on the roots of *Ficus obtusa* in the nests of *Acropyga acutiventris* Roger on Barkuda Island, in Chilka Lake, Madras District, India. He cites the following remarks of Annandale, which are interesting in connection with the above quoted observations of Bünzli: "Xenococcus is invariably found in the nests of the little yellow ant *Acropyga acutiventris* on the rootlets of various trees of the genus Ficus. In cold and dry weather both ants and coccids retire deep into the ground, but so long as the soil is damp and warm they remain under stones just below the surface. The workers of the ants are entirely subterranean in habit and the males and females apparently stay for some time in the nest after hatching from their cocoons before leaving to form new colonies. If the nest is disturbed the females as well as the workers carry off the coccids. When they leave the nest each female carries in her jaws a female of the coccid as a kind of dowry. This accounts for the universal distribution of the coccid in the nests of the ant, in which a very peculiar, blind, small, colorless Isopod is also usually to be found."

A few years later, Silvestri (1926) described an even more aberrant coccid, allied to Xenococcus but very different in the shape of the body, in having small biarticulate instead of large quadriarticulate antennæ and in lacking urosternal glands, as *Eumyrmococcus smithi,* which he found on two occasions in nests of *Rhizomyrma sauteri* Forel near Macao and Taipò Market, China. The subterranean galleries were under stones or in humus surrounding the roots of an unidentified plant. Subsequently he collected the same coccid with the same ant at Ziccavei, near Shanghai, and observed the disturbed workers carrying away some of the coccids while others remained attached to the plant-roots by means of their beaks.

Now unusual interest attaches to the species of Acropyga (Rhizomyrma) received from Mr. Berwick, because its associated coccids must belong either to Silvestri's genus Eumyrmococcus or to some very closely allied genus. In either case the occurrence in tropical America of a very aberrant coccid so closely related to a Chinese species and living in trophobiosis with a closely related species of Rhizomyrma is zoogeographically important. Some of the coccids have been sent to Dr. Harold Morrison for more precise identification.[1] The ant, of which I have received only worker specimens, is here described and figured.

Acropyga (Rhizomyrma) berwicki sp. nov.

(Fig. 1)

Worker. Length: 1.5–1.8 mm.

Integument thin and collapsable. Head as long as broad, with nearly straight, parallel sides, broadly rounded posterior corners and feebly convex posterior border. Eyes minute but deeply pigmented, consisting of 6 or 7 unequal, indistinct ommatidia, situated at the anterior sixth of the sides of the head. Mandibles narrow, curved, with very oblique apical borders bearing four subequal, acute teeth, the basal tooth separated from the other three by a distinct diastema and in some specimens stouter and less obliquely

[1] After examining the specimens Dr. Morrison reported as follows: "The species is extremely interesting and shows definite affinities with *Eumyrmococcus smithi* Silvestri. From the specimens submitted, we are not able to obtain positive evidence that any adults of the species are included in the lot. So little is known of the different stages of these specialized Coccids that it is within the limits of possibility that these specimens represent immature stages of Silvestri's species. On the other hand, if they are actually adult females then they differ from the Silvestri genus and species to such an extent that, on the basis of our present standards in the Coccidae, a new genus would have to be erected for the reception of this Trinidad species."

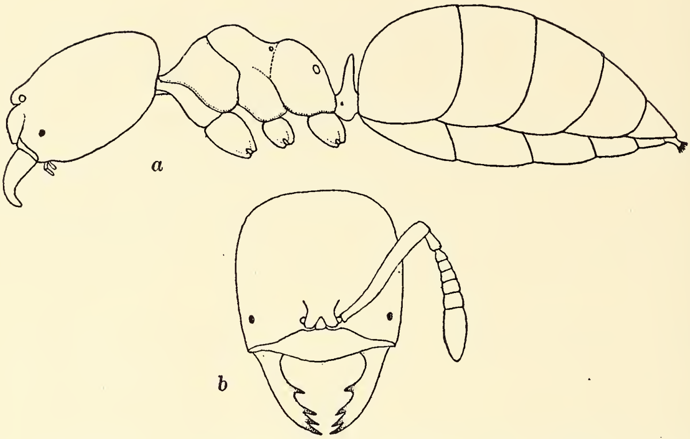


FIG. 1. *Acropyga* (*Rhizomyrma*) *berwicki* sp. nov. Worker; *a*, lateral view; *b*, head, dorsal view.

inserted. Clypeus rather short, convex in the middle, with broadly rounded anterior border. Frontal carinæ small, rounded; frontal area distinct, impressed, subtriangular; frontal groove obsolete. Antennæ 8-jointed; scapes not reaching the posterior border of the head by fully one-fifth of their length; first funicular joint as long as the two succeeding joints together; second joint slightly longer than broad, narrowed at the base; 3–6 distinctly broader than long, increasing gradually in size distally to the terminal joint which is swollen and somewhat longer than the three preceding together. Thorax very short, less than twice as long as broad, widest through the pronotum which is twice as broad as long, in profile rising posteriorly to the mesonotum which is small but convex, sloping posteriorly to the distinct but short mesoëpinotal constriction; epinotum broader than long, broader behind than in front, in profile nearly as high as the mesonotum, with anteriorly rather abruptly convex base passing gradually into the longer, flattened, sloping declivity. Petiole short, convex ventrally, its scale erect, rather small and thin, though thicker at the base than at the superior border, which is blunt, broadly rounded and much lower than the base of the epinotum. Gaster large and convex anteriorly as in the other species of the genus. Fore tarsi slightly dilated.

Shining; mandibles smooth, with a few scattered, piligerous punctures; remainder of body very finely reticulate, or superficially shagreened.

Pilosity and pubescence yellowish, short, erect or suberect, the former dense and abundant, especially on the head, merging with the pilosity which is much sparser and longest on the pro- and mesonotum and tip of gaster.

Pale yellow throughout, except the mandibular teeth which are deep red or dark brown.

Described from 22 specimens taken at San Raphael, Trinidad, by Professor Berwick, who found them in cultivated, cocoa soil. He states that the number of coccids in the nests seemed to be correlated with the number of ants present and that both insects seemed to reach their maximum concentration at depths of 3–5 inches from the surface.

R. berwicki is most closely related to *fuhrmanni* Forel of Colombia, but this species has the head more rectangular, distinctly longer than broad and broader in front than behind, with slightly emarginate posterior border, the antennal scapes are longer and the 4-toothed mandibles are widened at the basal tooth, which is not the case in *berwicki*.[1]

Most genera of ants, like most Aculeates, have 12 antennal joints in the female and workers and 13 in the male, but Rhizomyrma shows a peculiar reduction and in some species also considerable inconstancy in these numbers. The following is a list of the 12 Neotropical species of which the workers are known, with date of publication, habitat, body-length and number of antennal joints.

R. marshalli Crawley (1921), Barbados. 2 mm.; 10–11.
R. pickeli Borgmeier (1927), Brazil, Surinam. 2–2.2 mm.; 10–11.
R. decedens Mayr (1887), Brazil. 2–2.5 mm.; 9–11.
R. goeldii Forel (1893), Brazil. 2–2.3 mm.; 9–11.
R. parvidens Wheeler and Mann (1914), Haiti. 1.8–2 mm.; 10.
R. bruchi Santschi (1929), Argentina. 2 mm.; 9.
R. pachycera Emery (1905), Brazil. 2.2 mm.; 9.
R. wheeleri Mann (1922), Honduras. 1.5 mm.; 9.
R. exsanguis Wheeler (1909), Mexico. 1.4–1.6 mm.; 8–9.
R. fuhrmanni Forel (1913), Colombia. 1.7–1.9 mm.; 8.
R. berwicki sp. nov. Trinidad. 1.5–1.8 mm.; 8.
R. paramaribensis Borgmeier, Surinam. 1.8 mm.; 7–8.

The following numbers of antennal joints have been recorded for the known females of

[1] There are several species of Acropyga in Trinidad. Dr. Neal A. Weber has recently sent me at least three other undescribed species of the subgenus which he has taken on the island.

R. pickeli. 2.8 mm.; 11.
R. decedens. 3–3.3 mm.; 10.
R. pachycera. 3.7 mm.; 9.
R. wheeleri. 2 mm.; 9.
R. fuhrmanni. 2.5–2.7 mm.; 8.
R. paramaribensis. 2.5 mm.; 8.
R. smithi. 2–2.2 mm.; 7.

R. smithi Forel (1893) from St. Vincent, B. W. I., is known only from the female, which is peculiar on account of its small size and 7-jointed antennæ. Forel surmised that its worker must be "d'une exiguité remarquable," but it is probably not much if any smaller than the worker of *berwicki.* The males of only four species are known, namely:

R. dubitata. 2 mm.; 12.
R. decedens. 2 mm.; 11.
R. paramaribensis. 2.2 mm.; 10.
R. pickeli. 1.3–1.6 mm.; 9.

Of *R. dubitata* Wheeler and Mann (1914) from Haiti the male is the only known caste unless *R. parvidens* also from Hispaniola, is the worker.

It will be seen, therefore, that within the single subgenus Rhizomyrma the numbers of antennal joints range from 7–11 in the worker and female and from 9–12 in the male, and that there is in all the castes a rough correlation between these numbers and the body-length.

LITERATURE

BORGMEIER, T. Um caso de trophobiose entre uma formiga e um parasito de cafeeiro. Bol. Mus. Nac. Rio de Janeiro 3, 1927, pp. 285–289, 2 figs.

BORGMEIER, T. *Acropyga pickeli* Borgm. Revist de Entom. 1, 1927, pp. 105–106.

BORGMEIER, T. Contribuição paro o contecimento da fauna mirmecologica dos cafezais de Paramaribo, Guiana Holandesa. Arq. Inst. Biol. Veget. Rio de Janeiro 1, 1934, pp. 93–111, 2 pls., 9 figs.

CRAWLEY, W. C. New and little-known species of Ants from various localities. Ann. Mag. Nat. Hist. (9) 7, 1921, pp. 87–97, 2 figs.

FOREL, A. Formicides de l'Antille St. Vincent. Trans. Ent. Soc. London, 1893, pp. 333–418, 1 fig.

GOELDI, E. A. Relatorio sobre a molestia do cafeeiro na Provincia do Rio de Janeiro. Arch. Mus. Nac. Rio de Janeiro, 8, 1892, p. 76.

LIMA, A. DACOSTA. Relatorio sobre a doença dos cafeeiros em Pernambuco. Imprensa Official 1928.

LIMA, A. DACOSTA. A proposito da *Acropyga pickeli* Borgm. Bol. Biol. Rio de Janeiro, Fasc. 17, 1931, pp. 1–8, 1 pl.

PICKEL, D. BENTO. Os parasitos do cafeeiro no Estado da Parahyba. Um novo parasito do cafeeiro, o piolho branco *Rhizoecus lendea* n. sp. Chacaras e Quintaes 36, 1927, p. 592.

SANTSCHI, F. Nouvelles fourmis de la Republique Argentine et du Brésil. An. Soc. Cient. Argentina, 107, pp. 273–318, 36 figs.

SILVESTRI, F. A New Myrmecophilous genus of Coccidæ from India. Rec. Indian Mus. 26, 1924, pp. 311–315, 5 figs.

SILVESTRI, F. Descrizione di un novo genere di Coccidae mirmecofilo della Cina. Boll. Lab. Zool. Gen. Agrar. Portici, 18, 1926, pp. 271–275, 2 figs.

South America As I Saw It; the observations of a naturalist on the living conditions of its common people, its topography and products, its animals and plants. By W. S. Blatchley, 12 mo., cloth, 391 pages, illus., Indianapolis, Ind., Nature Pub. Co., 1934, $2.50.

Any well written account of the rambles of an entomologist must always be of interest to his colleagues. This is especially true when these records cover entomological exploration in a part of the world as rich in opportunities for new entomological discoveries and as fascinatingly alluring in other ways as is South America. In this instance, the narration has been made by the distinguished author of four internationally used entomological monographs having a background of long years of entomological training and experience, and by one who possesses to an unusual degree the power of sustained interest in and graphic visualization of his subject matter.

Based on a daily journal, kept up to date in great detail with scrupulous exactness, there may be found a day to day—nay at times hour to hour—narration of principal events, and descriptions of the places seen during the journey. These entries include such subjects as full discussion of the countries, cities and localities visited whether in valley or on mountain-top, transportation by steamship and by rail, amounts paid for various items of travel, intimate details concerning the habits and daily life of the people (even to enumerations of types of merchandise and food stuffs offered at the various market places), outstanding entomological and other exhibits of South American museums, and much other like information. Much attention is given to the flora of the different countries, particularly the weeds. As befitting an entomologist, there are given many facts of ecological and biological interest relating to insects at different latitudes and altitudes, and on various host plants, particularly to collections made of Coleoptera, Hemiptera, Heteroptera, and Lepidoptera. An especially illuminating discussion of several pages is given of the grasshopper situation in the Argentine, while considerable space is devoted to accounts of visits with the local and foreign entomologists located in the different countries and of the problems on which they are engaged. All these matters are treated with a sufficiency of detail to make up an exceedingly interesting and unusually instructive travel work.

To most of us there is something very appealing and extremely fitting in the fact that naturalists of mature experience like Howard, Chapman, and Blatchley are spending the leisure period of their lives in turning out, year after year, readable books based upon a wealth of lifetime study, observation, and experience. The entomological fraternity particularly will be grateful to Dr. Blatchley for making available his recent books "My Nature Nook" (1931); "In Days Agone" (1932); and now, his "South America As I Saw It." Let us hope he may write more of the same kind.—J. S. W.

A LIST OF COCCINELLIDÆ OF BRITISH COLUMBIA

TH. DOBZHANSKY
CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA

The following list is based primarily on the material collected by the author in summers of 1931 and 1934. This list is admittedly incomplete, and further collecting will undoubtedly increase the number of species recorded from British Columbia. The fauna of Coccinellidæ of British Columbia has, however, more than usual interest, due to the fact that many common American species find there the northern and northwestern limits of their distribution. The publication of this note is, therefore, considered justifiable.

Unless otherwise stated, the specimens referred to below were collected by the author, and are preserved in his collection. The symbol "ES" stands for the list of Coccinellidæ published (anonymously) in the *Bulletin* of British Columbia Entomological Society, No. 1, 1906, pp. 3–4 (reprinted in 1926). NM refers to the specimens in the collection of the National Museum (Washington, D. C.) examined by the author. For species that are known to occur in the regions north of British Columbia, this fact is stated with appropriate references.

1. *Hyperaspis lateralis* Muls. subsp. *montanica* Csy. Pavilion, July 25, 1 sp.; Lake Skaha, June 25, 2 sp. In one of the specimens the discal spot is almost wanting.

2. *Hyperaspis postica* Lec. Lake Skaha, June 25, 3 sp.; Kaslo, Aug. 2, 2 sp.; Victoria, Goldstream (ES, "*Hyperaspis posticata* Lec.").

3. Hyperaspis n. sp. Chilliwack, July 24, 1 male. This species is related to *quadrivittata* Lec. and *moerens* Lec., and may be a subspecies of one of these. Pronotum black with triangular yellow spots in the anterior angles; elytra black with a sharply defined longitudinal wedge-shaped yellow spot in the apical part, located closer to the suture than to the external margin.

4. *Brachyacantha ursina* Fabr. Keremeos, June 26, 1 male. The only representative of this species from British Columbia

differs from the typical form of the species in having a more oblong body, the external margins of the elytra subparallel in the anterior half of their length, the yellow markings on the pronotum somewhat reduced in width, and the yellow markings on the elytra smaller than those in the typical *ursina.* The juxtascutellar spot is triangular, the discal one is small, transversally oval. This form seems to be at least subspecifically distinct from the typical *ursina,* but more material is needed before its status can be established. *Brachyacantha 10-pustulata* Melsh. mentioned in ES undoubtedly belongs here.

5. *Psyllobora vigintimaculata* Say subsp. *taedata* Lec. Campbell River, Aug. 14, 2 sp.; Nanaimo, Aug. 2, 2 sp.; Victoria, Aug. 13, 3 sp.; Vancouver, July 28, 56 sp.; Capillano Canyon, Aug. 1, 50 sp.; Chilliwack, July 24, 1 sp. Common in the coastal region on leaves of deciduous trees. About one-third of the specimens examined have black spots on the elytra, the remainder have spots of various shades of brown. Individuals of this species found in California are all pale brown, those from the eastern states are black. This species is found also in Alaska (Skagway, June 7, 1897, Harrington collector, NM).

6. *Macronaemia episcopalis* Kby. Kaslo, Aug. 2, 1 sp. I have seen this species also from Alberta (Cypress Hills, F. S. Carr collector), and from Idaho (Parma, H. P. Lanchester collector).

7. *Hippodamia tredecimpunctata* L. Chilliwack, Aug. 24, 2 sp.; Victoria, Wellington, Vancouver, Sumas (ES). This species is common in northern Asia (including Kamchatka) and in Europe, but is not so far known from Alaska.

8. *Hippodamia parenthesis* Say. Merritt, June 27, 1 sp.; Wellington (ES). Yukon Territory: Whitehorse, May 30, 1916, J. A. Kushe collector, 2 sp. (NM).

9. *Hippodamia lunatomaculata* Mots. Pavilion, July 25, 12 sp.; Kamloops, July 30, 1 sp.; Lake Skaha, June 25, 5 sp.; Keremeos, June 26, 2 sp. Common in the interior on xerophytic grassy vegetation, especially on Artemisia. Most individuals have the elytral pattern similar to that represented in Fig. 43e of Johnson's work (Carnegie Inst. Washington, publ. 122, 1910), but one specimen from Lake Skaha has the pattern represented in Fig. 43g of the same work.

10. *Hippodamia sinuata* Muls. subsp. *spuria* Lec. Chilliwack, June 24, 2 sp.; Wellington, Duncans, Vancouver, Vernon (ES). The listing of the typical *sinuata* Muls. for British Columbia (Victoria, ES) is almost certainly based on an erroneous determination, since it is a Californian species.

11. *Hippodamia convergens* Guer. Keremeos, June 26, 1 sp.; Lake Skaha, June 25, 2 sp.; Kaslo, Aug. 2, 8 sp.; Vernon (ES). All individuals examined have the typical elytral pattern, except one from Kaslo which has spotless elytra.

12. *Hippodamia caseyi* Joh. Nanaimo, Aug. 2, 1 sp.; 150 Mile House, July 26, 1 sp.; Lake Canim, July 28, 1 sp.; Pavilion, July 25, 3 sp.; Yale, July 24, 3 sp.; Keremeos, June 26, 1 sp.; Arrowhead, July 31, 1 sp. This species is frequently misnamed *lecontei* Muls. *Hippodamia lecontei* Muls. is a species occurring in the southwestern United States, and its finding in British Columbia (ES) is doubtful. I am obliged to Dr. P. H. Timberlake who has determined this species for me.

13. *Hippodamia quinquesignata* Kby. Victoria, Aug. 13, 1 sp.; Nanaimo, Aug. 2, 18 sp.; Departure Bay, Aug. 2, 3 sp.; Cowichan, Aug. 13, 1 sp.; Quesnell, July 27, 1 sp. Alaska: Chitina, July 14, 1 sp.; Fairbanks, July 1934, 2 sp., F. W. Went collector. Individuals from Vancouver Island have most of the spots constituting the typical pattern much reduced in size or absent, with the exception of the humeral band ($\frac{1}{2}+3+1$) which is uneven in its outline, and sometimes (27%) broken into separate spots. In Alaskan individuals the pigmentation is much heavier.

14. *Hippodamia quinquesignata* Kby. subsp. *puncticollis* Csy. Keremeos, June 26, 1 sp.; Arrowhead, July 31, 4 sp. This race differs from the typical form by its smaller size, a heavy, even humeral band, broadly fused oblique spots $4+5$, and a less pronounced punctuation of the elytra. Dr. P. H. Timberlake kindly informs me that the genitalia of this race are not different from those of the typical quinquesignata.

15. *Hippodamia moesta* Lec. Chilliwack, July 24, 3 sp.; Victoria, Goldstream, Wellington, Vancouver (ES). On ferns. One of the specimens from Chilliwack has solid black elytra, the other two have a yellow spot in the subapical region.

16. *Hippodamia moesta* Lec. subsp. *bowditchi* Joh. Kaslo, Aug. 2, 4 sp.; between Hope and Okanogan (Johnson 1910, p. 46). Leng and Timberlake consider *bowditchi* Joh. to be subspecifically related to *moesta* Lec. This is probably correct, although no intergrades seem to be known.

17. *Coccinella novemnotata* Hbst. subsp. *oregona* Casey. Nanaimo, Aug. 2, 3 sp.; Merritt, June 27, 1 sp.; Lake Skaha, June 25, 5 sp.; Keremeos, June 26, 12 sp.; Wellington, Vancouver (ES). The elytral spots very small, spots 1 and 2 sometimes missing. This species is found on Queen Charlotte Island (Keen, Canadian Entomologist, 27, 1895, p. 317).

18. *Coccinella prolongata* Cr. Keremeos, June 26, 1 sp.; Vernon (ES).

19. *Coccinella californica* Mann. Victoria, Aug. 13, 3 sp.; Cowichan, Aug. 13, 1 sp.; Nanaimo, Aug. 2, 24 sp.; Departure Bay, Aug. 2, 7 sp.; Vancouver, July 24, 2 sp.; Abbotsford, July 24, 3 sp.; Chilliwack, July 24, 5 sp. Common in the coastal region on grassy vegetation.

20. *Coccinella johnsoni* Csy. Victoria, 1 sp. (California Acad. Sci. collection); Chilliwack, July 24, 1 sp. The specimen from Chilliwack has the humeral spot missing.

21. *Coccinella transversoguttata* Fald. Quesnel, July 27, 1 sp.; Pavilion, July 25, 2 sp.; Vancouver, Vernon, Penticton, Merritt, Fort McLeod (NM). On xerophytic vegetation. Yukon Territory: Whitehorse, Carcross, White Pass, Dawson (NM). Alaska: Skagway, Chitina Glacier, New Rampart House (NM), Chitina, July 14, 1 sp.; Fairbanks, July 1934, 19 sp., F. W. Went collector. Alaskan individuals are larger and more heavily pigmented than those from British Columbia.

22. *Coccinella transversoguttata* Fald. subsp. *nugatoria* Muls. Keremeos, June 26, 238 sp.; Lake Skaha, June 25, 2 sp. On Carduus. Vancouver, Merritt, Penticton, Vernon (NM). All intermediates between subsp. *nugatoria* and the typical form are present. 72% of the individuals examined have the humeral band intact and the discal spot more or less transverse; 20% have the humeral band broken into separate spots; in 7% the humeral band is broken, and the humeral spot is missing; 1% have the discal spot missing but the humeral band intact.

23. *Coccinella nivicola* Men. subsp. *alutacea* Csy. Keremeos, June 26, 6 sp.; Victoria, Vancouver, Fort McLeod (NM). On Carduus. This form may easily be confused with the preceding species; its differs by the absence of any trace of humeral spot, and by an oblique and distinctly transverse discal spot. In doubtful cases an examination of the genitalia has to be resorted to.

24. *Coccinella trifasciata* L. 150 Mile House, July 26, 1 sp.; Pavilion, July 25, 1 sp.; Chilliwack, July 24, 1 sp.; Victoria, Glacier, Agassiz, Vernon (NM). The species is found also in Yukon Territory (Whitehorse, Dawson, NM) and in Alaska (22 miles below Eagle, NM).

25. *Coccinella trifasciata* L. subsp. *subversa* Lec. Abbotsford, Aug. 5, 9 sp.; Chilliwack, July 24, 22 sp.; Yale, July 24, 9 sp. 42% of the specimens examined have no spots on the elytra (or only a remnant of the scutellar spot), 56% possess a discal spot, and 2% have a subhumeral band, similar to that characteristic for subsp. *juliana* Muls. Common in the coastal region in fields and on meadows.

26. *Adalia bipunctata* L. Nanaimo,Aug. 2, 1 sp.; Chilliwack, July 24, 3 sp.; Lake Skaha, June 25, 1 sp.; Wellington, Vancouver (ES). All specimens have the typical elytral pattern. The ES lists also *Adalia frigida* Schn. and *Adalia annectans* Cr. as occurring in British Columbia. The occurrence of the former is very probable, since it is found also in Alaska (Rampart House, NM). As to *annectans,* it is supposed to be a southern species, although I find the distinction between it and *frigida* very questionable.

27. *Cycloneda munda* Say. Victoria, Aug. 13, 1 sp.; Nanaimo, Aug. 2, 4 sp.; Vancouver, July 28, 2 sp.; Capillano Canyon, Aug. 1, 2 sp.; Yale, July 24, 1 sp.; Keremeos, June 26, 1 sp. The ES lists *Cycloneda sanguinea* L. rather than *munda* as the species occurring in British Columbia. This is probably a misidentification, although the conventional character used for distinguishing these species (the pronotal pattern) is not to be depended upon too much. The genus badly needs a revision.

28. *Cleis picta* Rand. subsp. *minor* Csy. Merritt, June 27, 1 sp.; Lake Skaha, June 25, 2 sp. On pines. The specimens

examined have a pale brown elytral pattern, which is a characteristic of the "species" *minor* Csy. I doubt the validity of *minor* not only as a species, but even as a subspecies. Since, however, the western representatives of this species do differ from the eastern ones in coloration and perhaps in size, sinking the name *minor* Csy. as a mere synonym is premature.

29. *Mysia randalli* Csy. Pavilion, July 25, 1 sp.; Merritt, June 27, 1 sp.; on pine trees. I have seen this species also from Moscow, Idaho (5 sp., Paul Rice collector). The ES lists *Mysia horni* Cr. rather than *randalli.* It is, of course, possible that both are found in British Columbia. Casey segregated the American species of the genus Mysia from the palaearctic ones under a generic name Neomysia Csy. I regard Neomysia entirely superfluous, and treat it as a synonym of *Mysia* Muls.

30. *Exochomus septentrionis* Weise. Lake Skaha, June 25, 5 sp.; Keremeos, June 26, 1 sp. On pines. All specimens have heavy black markings, being somewhat similar to the subsp. *davisi* Leng. of this species.

In addition to the species enumerated above, my British Columbia collection contains three species of the genus Scymnus Kug. At the present, however, the taxonomy of the American species of Scymnus is in a state of utter confusion, and will remain so until the genus is revised, and the types of the numerous "species" described by Casey are reexamined. Considering that assigning doubtful names to species in faunistic lists does far more harm than good, I refrain from such a venture.

A general conclusion regarding the fauna of Coccinellidæ of British Columbia may be formulated as follows. As far as it is known, this fauna contains not a single species that does not occur in regions South or East of British Columbia. This is tantamount of saying that no known species finds its southern or eastern limits within the confines of this Province. On the other hand, most of the British Columbia species that extend further North are widely distributed, mostly circumpolar, forms. Real arctic species are not known to occur in British Columbia.

THE OVIPOSITING MECHANISM OF TREMEX COLUMBIA

BY CYRIL E. ABBOTT
MORGAN PARK, ILL.

The ovipositing mechanism of *Tremex columba* is similar to that of *Megarhyssa lunator,* but it differs from the latter in the following particulars: 1, all of the external hard parts of the drilling mechanism are short, compact, and sturdy; 2, the ovipositor itself is shorter than the abdomen, so that, unlike that of *Megarhyssa,* it does not become looped within the intersegmental membranes; 3, the muscles are large, and so arranged that a maximum drilling force is exerted.

Figs. 1 and 2 illustrate the chitinous parts of the mechanism. In the first drawing, which shows the external aspect of the left side, the second valve has been detached from the right valvifer and the whole ovipositor is twisted toward the observer. Notice, in Fig. 2, that the muscle tendon (MT) is wide and flat, as is also the posterior portion of internal ridge appearing just above it. This tendon is shown in greater detail in Fig. 3. It is about 7 mm. long and 2 mm. wide. The muscle (6) attached to it, and to the walls of the ninth tergum, draws the second valvifer (2Vf) toward the tergum, in so doing extends the lancet (1Vl in Figs. 1 & 2). Note that the tendon, unlike that of *Megarhyssa,* which is attached some distance down the margin of the plate, is fastened to the recurved end of the valvifer, in this way exerting a maximum pulling force. This may also compensate for the relatively small size of the muscle (5) which has a similar action, and which in *Megarhyssa* is large.

Muscle 3, by sliding the tergum back, rotates the first valvifer (1Vf) *back,* thus retracting the lancet. Muscle 7 corresponds with the dorsoventral muscle found in *Megarhyssa.* The muscles 1 extend the ovipositor before drilling begins.

The muscle 2 deserves brief consideration. It appears to be stretched between the upper and lower margins of the second valvifer. A corresponding muscle in *Megarhyssa* I have de-

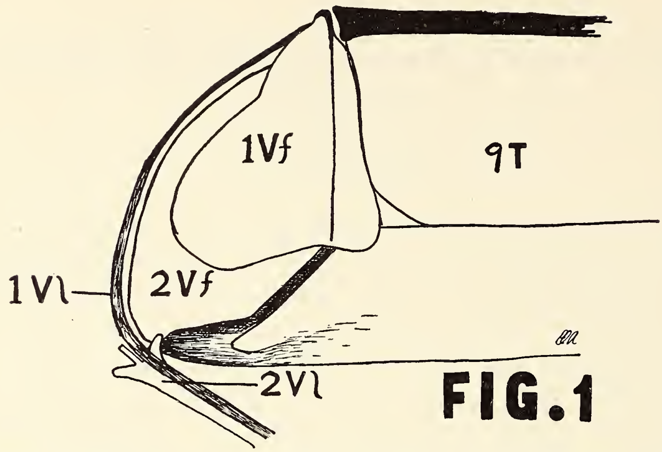


FIG. 1

scribed as attached to the first valvifer, but Snodgrass claims, and I think correctly, that the muscle is attached in *Megarhyssa* as it is in *Tremex*. Snodgrass also states that this muscle is peculiar to the *Hymenoptera*.

Of course the parts so far described (with the exception of the second valves, which are fused) represent *one side only;* the mechanism is duplicated on the opposite side of the animal.

The *ovipositor* proper is broadly oval in outline with the long axis vertical—not V-shaped as in *Megarhyssa*. In Fig. 4 it is represented in section with one of the lancets (first valve) partly

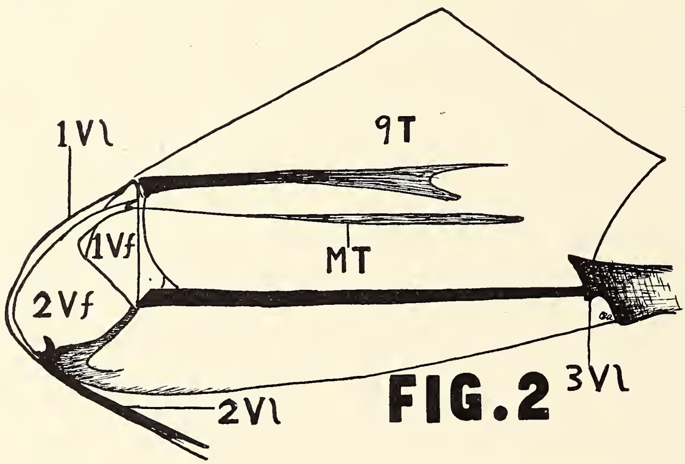


FIG. 2

withdrawn. The *third valves,* though technically part of the ovipositor, take no part in the drilling. The proximal end of one is shown in Figs. 2 & 3.

All of the drawing are × 8, and are drawn to scale. OV and AG in Fig. 3 represent the oviduct and accessory gland respectively.

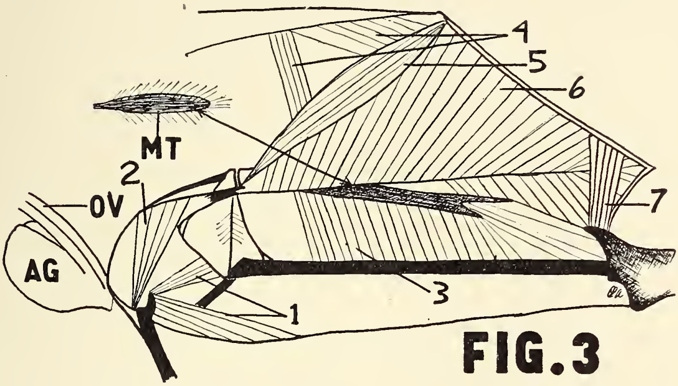


FIG. 3

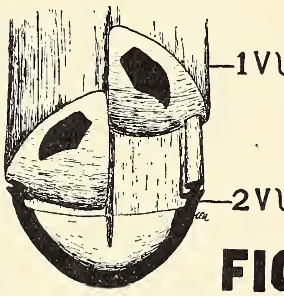


FIG. 4

The general impression one obtains from an examination of this mechanism is that it is fitted for much more strenuous use than is that of *Megarhyssa.* This becomes more significant when one knows, through observation, that *Tremex* actually *drills* through more or less solid wood, while the oviposition of *Megarhyssa* is confined to insertion of the ovipositor through the bark to the open end of a burrow, and down the burrow the length of the instrument.

LITERATURE CITED

AARON, S. F. 1908.
Mechanism of the ovipositor drill. Sci. Amer., 99, p. 435.

ABBOTT, C. E. 1934.
How Megarhyssa deposits her eggs. Jour. N. Y. Ent. Soc., 42, pp. 127–133.

SNODGRASS, R. E. 1933.
Morphology of the insect abdomen. Part II. Smithsonian Misc. Col., 89, No. 8, p. 133.

TECHNIQUE FOR THE DISSECTION OF SERICA

In the genus *Serica* one encounters a wealth of species feebly marked by external characters, but strongly differentiated by the structure of the male genital armature. Hence it is often necessary, and always desirable, to remove and mount the armature along with the specimen to serve as an aid in the determination of the species, and later in its recognition. It usually happens that specimens are pinned and labelled long before thought is given to their identification or to the special technique of their proper display for study. Notes, then, on a method of handling such material without injury to the specimens or to the labels should be helpful to students of the genus. Some of the suggestions which follow may be of value in handling other types of insects as well.

The labels accompanying the specimens to be dissected should first be removed and placed on a thinner, (''O'' or ''OO'') insect pin and locked into position by a slip of paper bearing a serial number, written in pencil. A duplicate number label should be placed upon the pin from which the data labels were removed. By so handling specimens, one at a time, some 20–30 sets of labels may be removed and filed in order on the pin, later to be correctly returned to the specimens from which they came.

The specimen to be relaxed is then immersed in a glass of water, (preferably distilled, or at least soft) to which 5–10% of alcohol has been added. Usually within 24 hours the specimen will be pliable and ready for dissection. To insure a clean, beautiful specimen, showing almost all of the original lustre and iridescence, first brush it with a soft camel's hair brush *under* water. Then remove the pin, and gently wipe the elytra dry with a soft linen handkerchief. During the dissection the specimen should be held back downward between the thumb and finger with the soft linen cloth between the finger and the elytra. The dissection, though simple, should be done under the low power of a binocular microscope. The chief instrument needed is best home made by taking a thin, limber, white insect pin (the old style) pushing it through a small piece of cork, to serve as a handle, and buckling the point against a hard surface to form a delicate grab-hook. With this hook lift the pygidium, break the ventral membranes connected to it, and fish out the armature. Drop it in water while repinning the specimen with a larger sized pin than that originally used. Push the specimen above the level desired on the pin, rub a little duco, or white shellac, on the pin at the correct level (one-third down from the head of the pin) and push the specimen down to position. Thus it may be as nearly and firmly attached to the pin as in the original mounting.

The genital armature should be mounted under the specimen, projecting to the left. For this purpose cardboard points punched from three-ply Reynolds bristle board are best. By aid of the binocular and the little grab-hook remove all adhering dirt and membranes from the armature, flex the claspers if possible into a normal position, and attach the open, basal end of the armature to the tip of the cardboard point with duco or white shellac. The original data labels should go on the pin below the cardboard holding the armature. The larger size of the pin used in remounting the specimen will cause the labels to stand as firmly in position as they did originally.

Occasionally a specimen, due to previous treatment or to the nature of the abdominal contents, will not relax sufficiently to permit the operation just described without risk of injury to the armature and the pygidium. A satisfactory modification of the technique in such cases is to remove the whole abdomen. To accomplish this, rupture the membrane connecting the first abdominal sternite with the thorax by pushing the curved tip of the little grab-hook through it in several places, then dislodge the abdomen by tension from the hook. Remove the armature through the open basal end of the abdomen, place a drop of glue in the specimen, and reset the abdomen in position. This operation can be accomplished so successfully that even a binocular microscope will reveal no trace of the manipulation. The first, simpler method, however, should be employed for all specimens which will relax readily.

A few comments upon the comparative advantages of the method above outlined may be desirable. In the first place, soaking the specimens in water rather than slowly relaxing them in a moist chamber is to be preferred because complete relaxation can be secured before the pins rust or corrode, and before mold or decay can cause injury. Further, highly soluble substances in the specimens will largely go into solution and diffuse out into the glass of water. In a moist chamber they could not escape from the specimen and would in part collect on the surface in drying, with a resulting injury to the lustre and iridescence. Many specimens are dirty when first mounted, and accumulate more dirt afterward. The appearance and usefulness of such specimens is greatly enhanced by washing them in water.—R. W. DAWSON, University of Minnesota.

Principles of Insect Morphology. By R. E. Snodgrass, United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, 1st ed., 8 vo., cloth, 667 pages, 319 illustrations, New York, McGraw-Hill Co., 1935, $6.00.

Written by an international authority on insect morphology, this book has been a number of years in course of preparation, and its issuance is a real event in scientific circles. Designed as a guide on insect structures, the book presents the latest developments and ideas on insect morphology (including embryology and histology) and physiology. There has been brought together here under one cover a large body of valuable and significant material which otherwise could be obtained only from widely scattered scientific journals and other publications written in many languages. Primarily morphological in approach, particular attention is given to structural relationships of insects, annelids, and arthropods, the evolution of organs within the various groups, and correlation of structure with functions where possible. Some idea of the general plan and scope of this work may be gained by enumeration of the subject subdivisions: general organization and development; the body wall and its derivatives; body regions; sclerites, and segmentation; the segmental appendages of arthropods; the head; the head appendages; the thorax; the thoracic legs; the wings; the abdomen; the organs of ingestion; the alimentary canal; the organs of distribution, conservation and elimination; the respiratory system; the nervous system; the sense organs; the internal organs of reproduction; and the organs of copulation and oviposition. Attention also should be directed to the 319 illustrations which include more than one thousand individual drawings, a large number of which were prepared by the author and which are of great helpfulness in elucidation of the text. Another feature which adds greatly to ease of understanding of the subject matter are the lists of technical terms defined in the order of their occurrence and placed in alphabetical sequence at the end of each chapter. Published as the latest volume of the McGraw-Hill series in the Zoological Sciences, this work forms a worthy addition to this well known series. Comprehensive and unique in its scope and representing long years of study and an almost incredible amount of toil and pains in its preparation, it is predicted that this book will attain a world-wide usefulness and probably will remain *the* standard text on insect morphology for some time to come.—J. S. W.

FIELD EXPERIMENTS WITH THE JAPANESE BEETLE AND ITS NEMATODE PARASITE*

BY R. W. GLASER AND C. C. FARRELL

WITH A STATISTICAL ANALYSIS BY J. W. GOWEN

Introduction

In 1929 a nematode parasite of the Japanese beetle (*Popillia japonica* Newm.) was discovered in one locality in New Jersey (1). The same year Steiner (2) placed the form among the Oxyuridæ, and described it as a new genus and species under the name of *Neoaplectana glaseri*. In 1931 (3), the senior author reported the cultivation of the parasite on an artificial medium, and the following year (4) he published some detailed studies on the subject. Among other matters, it was found that experimental infections of healthy grubs with the second-stage nemas caused a high mortality among beetles in the grub and pupal stages. The parasites infected the host by way of the mouth, developed two or three generations within the body and destroyed the grubs by feeding upon their tissues. The development of *Neoaplectana* continued within the grub cadavers until most of the tissues had been consumed. In dying and newly dead individuals all stages of nematode development were found; in cadavers that had been dead longer, the second-stage or free-living invasive form dominated. These free-living forms vacated the grub remains to seek other victims after everything had been consumed. The entire life cycle of *Neoaplectana,* corresponding to the life history within the host, was successfully cultivated upon a special artificial medium (3, 4). A generation developed every 4 or 5 days and cultivation apparently did not alter the pathogenicity of the nemas for Japanese beetles. Preliminary field experiments, on a small scale (4), indicated that the parasite could be established in a region where it did not occur naturally and, when so established, produced a high mortality.

* Conducted cooperatively by The Rockefeller Institute for Medical Research, Princeton, N. J., and the New Jersey State Department of Agriculture.

The field experiments initiated in 1931 on a small scale were continued. It seemed desirable to determine whether or not the introduced parasites had permanently established themselves; in other words, whether they could remain dormant through successive winters and become parasitically active again during the warm months.

Large field experiments were also planned and executed with two chief questions in mind. First, how can the nematodes be best introduced and established on a large scale in a region so that they will become an important control factor? In the solution of this problem the number of the host population in an area must be considered, as well as the actual method for introducing the parasites. Second, with all the variable factors which are encountered in the field, is it possible to obtain quantitative results which will enable an appraisal of the extent of parasitism and the consequent reduction in host population? Quantitative data, on work with insect parasites generally, are much needed at the present time. No criticism can be made of those few striking cases where a complete or nearly complete extermination of a pest has been accomplished by means of introduced parasites. In many instances, however, extermination of a noxious insect by introduced foreign parasites has not been effected. Some of these parasites established themselves and a measure of control is claimed for them, but the chief question cannot be answered from the available data. The problem of how much host reduction the parasites accomplish—*i.e.*, how effective the parasites really are, remains unsolved. In fairness to certain workers with insect parasites, it must be stated that the Japanese beetle during the grub stage lends itself very well to investigations of a quantitative nature. The larvæ live in the soil and consequently, by making a large number of standard diggings and counting the larvæ so obtained, a fairly reliable index of the population from year to year can be obtained. The effect of a parasite on such a population should yield fairly reliable results. One section of the present paper deals with quantitative aspects obtained during the course of some field work with the nematode parasite of Japanese beetle grubs.

Further Observations on Two Small Plots Inoculated with Nematodes in 1931

In the spring of 1931, as described in a previous publication (4), two localities in southern New Jersey were chosen on two separate farms about two miles apart. On each farm an experimental and a control plot, separated from each other by 150 yards, were selected. Each plot comprised 6 square feet and originally contained between four and five hundred grubs. Boards were driven one foot into the ground to enclose the grubs and to prevent their lateral migration out of the plots. During the summer the insects remain in and near the root system of plants and do not migrate vertically more than 3 or 4 inches.

On May 15, 1931, the soil within the four plots was carefully sifted to a depth of over 6 inches and all of the grubs examined and counted. They were all found to be healthy and in the second and third instars. On one farm, the grubs were equalized to 600 in each plot. On the other farm, the grubs were equalized to 450 in each plot. Since the grass was entirely uprooted and injured during this procedure, rye for food was heavily sown in the four plots.

On May 18, the soil in one plot, A, on the first farm, was treated with a culture of *Neoaplectana* and on May 22, the procedure was repeated on Plot B, on the second farm. The control plots on each farm remained untreated throughout the season. The method for preparing and applying the nematode cultures was described in the previous publication.

During the entire season of 1931, 47 parasitized grubs were found in inoculated Plot A and 64 in inoculated Plot B. No cases of parasitism were found in either of the control plots. Table I gives the number of adult beetles that emerged from each plot. Counts showed that a large number of grubs were being lost from some cause other than parasitism. It was discovered that birds were a factor, so screened cages were placed over each plot. However, in spite of the enormous losses, several points were evident. The parasite was established in the field in a region where it did not naturally occur and produced a high mortality, although the percentage of mortality from nematodes cannot be computed because of unfortunate losses from other

TABLE I
ADULT BEETLE EMERGENCE OVER A PERIOD OF FOUR YEARS IN EXPERIMENTAL PLOTS

Year	No. of grubs in each plot	Adult Emergence				Remarks
		Experiment A		Experiment B		
		Control plot	Infected plot	Control plot	Infected plot	
1931	600 in A plots 450 in B "	50	1	175	30	Each of 6 adults collected from Infected Plot B harbored between 5–8 nemas
1932	200	128	8	158	0	Each of 4 adults collected from Infected Plot A harbored a large number of nemas
1933	200	158	0	143	0	
1934	300	146	0	180	0	

causes. The number of deaths by agents other than nematodes was approximately the same in each of the four plots.

During 1931 after the emergence of the adults, soil was frequently sedimented in a "Baermann isolation apparatus" to see if the second-stage nemas were still active. Each test revealed many of the parasites which were always cultured to the adult stage for accurate identification. *Neoaplectana* was not recovered from similar samples of soil taken from the control plots nor from samples of soil from eleven other localities in the vicinity. Samples immediately outside of the infected areas were also frequently tested during 1931 for the presence of the parasite with negative results. Therefore no evidence on the migration of *Neoaplectana* from its place of introduction was obtained at this time. However, it will be recalled that, for the purpose of the experiments, the grubs were prevented from migrating laterally. This restraint probably also assisted in keeping the nematodes within the circumscribed area.

The small plots were studied from 1931 through 1934 (Table I). Each fall after the adult emergence a certain number of grubs were always added to the soil in each plot. In the spring two grub equalizations were made; one in April, the other during the latter part of May. In the plots inoculated with nematodes the first lots of grubs were always so reduced numerically by the parasites within 3 or 4 weeks that a second grub introduction was made. After the pupæ are fully formed, at the middle of June or later, grubs that have escaped infection or are possibly immune reach maturity.

The figures in Table I, second column, represent the numbers of grubs added each year during the last equalization. In infected Plot A no adults have emerged during the past 2 years, and in infected Plot B none have appeared since 1931. The plots were examined at intervals for parasitized grubs. During 1932 infected Plots A and B yielded 133 and 93 cases, respectively. During 1933 Plot A yielded 48 cases; Plot B was only disturbed once that year when 5 cases were collected. During 1934, 15 cases were found in Plot A and 46 in Plot B. No parasitized cases were ever found in the two controls. The data given do not present a complete record of all of the parasitized material. The observations were necessarily intermittent and during the intervals many cases undoubtedly disintegrated beyond recognition. Only diseased individuals and cadavers that revealed large numbers of the specific parasite were recorded.

The table giving the adult emergence shows losses in the control plots. Those for 1931 may be largely accounted for by birds. This cannot be true for the losses sustained during the succeeding 3 years because the plots were screened. Some trouble was encountered during 1932 and 1933 with moles and this was corrected by transferring the soil two feet in depth from each plot to wooden frames with bottoms of copper screen. The plots were now protected from birds, moles, and rodents. Nevertheless, during 1934 the two control plots showed decided losses which may possibly have been due to bacterial and other diseases.

As recorded in the table, during 1931 and 1932 all together 10 adults emerged that harbored second-stage *Neoaplectana* within their intestinal tracts. This observation presents the possibility that the adult beetles, which are vigorous fliers, may assist in the natural dispersion of the nemas.

After emergence in August and September of 1932, 1933 and 1934, samples of soil were sedimented from each of the four plots and in the soil from the inoculated ones, active second-stage *Neoaplectana* larvæ were found in abundance and cultured up to the adult stage. The same tests were repeated with the same result in the early spring before the warm weather had caused the nematodes to become parasitically active among the grubs.

From the evidence presented, therefore, there can be no doubt that *Neoaplectana* became definitely established in the inoculated areas, and caused a high mortality among the Japanese beetle grubs.

Experiments to Test the Possibility of Introducing the Nematodes by Spraying

During the early autumn of 1931, the authors selected some lawn grass which showed considerable damage by Japanese beetle grubs and staked two 15 foot square plots; one was used as a control and the other as an infection experiment. Each area was separated from the other by 15 feet. The grub population averaged $\pm$ 22 per square foot in the control and $\pm$ 29 per square foot in the other plot.*

On the day the nematodes were introduced each plot was first sprinkled with 100 gallons of water. This was considered necessary because the ground, after a prolonged drought, was exceedingly hard and dry, and it was thought that the parasites might experience difficulty in penetrating the surface. Four large pie plate cultures** with a heavy growth of second-stage nemas on

* The values of 1 square foot diggings were obtained by marking off a square foot on the surface of the ground with the handle of a grubbing hoe notched at the proper length from the end. The turf root system and the soil to a depth of 6 inches were then carefully sifted and examined for grubs. During the warm season grubs remain in and near the root systems of their food plants.

** The pie plates each contained about 60 cc. of dextrose veal infusion agar. The surface was first inoculated with a pure culture of yeast and 24 hrs. later inoculated with second-stage nemas from a Petri plate culture, after washing and sedimenting three times in water. The pie plate cultures were then incubated at room temperature (20–25° C.) for from 2 to 3 weeks. At the end of incubation the nemas had multiplied plentifully, the yeast cells had been consumed, and nearly all of the worms were in the second-stage which is the only stage that survives in the soil. (See literature citations 3 and 4.)

the agar yeast medium, previously described (3, 4), were washed off and suspended in 8 gallons of water and with sprinkling cans rapidly distributed over the experimental plot. Subsequently, although many 1 square foot diggings were made, no cases of parasitism were found. Six weeks after the treatment 4 samples each, consisting of 1 lb. of soil taken at four different points in the infected plot at levels from 1 to 6 inches deep and sedimented, did not yield any parasites. Two months later this procedure was repeated with negative results. Ordinary soil nemas were found in abundance, however.

During the early spring of 1932 the grubs in each plot averaged $\pm$ 22 per square foot, showing that no reduction in the population had occurred and no cases of parasitism were found. During the middle of June the average grub count for the control plot was $\pm$ 20 and for the inoculated plot $\pm$ 15. This slight reduction is within the bounds of experimental error and signifies nothing in so far as the treatment is concerned, because no cases of parasitism were uncovered.

The reason for the failure of this attempt at introduction is difficult to interpret. The method used was similar to the one used on the small plots which were so successful. However, the drought and condition of the soil may have prevented the nemas from penetrating. If they penetrated through cracks and crevices, they may have found conditions too dry in spite of the preliminary moistening, which probably had little effect on the soil below the surface. The grub population, and the dosage of nematodes used may also have been important factors.

In the autumn of 1931, a section of a timothy and clover pasture, showing considerable grub damage, was enclosed by a wire fence to keep out cattle. This area measured 450 feet by 50 feet and yielded an average grub count of $\pm$ 31 per square foot. The enclosed area was divided into three plots each measuring 130 feet by 30 feet. These were so spaced that each was surrounded by a so-called neutral area. A space of 20 feet existed between the plots and 10 feet between them and the fence surrounding the entire enclosure. The timothy and clover were first cut to prevent the nemas from lodging on the vegetation where they would have been rapidly desiccated. The three plots were then well watered from a clean power sprayer. One of the three remained untreated as a control. The second was treated by evenly distributing with sprinkling cans, 6 heavy pie plate cultures in doses of 1 pie plate culture to 2 gallons of water. Although most of the nemas were carefully washed off the surface of the agar, some of them stuck to the medium, so the agar was cut into small pieces and also broadcast over the surface of the ground. The ground was again gently sprinkled with the power sprayer to wash off those nemas that had lodged on the vegetation.

The third plot was treated directly with the power sprayer. This sprayer, of 300 gallons capacity, had not been used for insecticide work for an entire year. The tank, pump, pipes, hose, etc., had been thoroughly washed and treated to eliminate all traces of poison. For the inoculation the surface growth of 7 heavy pie plate cultures was washed into the tank containing 250 gallons of water. The agitator was rotated slowly to keep the worms in suspension and very little pressure was used. Samples of water taken from the end of the spray nozzle showed that the parasites issued alive at the rate of about 5 to 10 per 10 cc. of water.

Subsequently, the three plots were frequently visited and from between 10 and 20 one square-foot diggings made on each plot at every examination. No parasitized cases were found until the spring of 1932 when three typical cases were discovered in the plot treated with the sprinkling cans.

From the autumn of 1931 to the spring of 1934, the grub count dropped from ± 31 per square foot to about 12 per square foot without nematode parasitism an apparent factor. However, the grub counts in the control plot during two years dropped far below the counts in either of the infected areas until the spring of 1934 when the mean counts for all three of the plots were approximately equal; 15 for the control, 13 for the hand treated and 12 for the machine treated sections. A representative number of diggings in the neutral areas yielded approximately the same grub counts and no cases of parasitism.

The above experiment may be summarized by stating that three cases of parasitism were found in the plot treated with the sprinkling cans about 8 months after the introduction of the nematodes. Nothing was found subsequently. The parasite apparently did not become well established and this fact may be correlated with the rapid drop in grub counts due to other factors. Where grubs are numerically low, the chances for the spread of an infection become less. Other factors, as mentioned previously, such as the method of introduction, the dosage or the character of the soil, etc., might also be important. These factors must be determined, and this can only be accomplished through experimentation and observation over a long period of time. Since the parasite became established, although poorly, further studies of this locality are indicated. For instance, the host population may rise appreciably again and if this should occur, as seems likely, the parasite story might assume a different aspect.

In April, 1932, the experiment just outlined was repeated in another locality. The field used was covered with meadow grass and harbored a grub population of approximately 41 to the square foot. The three plots were handled as above with the exception that the nematode treatment followed a steady, 24-hour rain. From May, 1932, to November of the same year, the grub population gradually dropped to a mean of 3 per square foot. By September, 1933, a rise of 20 to the square foot occurred and in October one parasitized case was found in the hand-treated plot. Although 20 diggings were made in each plot at every visit and samples of soil from them were frequently sedimented, the nematodes were not again recovered. One and a half years intervened from the time of introduction until the single case recorded was found, but this poor result may have been due to the almost complete disappearance of the host due to unknown causes. Obviously, it is important to continue the study of this locality, especially as a gradual rise in population again seems to be in progress. It seemed to be impossible to obtain a population that would remain stable for a period of years.

Experiments on the Subsurface Introduction of the Nematodes

To obtain a reasonably heavy and stable population for at least a few years, the next experiment was conducted in a region invaded by the Japanese beetle during the previous year. It has been claimed that a new, heavy infestation lasts for a few years, then declines and may or may not rise slightly again. Evidence as yet does not exist that the infestation goes through a series of high peaks and low points as is the case with some other insects such as the tent-caterpillar. According to the Government entomologists engaged on the Japanese beetle project, the rise and fall of the pests seems probably to be correlated with the extent of rainfall during July and August when the soil population consists of eggs and first-instar larvæ. A deficient rainfall apparently causes a high mortality during the early stages. It is quite possible that, if several favorable years occurred in sequence, a declining population might again rise heavily. Since the main infestation in New Jersey seems to be moving slowly southward, a freshly invaded section was chosen on its southern fringe.

During the spring of 1933 a site was located on a six acre field of pastureland and an area 120 feet by 80 feet was surrounded by a barbed wire fence as a protection from cattle and pigs. The grass within the fenced area was mowed and three plots were staked off, in such wise that each measured 110 feet in length by 20 feet in breadth. (See diagram.) Each plot was separated from the other and from the fence by 5 feet. Plot A (diagram) was heavily inoculated with nematodes, Plot B served as an uninoculated control, and Plot C was lightly inoculated. The 5 feet strips that surrounded the plots were designated neutral areas. Tables II, III, IV, and V give, among other data, the average number of grubs per square foot for each plot prior to the nematode introduction, and it will be seen that the grub infestation was exceedingly heavy.

Pie plate cultures were prepared on May 9, 1933, from cultures that had been transferred on the artificial medium 7 times at intervals of from 10 days to 2 weeks. By May 23, the cultures were heavy and the nemas were practically all in the second-stage. These cultures were taken into the field and introduced on May 23 and May 29. Seventy-five holes about 3–4 inches deep and spaced approximately 5 feet apart were made on Plot A. One-half of each pie plate culture, together with the agar, was placed in each of the 75 holes. All grubs were carefully replaced, the hole watered with a sprinkling can and the soil and sod replaced. Each hole so treated was marked with a stake and the surface of

TABLE II

EXPERIMENT SHOWING ESTABLISHMENT OF INFECTION AT POINTS OF INTRODUCTION AND SPREAD AWAY FROM THESE POINTS IN PLOT A

Date of diggings	No. of dig-gings	Total No. of grubs	Average per sq. ft	No. of parasitized cases	Per cent of total parasitized	Date of diggings	No. of dig-gings	Total No. of grubs	Average per sq. ft	No. of parasitized cases	Per cent of total parasitized
Prior to parasite introduction						Prior to parasite introduction					
4/20/33	10	953	95.3	0	0	4/20/33	10	953	95.3	0	0
After parasite introduction at stakes						After parasite introduction between stakes					
6/12/33	17	214	12.6	6	2.80	6/12/33	7	121	17.2	0	0
9/28/33	32	1104	34.5	8	0.72	9/28/33	20	741	37.0	12	1.62
5/14/34	75	2496	33.2	64	2.56	5/14/34	75	2032	27.0	43	2.11
6/9/34	75	856	11.4	39	4.55	6/9/34	75	909	12.0	28	3.08
9/26/34	75	347	4.5	32	9.22	9/27/34	75	490	6.5	25	5.10
10/24/34	75	156	2.08	16	10.20	10/24/34	75	321	4.2	33	10.28

TABLE III

EXPERIMENT SHOWING ESTABLISHMENT OF INFECTION AT POINTS OF INTRODUCTION AND SPREAD AWAY FROM THESE POINTS IN PLOT C

Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized	Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized
Prior to parasite introduction						Prior to parasite introduction					
4/20/33	10	875	87.5	0	0	4/20/33	10	875	87.5	0	0
After parasite introduction at stakes						After parasite introduction between stakes					
6/12/33	10	117	11.7	6	5.13	6/12/33	10	202	20.2	0	0
9/28/33	22	580	26.3	11	1.89	10/12/33	15	397	26.4	8	2.01
5/14/34	22	460	20.9	13	2.82	5/14/34	22	473	21.5	49	10.35
6/9/34	22	141	6.4	12	8.51	6/9/34	22	196	8.9	7	3.57
9/27/34	22	129	5.8	3	2.32	9/27/34	22	121	5.5	2	1.65
10/24/34	22	50	2.2	0	0	10/24/34	22	107	4.8	1	0.93

TABLE IV

Data from Each Infected Plot Combined

Date of diggings Plot A	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized	Date of diggings Plot C	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized
Prior to parasite introduction						Prior to parasite introduction					
4/20/33	10	953	95.3	0	0	4/20/33	10	875	87.5	0	0
After parasite introduction						After parasite introduction					
6/12/33	24	335	13.9	6	1.79	6/12/33	20	319	16.0	6	1.88
9/28/33	52	1845	35.7	20	1.08	9/28/33	37	977	26.4	19	1.94
5/14/34	150	4528	30.2	107	2.36	10/12/33					
6/9/34	150	1765	11.8	67	3.79	5/14/34	44	933	21.2	62	6.65
9/26/34	150	837	5.6	57	6.81	6/9/34	44	337	7.7	19	5.64
9/27/34						9/27/34	44	250	5.7	5	2.00
10/24/34	150	477	3.2	49	10.27	10/24/34	44	157	3.6	1	0.64

TABLE V

EXPERIMENTALLY UNINFECTED PLOT B WHICH LATER BECAME NATURALLY INFECTED

Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total paratisized
Prior to parasite introduction into A and C					
4/20/33	10	787	78.7	0	0
After parasite introduction into A and C					
6/12/33	10	202	20.2	0	0
9/28/33	10	349	34.9	0	0
5/14/34	20	394	19.7	1	0.25
6/9/34	20	252	12.6	2	0.79
9/26/34	20	58	2.9	1	1.72
10/24/34	20	39	1.9	0	0
Six acre field outside experimental enclosure					
9/26/34	110	1025	9.3	0	0
10/24/34	100	719	7.19	2	0.28

the ground at each site was again watered. Plot C was similarly treated except that on May 29, 22 holes were made spaced at 18 to 20 feet from one another. Thus only 11 pie plate cultures were consumed, one-half a culture to each site.

Following the introduction, intermittent diggings were made in the three plots and later also in the neutral areas, and in the 6-acre field in which the experimental area was situated. Within the two experimental plots, diggings were made at the stakes (the points of introduction) and halfway between stakes, to obtain an idea of the rate of the migration of the parasites. Diggings in the neutral areas, the control plot and in the field outside all contributed to this rate of migration and to the final estimate of the value of the parasite. At each examination one square foot of earth was dug, the sod was shaken, the soil carefully sifted and the number of grubs and their instars recorded. A separate record was kept for each digging. A heat sterilized tin can was reserved for each hole and all diseased, dead or otherwise abnormal grubs were taken to the laboratory within 12 to 24 hours for microscopical examinations and cultural tests.

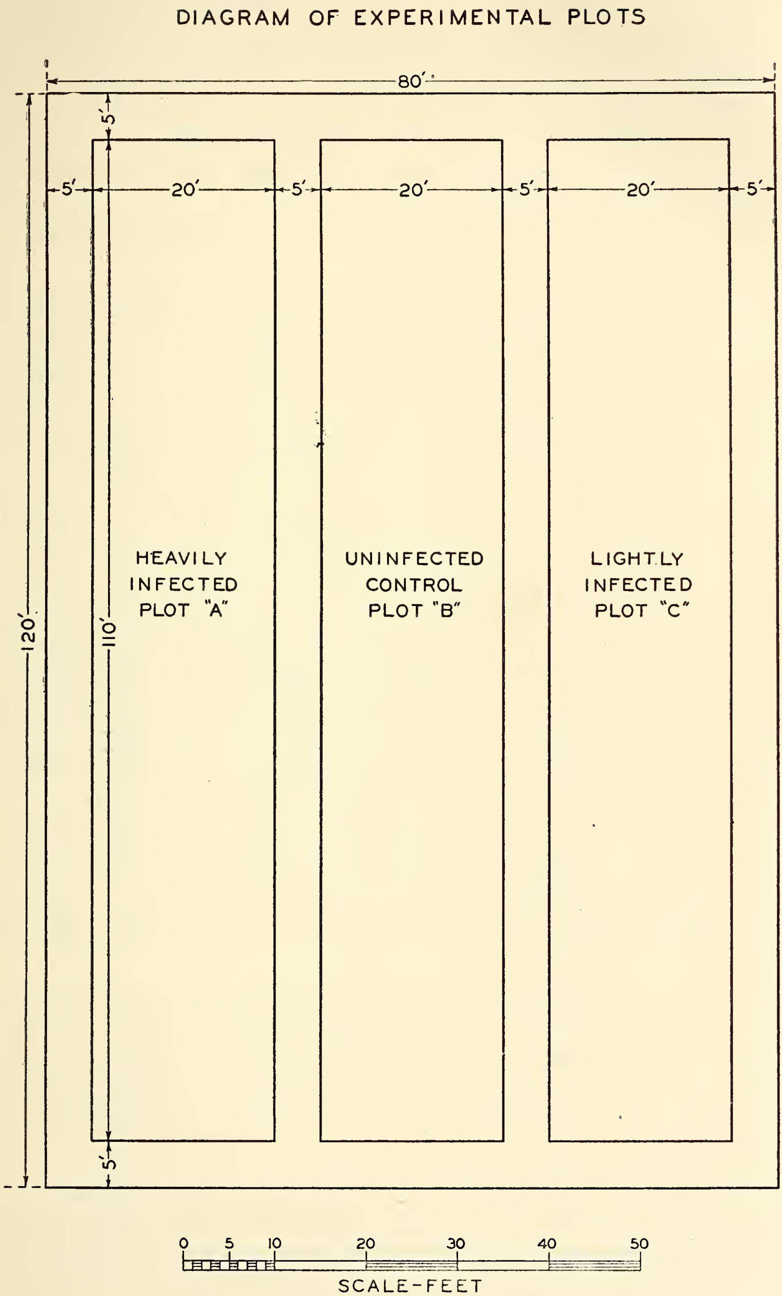


DIAGRAM OF EXPERIMENTAL PLOTS
80′
120′
110′
5′
5′
5′
20′
5′
20′
5′
20′
5′
HEAVILY INFECTED PLOT "A"
UNINFECTED CONTROL PLOT "B"
LIGHTLY INFECTED PLOT "C"
0 5 10 20 30 40 50
SCALE-FEET

The field examinations for grub counts and parasitized material were necessarily widely spaced in time, even during the warm months. This was necessary because of the labor and the cost involved, especially, since the experiments were located at a distance of about 85 miles from the laboratory. In order not to create abnormal conditions, it was also thought best not to disturb the population too frequently.

The tables show the date, month, and year when the examinations were made.

Table II shows that parasitized material was found in Plot A at the stakes on the first examination made after the introductioun of the nematodes. About 3 per cent of the total number of grubs recovered had been killed by *Neoaplectana*. No cases were recovered at that time in the diggings made between the stakes. Subsequently, cases were found at the stakes and between the stakes, at each visit, and the mortality due to nematodes reached 10 per cent of the total grubs recovered in October 1934. These results on this plot show that the parasites established themselves and migrated from the original places where they were introduced. Table III shows similar results obtained on Plot C although the high point of parasitism was reached somewhat earlier. The two sections of Table IV combine the results from Plots A and C respectively. Table V represents control Plot B and shows that the nemas migrated into this area in May 1934, so from that time on this plot could no longer be considered a control, in the strictest sense of the word. Indeed the same table (at the bottom) gives two sets of diggings in the 6-acre field outside the experimental territory and in October 1934, two cases of parasitism were found approximately 20 yards from the fenced locality.

Tables VI, VII and VIII give the results obtained from all of the so-called neutral areas and show again that the nematodes became widespread over the entire enclosed space. Along the north side of A the number of parasitized cases found in October, 1934, equalled over 15 per cent of the total number of grubs recovered on that side.

The number of parasitized cases most frequently found per individual digging equalled 1 and 2 although 3, 4 and 5 were commonly collected and in 1 hole 11 cases were recovered. In general,

TABLE VI

Neutral Areas Which Became Naturally Infected

Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized	Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized
Between A and B						Between B and C					
5/24/34	10	218	21.8	0	0	5/24/34	10	217	21.7	2	0.92
6/6/34	10	152	15.2	6	3.94	6/6/34	10	106	10.6	0	0
9/26/34	10	69	6.9	2	2.89	9/26/34	10	74	7.4	1	1.35
10/24/34	10	46	4.6	2	4.34	10/24/34	10	43	4.3	1	2.32

TABLE VII

Neutral Areas Which Became Naturally Infected

Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized	Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized
Along north side of A						Along south side of C					
5/24/34	10	247	24.7	6	2.43	5/24/34	10	124	12.4	3	2.42
6/6/34	10	118	11.8	0	0	6/6/34	10	95	9.5	0	0
9/26/34	10	109	10.9	8	7.34	9/26/34	10	38	3.8	1	2.63
10/24/34	10	51	5.1	8	15.68	10/24/34	10	28	2.8	0	0

TABLE VIII

NEUTRAL AREAS WHICH BECAME NATURALLY INFECTED

Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized	Date of diggings	No. of diggings	Total No. of grubs	Average per sq. ft.	No. of parasitized cases	Per cent of total parasitized
Along east end of three plots						Along west end of three plots					
5/24/34	10	201	20.1	3	1.49	5/24/34	10	158	15.8	3	1.90
6/6/34	10	85	8.5	0	0	6/6/34	10	99	9.9	0	0
9/26/34	10	5	0.5	0	0	9/26/34	10	45	4.5	1	2.22
10/24/34	10	15	1.5	0	0	10/24/34	10	23	2.3	0	0

the number of parasitized individuals found was probably no absolute index of the mortality due to the nemas. However, the percentages parasitized, of the total number of grubs counted, is a more accurate estimate than would be possible by any other method. The data obtained during April, May and June only cover the larval time up to pupation. It is injurious to the grubs to disturb them when in the process of pupation and a record of a high mortality at this time would be misleading. Data on the extent of the adult emergence during July and early August, as were obtained from the small plots previously discussed, would have also been valuable, but it was impracticable to screen this large area. Autumn examinations were discontinued as soon as cold weather inhibited the grub and nematode activity.

Tables II to V show a general drop in the grub population from April 1933 to October 1934. Some of this downward tendency of the population may be ascribed to the parasites, as will be seen later, but it would be a misrepresentation of facts to ascribe all of it to this cause, because the same tendency was observed in the control plot and in the 6-acre area outside of the experimental enclosure before their invasion by the parasites. Frequently, during the morning hours, the surface of the ground was found riddled with bird holes and starlings, grackles, robins and others were seen feeding upon grubs. Birds, therefore, must have been a factor in this population drop. A similar claim might be made for deficient rain at certain times during the early stages of the insect. Bacterial and other diseases of the grubs were probably also factors.

Notwithstanding the difficulties enumerated and the unknown factors involved, which seem unsurmountable in any large field experiment, the data are considered significant. The degree of significance can only be determined through a statistical analysis which will be presented in the next section of this paper.

Statistical Analysis of the Data from the Previous Experiment

As indicated above, the experiment was begun April 20, 1933, by making diggings on three plots within a fenced area. The grubs found were derived from eggs laid during July and early

August, 1932. These plots were later used for separate experiments. Plot A was heavily inoculated with nematodes; B served as a control and C was lightly inoculated.

The average grubs per plot equalled:

A – 95.3; B – 78.7; C – 87.5

The first question which may be asked is whether or not it is reasonable to assume that the three plots were so chosen as to be random samples of the same general population. Working with the individual samples (10 for each plot) we find the

Variance between plots is 690 with 2 degrees of freedom
Variance within plots is 692 with 27 degrees of freedom

The ratio approximates 1.0 where 3.4 would be necessary for significance. The plots, within the errors of random sampling, may consequently be considered alike in grub population.

The nematodes were inoculated into Plot A May 23 and Plots A and C May 29. Grubs were found infected at stakes June 12, but the nematodes had not spread to "between the stakes."

The data obtained in June show:

Heavily inoculated Plot A at stakes had 12.6 grubs
Lightly inoculated Plot C at stakes had 11.7 grubs
Untreated control Plot B had 20.2 grubs

The points in between the stakes for Plots A and C which evidently correspond to the control show respectively 17.2 and 20.2 grubs. It is evident from the numbers of grubs and the percentages of infected individuals that Plots A and C at the stakes are identical. The same may be said for the points between the stakes and the control plot.

To decide whether or not the amount by which the grub population was lower at the stakes A and C is significant; is the mean 12.3 significantly less than the mean 19.2? Working with the individual diggings, we find the

Variance between the plots is 585 with 1 degree of freedom
Variance within the plots is 60 with 47 degrees of freedom

The ratio $\frac{\text{between}}{\text{within}}$ approximates 9.7 where 4.0 would be significant. It thus appears that the nematodes had significantly reduced the grub population close to the area in which they were planted, the amount of the reduction being perhaps 40 per cent. Interestingly enough, a slightly but not significantly greater number of grubs was found parasitized in the lightly infected Plot C than in Plot A.

The September 28, 1933, diggings followed just after the laying of the eggs by the 1933 crop of adult beetles. One would expect that since the beetles came from all the surrounding territory to lay their eggs the larvæ from them would be evenly distributed over all of the plots. The evidence indicates that this is the case since there is no significant difference between the average numbers of grubs for any of the plots whether at or between the stakes.

The variance between the plots is 463 with 4 degrees of freedom
The variance within the plots is 469 with 94 degrees of freedom

The ratio approximates 1.0 which is clearly not significant.* It is of further interest that the nematodes have at this time spread over both the A and C plots.

May 14, 1934, the following spring, revealed a drop in the grub population from an average of 32 per plot to 27.6 per plot, or 12 per cent. Grubs infected with nematodes have now appeared in the untreated Plot B. Besides the diggings on this plot, examinations were made on the so-called neutral areas surrounding the plots. All but the neutral area between A and B showed invasion by the nematodes. The whole area became covered with this parasite of the Japanese beetle. The greatest drop in the numbers of beetle grubs was obtained in Plot B, from 34.9 to 19.7 per square foot. This drop would certainly not be due to the parasites, if for no other reason than that they have only just invaded this area. Temperature experiments also indicate that until the

* It might possibly be argued that the points in Plot C at stakes and between stakes do not have as many grubs as the control Plot B. Testing this difference gives:

Variance between Plots B and C is 580 with 1 degree of freedom
Variance within Plots B and C is 288 with 45 degrees of freedom

A ratio of 2.0 is obtained where 4.0 is necessary for significance. This comparison simply supports the more general one.

warmer soil temperatures of middle May, the activity of the nematodes is at a low ebb. The significant differences in the drop of the grubs in Plot B as contrasted with Plot A must therefore be attributed to other causes. The most immediately significant fact for the study of the action of the nematode parasite under natural conditions is that Plot A commences the spring, which is the beginning of the active period for the nematodes, with a considerably larger population of grubs than the other plots.

By June 9, 1934, the grubs had dropped in Plot A at the stakes from 33 to 11, a difference of 22, and between the stakes from 27 to 12, a difference of 15. In Plot C at the stakes the grubs dropped from 21 to 6, a difference of 15, and between the stakes from 22 to 9, a difference of 13. The untreated Plot B dropped from 20 to 13, a difference of 7. The drop in the grub population of the treated plots was over twice that in the so-called control plot. This control has now become invaded with parasites and therefore can no longer be regarded as an uninfected control, since part of this drop may also be due to the nematodes. The difference between the drop in the grub population of Plot A, as a whole (18.4 ± 1.08) and Plot B, the control, (7.1 ± 2.36) is 11.3 ± 2.59, and the difference between A plus C (17.4 ± 0.98) and the control (7.1 ± 2.36) is 10.3 ± 2.55. These differences are 4 times their standard errors and are consequently significant. The conclusion that there is a distinct drop in grubs due to the nematode parasite thus appears justified. The numbers of grubs found parasitized by the nematodes have increased.

The September 26, 1934, diggings represent the distribution of the larvæ from the adults of the July and early August flight. Throughout all of the plots there has been a marked decline in their numbers over the 1933 year. All of the area has now become infected with the parasites. The numbers of grubs are now approximately 5 per digging as against approximately 100 or more which were present in the fall of 1932. The question may now be asked whether this infected area has less grubs than a corresponding area in the same locality which has not yet become infected with the nematodes. One hundred and ten samplings from such an area were made, 1025 grubs were found, or 9.3 per digging. In 214 samples from Plots A, B and C 1145 grubs or 5.4 per digging were found. The differences are significant since variance between the groups is 1176, while that within the groups is 47, a ratio of 1 to 25 where a ratio of 1 to 3.8 would be significant. It would thus appear that the grubs of the Japanese beetles are distinctly less in the area parasitized by the nematodes than in the uninoculated area. This fact is supported by more data obtained during the October 24, 1934, diggings.

The General Trend of the Japanese Beetle Infestation in the Experimental Area

The general trend of the population curve of the beetle grubs is rapidly progressing downward in all of the plots. The grub population of the fall of 1932 seems to be at least 10 per cent higher than that observed on April 20, 1933, but supposing they were the same, the change would be that observed on Tables IX and X. This analysis* of these data, for the causes contributory to the reduction in the grub population, shows that the only really significant variable is the year in which the census was taken. Time, which produces the tremendous drop in numbers of grubs from the peak of 95 per square foot in 1932 to 3 per square foot in 1934, is the significant variable. Since the grubs represent eggs from the adult beetles and since these within an infested area presumably distribute themselves at random, it is likely that the character of the plot influences the number of eggs laid upon it very little,—and this is what is found,—the plot population of grubs in the fall is not significantly different from plot to plot. It is in the spring and early summer that the nematodes destroy the grubs as shown above.

The influence of the nematodes is not widespread as yet. It seems to take them quite a while to invade adjoining fields. While, as shown above, it significantly reduces the grubs in its own area, it does not to the same extent influence the July–August flight of beetles coming from the much larger area surrounding these relatively small plots. We must at present regard other

* Since the observational data for the different classes are unequal in number the method used in this analysis is that of Yates, F., *J. Agric. Sci., 23,* 108, as cited by Snedecor, George W., in Analysis of Variance, 1934, Collegiate Press, Ames, Iowa, page 96.

TABLE IX

TREND OF GRUB POPULATION IN EXPERIMENTAL PLOTS

	PLOT A			PLOT B			PLOT C			TOTAL		
Fall	No. of samples	Grubs	$(Grubs)^2$	No. of samples	Grubs	$(Grubs)^2$	No. of samples	Grubs	$(Grubs)^2$	No. of samples	Grubs	$(Grubs)^2$
1932	10	935	97304	10	787	67669	10	875	83025	30	2615	247998
	Mean	95.3			78.7			87.5			261.5	
1933	52	1845	96575	10	349	14739	37	977	36171	99	3171	147485
	Mean	35.4			34.9			26.4			96.7	
1934	150	837	12203	20	58	402	44	250	2904	214	1145	15509
	Mean	5.6			2.9			5.7			14.2	
Total	212	3635	206082	40	1194	82810	91	2102	122100	343	6931	410992
	Mean	17.1			29.8			23.1			20.2	
Sum of means		136.3			116.5			119.6			372.4	

$$\text{Mean } \frac{372.4}{9} = 41.4$$

Source of variation	Degrees of freedom	Sum of squares	Variance
Total	342	270986	
Between	8	198881	24860
Within	334	72105	$215.88 \times .058406$

$$\frac{1/10 + 1/52 + 1/150 + 1/10 + 1/10 + 1/20 + 1/10 + 1/37 + 1/44}{9} = \frac{.525652}{9} = .058406$$

Sum of squares

TABLE X
ANALYSIS OF CONTRIBUTORY CAUSES OF VARIATION IN GRUB POPULATION

Sources of variation	Degrees of freedom	Sum of squares	Variance
Between means of 9 classes	8	10755.1	
Between means of plots	2	67.3	33.6
Between means of dates	2	10560.9	5280
Interaction	4	126.9	31.7
Experimental error	334		12.6

factors such as birds, moles, and probably many as yet unidentified, which have reduced the numbers of grubs which followed the successive yearly flights. It is comforting to realize that enemies and possibly other factors (climatic) tend to hold in check such an overgrowing population. It would be of interest to know accurately what each may be and what contribution each makes to the whole control problem. In the present work all that can be said is that the nematode parasite was one such factor, and produced a distinct reduction in Japanese beetle larvae.

Summary

The small field plots inoculated with *Neoaplectana* in 1931 were studied through 1934. These plots were each periodically infested with a definite number of grubs and examined from time to time for parasitized material. The soil was frequently tested for the presence of larval nematodes in the second-stage, which is the only form capable of a free-living existence. Accurate yearly records were kept of the adult emergence from these plots. The evidence obtained showed that the parasite had permanently established itself and produced a high mortality. Large field experiments were also executed and two methods for the introduction of the nematodes were practiced. One method may be defined as surface introduction by spraying; the other subsurface introduction by burying. The spraying method, to date, has not yielded encouraging results. The subsurface method of introduction, however, yielded significant results. The nematodes became established, produced a high mortality, spread over the

entire experimental area and later to the surrounding field. No pronounced difference was noted in the results obtained between the heavily and lightly inoculated plots.

A statistical analysis of the experiment, started in the spring of 1933, showed that the plots within the errors of random sampling were alike in population. Later, during the same spring, the introduced nematodes significantly reduced the grub population close to the area in which they were planted, the amount of the reduction being perhaps 40 per cent. In the autumn of 1933, a fresh crop of beetle larvæ showed a population decline, but no significant difference was noted between the average number of grubs in any of the plots. In May 1934 a further drop in the population, not ascribed to nematodes, occurred in all of the plots. By June, however, the drop in the treated plots was over twice that in the control plot. Since by that time the control also became invaded by the parasites, part of the drop in this plot might have been due to them. The difference, therefore, between the treated and untreated areas is probably greater than indicated. The difference between one inoculated plot and the control and the difference between two inoculated plots and the control constitute differences of over 4 times their standard errors and are consequently significant. During September, 1934, a fresh crop of beetle larvæ showed a further marked decline in population. The parasites at this time were spread all over the experimental area. A test made between this parasitized area and the surrounding uninoculated field showed that the grubs had been distinctly reduced within the former.

Unfortunately it is impossible to maintain a constant, heavy population over a period of years within a given territory. Birds, moles, climate and unknown factors are undoubtedly responsible for this instability, which complicates any experimental procedure.

Acknowledgments

The writers wish to thank Mr. Harry B. Weiss and Mr. Edgar Rex of the New Jersey Department of Agriculture for their kindly interest and aid without which the field work would have been entirely impossible.

REFERENCES

1. GLASER, R. W., AND FOX, HENRY, A nematode parasite of the Japanese beetle (*Popillia japonica* Newm.), *Science* 71: 16, 1930.
2. STEINER, G., *Neoaplectana glaseri* n. gen., n. sp. (*Oxyuridæ*), a new nemic parasite of the Japanese beetle (*Popillia japonica* Newm.), *J. Wash. Acad. Sci.* 19: 436, 1929.
3. GLASER, R. W., The cultivation of a nematode parasite of an insect, *Science* 73: 614, 1931.
4. GLASER, R. W., Studies on *Neoaplectana glaseri*, a nematode parasite of the Japanese beetle (*Popillia japonica*), State of New Jersey, Department of Agriculture. Bureau of Plant Industry, Circular No. 211, 1–34, 1932.

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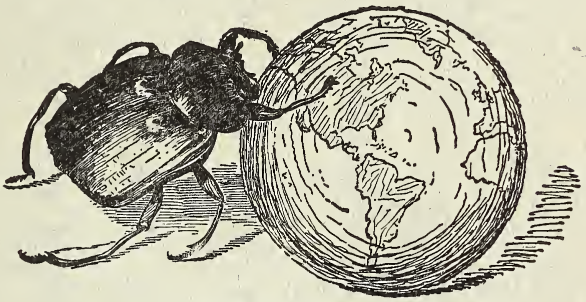

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DESCRIPTIONS OF NEW MEMBRACIDÆ FROM MEXICO[1]

BY C. C. PLUMMER

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, UNITED STATES DEPARTMENT OF AGRICULTURE

Very little concerning the Membracidæ of Mexico has appeared in the literature since Canon Fowler's monumental work was published. (Biol. Centr. Amer., Rhynch. Homop., v. 2, pt. 1, 339 pp., illus. 1894–1909.) This is the first of a series of papers in which the author hopes to add to our knowledge of this group in Mexico. It will be noted that the types, allotypes, and many of the paratypes are now in the collection of the author. They will eventually be deposited in the United States National Museum.

Ceresa mexicana new species. (Figs. 1–4)

Dark brown with black punctuations on suprahumeral horns and along each side of pronotum near dorsal ridge. Suprahumerals very heavy, not recurved. Apical third of tegmina smoky. Close to *vacca* Fowler, as judged from his figure. Length, 12 mm.; width between suprahumerals, 7 mm.

Head finely sculptured; ocelli nearer to each other than to the eyes; base arcuate.

Pronotum with suprahumeral horns heavy, long, straight, rounded at apex, extending forward well beyond face, upward to a point well below highest part of dorsum, laterally in an almost horizontal plane when viewed from the front, three definite sides, the posterior and lateral ones flat, the dorso-

[1] The author is greatly indebted to Dr. W. D. Funkhouser for his review and criticism of the manuscript.

cephalic one gently rounded; metopidium straight; flattened area between bases of suprahumerals; dorsum high, evenly and gradually rounded, sides tectiform, terminating in a long terminal process that sometimes extends past apex of fifth apical cell of tegmina; ventral margin of pronotum a long perfect arc from above first abdominal segment to apex of terminal process; uniformly, not rugosely, punctate.

Color dark brown, when well illuminated appearing reddish brown, and under magnification light brown with small reddish-brown markings or, sometimes, reddish brown with light-brown markings; black punctations on suprahumeral horns and along each side of pronotum near dorsal ridge; reddish-brown ridge separating posterior and lateral sides of each suprahumeral horn. Thorax and legs light brown. Abdomen dark brown and black. Tegmina hyaline, apical third smoky.

Type, ♀, Tenancingo, State of Mexico, October 22, 1933.

Allotype, ♂ (similar), Cuernavaca, Morelos, October 8, 1933. Described from 1♀ and 6♂♂ taken at type localities by author. Type, allotype, and 4♂♂ paratypes in author's collection; 1♂ paratype in collection of W. D. Funkhouser. Taken on oak (*Quercus* sp.) in Cuernavaca.

Fowler described and figured *C. vacca* from Guerrero. (*Ibid.*, p. 106, tab. vii, figs. 14–14a.) His figure 14 indicates that the suprahumerals rise above the crest of the pronotum, but in figure 14a they are much lower. Since his description was based on a single specimen, his drawings must have been made from it. From the drawings and the description it is possible to separate *mexicana* from *vacca,* but they are very close. Funkhouser has determined as *vacca* a more common species of *Ceresa* taken by the author in several localities in Mexico. He had compared some of his material with that in the British Museum and the Paris Museum and was quite confident of his determination. This *vacca* has much shorter horns than the species figured by Fowler and the present author. The horns of this species, when viewed from the side, project forward only a short distance and scarcely interrupt the dorsal line of the pronotum.

Since there may be some difficulty in separating these species, the male genitalia of *mexicana* are illustrated (Fig. 4). The striking feature is the extreme length of the aedeagus, extending to or above the rectum. In *vacca* it is shorter. The hook on the apex is usually not so definite and prominent in *vacca.* When the aedeagus of *mexicana* is viewed from behind, the sides are straight except at the apex, where the hook is located. At that point the aedeagus is narrower. In *vacca* it is wider just before the apical hook and a wide transparent central area is to be seen at that point. A similar transparent area is visible in *mexicana,* but it is much narrower. Near the base of the aedeagus (viewed from behind) there is another widened area with no transparent central area and sometimes a spine on each side above it. In *mexicana* the base is straight-sided. The styles are usually much heavier and darker than in *vacca.*

Poppea longicornis new species. (Figs. 5–7)

Cream to faded brown, sometimes yellow with light or dark brown markings. Long, heavy, recurved suprahumeral horns, with small space between them at their bases on dorsum of pronotum. Lateral processes of terminal trifurcate process very heavy, forming right angle with each other. Readily distinguished from *formosa, concinna, affinis,* and *munda* group by these pronotal characters. Very close to *rectispina* Fairmaire, but differing in having hairs on the pronotal disk, by black markings, and by smaller size. Length, 8 mm.; width between tips of suprahumeral horns, 4 mm.

Head smooth, shining, nearly three times as broad as long; ocelli nearer to eyes than to each other; base arcuate.

Pronotum with small node at base above each eye; metopidium almost straight; suprahumeral horns very close together, a narrow space between them on dorsum, subovate, massive basal half extending upward, outward, and sometimes slightly forward, distal half smaller, recurved, acuminate; dorsal elevation behind suprahumerals triangularly indented in front, constricted in front of enlargement bearing terminal trifurcate process; small node on each side below mid-dorsal enlargement; trifurcate process with long middle process, decurved, tip pointed, outer processes forming right angle with each other, slightly decurved, very heavy, subovate on basal two thirds, apical third much smaller, round, acuminate; punctate, large shallow punctations on sides from behind suprahumerals to front of enlargement in front of trifurcate process.

Color cream to faded brown throughout, sometimes bright yellow with light or dark brown markings and with dull brown abdomen. Pronotum pellucid where large punctations occur; extreme tips of suprahumerals and terminal processes black; numerous long black and yellow hairs on all parts of pronotum except nodes above eyes, humeral angles, and vicinity of large punctations. Small black spot on lateral margin of face below each eye; black spots near spiracles on fourth and fifth abdominal segments. Tegmina hyaline; veins cream to faded brown, sometimes yellow and dark brown.

Type, ♀, Cuernavaca, Morelos (5,050 ft.), November 29, 1931.

Allotype, ♂ (similar), same locality, November 22, 1931. Described from 8♀♀ and 2♂♂ from type locality and 1♀ from Coatepec, Vera Cruz. Type, allotype, 7♀♀ paratypes, and 1♂ paratype in author's collection; 1♀ paratype in collection of W. D. Funkhouser.

Antonae evelyna new species. (Figs. 8–10)

Pronotum usually cream and tinged with light brown and light green, sometimes light brown with cream-colored spots. Eight nodes on pronotum, the one in middle of dorsum much higher than others. Tegmina usually hyaline. Distinguished from *nodosa* Funkhouser and *bulbosa* Funkhouser by height of mid-dorsal node. Length, 6.5 mm.; width between tips of horns, 3.5 mm.

Head smooth, shining; ocelli nearer to eyes than to each other; base straight.

Pronotum with small node above each eye and in front of humeral angles; large suprahumeral nodes extending backward below front half of mid-dorsal node, usually slightly elevated above dorsum of pronotum in front of mid-dorsal node, each bearing an acuminate spine, projecting upward and backward; mid-dorsal node higher than suprahumeral nodes and node at base of terminal process; small node on each side below posterior half of mid-dorsal node; node in front of terminal process large, inflated, a deep semicircular impression on each side at attachment of terminal spine; terminal spine heavy at base, distal half attenuate, not straight; punctate, large shallow punctations in depressions between mid-dorsal node and caudal portions of suprahumeral nodes and nodes below mid-dorsal node, especially prominent at anterior constriction of node in front of terminal process.

Color of pronotum usually cream throughout, with faint light-brown markings, sometimes tinged with light green; sometimes light brown predominating and marked with irregular cream-colored patches; extreme tips of suprahumeral horns brown or black; extreme tip of terminal spine black; long light-brown and black hairs on all parts of pronotum except on nodes above eyes, humeral angles, nodes below mid-dorsal node, and depressions between nodes. Head, body, and legs cream to light brown; few black spots on face; legs marked with black spots, never appearing as rings. Tegmina hyaline throughout; venation cream to light brown, sometimes a few veins marked with dark brown.

Male: Pronotum always glossy light brown with cream and yellow markings, which predominate on nodes on sides of pronotum. Head, under surface of body, and parts of legs usually bright yellow; tibiae and tarsi light brown. Wing venation darker than in female. In other respects entirely similar to female.

Type, ♀, Cuernavaca, Morelos, October 15, 1933.

Allotype, ♂, Jiutepec (Xiutepec), Morelos (5,050 ft.), October 2, 1932.

Twenty ♀♀ and 9♂♂ paratypes from same localities. Two ♂♂ and 3♀♀ paratypes in collection of W. D. Funkhouser; others in collection of author. Described from 32♀♀ and 20♂♂.

The genus *Antonae* includes some species with six nodes on the pronotum and some with less. *A. evelyna* would probably come under that group having six nodes, such as *nodosa* and *bulbosa,* but the author feels justified in adding the small node above each eye, thus bringing the total to eight.

Parantonae ornata new species. (Figs. 11 and 12)

In general shape similar to *dipteroides* Fowler, but easily distinguished from that and other species of the genus by its basal cream color and mottled reddish-brown markings. Length, 9 mm.

Head smooth, shining, not punctate; three times as wide as long; base faintly arcuate; ocelli slightly nearer to each other than to the eyes, situated below a line drawn through centers of eyes; inferior margins of genae straight; clypeus deflexed, extending more than half its length below inferior margins of genae.

Pronotum punctate; humeral angles prominent, blunt, extending laterad much beyond the eyes; metopidium very sloping and rounded on sides; round lateral swelling on each side of mid-constriction extending laterad beyond lateral margins of cephalic half of pronotum, but not so far laterad as humeral angles; no rounded elevation on dorsum of posterior part of cephalic half of pronotum in front of constriction, as in *dipteroides.*

Color basal cream throughout, with uniform reddish-brown markings on head, pronotum, thorax, base of tegmina, and legs. Tip of pronotal spine, parts of veins of tegmina, femora, and parts of tibiae of third pair of legs, and base of ovipositor black; eyes dark brown, almost black; ocelli yellow with adjacent black spots. Few short yellow hairs on pronotum.

Type, ♀.

Described from 1♀ collected by the author at Cuernavaca, Morelos, September 9, 1933. In collection of author.

Xolonia new genus.

Short, subconical suprahumeral prominences, usually bluntly pointed behind humeral angles, points extending laterad but not attaining apices of these angles. Suprahumeral prominences usually elevated slightly higher than cephalic third of dorsum. Large mid-dorsal expansion behind suprahumeral prominences and higher than the latter, strongly depressed in front by percurrent carina, weakly depressed thereafter. Bulbous expansion on each side of mid-dorsal enlargement. Dorsolateral constriction behind mid-dorsal enlargement and in front of terminal process. Terminal process swollen, trispinose, the middle process much longer than the two lateral ones. Scutellum concealed; tibiae not dilated, posterior tarsi not reduced; tegmina membranous, third apical cell stylate, venation like that of *Clepsydrius constrictus* Fowler.

Type, *Xolonia variegata* new species.

One male specimen taken by Alfonso Dampf at a trap light in Tetela del Rio, Guerrero, has sharply pointed suprahumeral prominences, and these prominences are not elevated above the cephalic third of the dorsum. Thirty-six specimens from Cuernavaca, Morelos, and Oaxaca, Oaxaca, have bluntly pointed suprahumeral prominences that are elevated above the cephalic third of the dorsum.

This genus appears to stand between *Clepsydrius* Fowler and *Antonae* Laporte. It is very close to the former in many respects. The terminal process is the same as in *Clepsydrius,* but in most specimens it is not inflated quite so much. It can readily be distinguished from that genus by other pronotal characters.

Fowler described the genus *Clepsydrius* from a single specimen in which part of the middle spine of the trispinose process was missing. (*Ibid.,* p. 95, tab. vii, figs. 1–1a). Since a comparison is made with his type species, it can be said that he very closely estimated the length of the broken spine as shown in his figure. These spines are similar to those of *Xolonia* and are tipped with black, the middle spine also having a black band at the middle in specimens from Acapulco, Guerrero. One dark-brown specimen from an unkown locality in Mexico has brown trispinose markings.

Xolonia variegata new species. (Figs. 13–15)

Varying in color from dark brown to black with dark-brown markings. Distinguished from *Clepsydrius constrictus* Fowler by suprahumeral prominences. Length, 5.25 to 6 mm.

Head three times as wide as long, shining, not punctate, not pubescent, few hairs on face; clypeus extending below inferior margins of genae for slightly more than half its length, hairy; base straight; attachment of eyes not straight as in *Clepsydrius constrictus* and *Cyphonia clavata* Fab.; ocelli same distance from each other as from the eyes.

Pronotum coarsely punctate, largest punctations on middle third; usually well covered with long hairs except on latero-posterior parts of suprahumeral enlargements; with bulbous expansions on each side of mid-dorsal enlargement and a constriction in front of terminal enlargement; spines of trispinose terminal process not acuminate, outer ones usually pointed and slightly curved laterad, middle one pointed at apex and slightly decurved, usually, but not always, extending well beyond tip of abdomen.

Color varying so much from light brown to black as to be of little value as a character. All specimens with dirty yellow translucent trispinose terminal processes, the extreme tips usually black, sometimes dark brown; the middle spine usually banded at middle with black or dark brown. Tegmina hyaline, veins light brown, those from Cuernavaca with discoidal area dark brown to black; five apical and three discoidal cells. Wings with four apical cells.

Type, ♀, Oaxaca, Oaxaca (about 5,000 ft.), September 16, 1933. Allotype, ♂ (similar), from same locality. Taken by author at ruins of Monte Alban. Described from 9♀♀ and 2♂♂ from type locality; 13♀♀ and 12♂♂ collected by W. E. Stone at Cuernavaca, Morelos, and 1♂ taken at a trap light at Tetela del Rio, Guerrero, by Alfonso Dampf. Two ♀♀ and 2♂♂ paratypes in collection of W. D. Funkhouser; remainder, 31 paratypes, in collection of author.

Publilia erecta new species. (Figs. 16–18)

Light to dark brown with white or cream markings; female with erect horn on pronotum, male with no horn; pronotum wider from dorsum to venter at middle than in *porrecta* Fowler; only one discoidal cell in tegmina. Length, 5 mm.

Head typical of genus.

Pronotum with erect horn straight or nearly straight above head, apex of horn rounded or almost a right angle in front, almost a right angle in back; mid-dorsal depression behind horn followed by slight convexity and abrupt straight line to apex; apex not pointed; a line from highest point of convexity behind horn to lower margin of pronotum and parallel with vertical line of face and metopidium approximately one-third longer than a similar line made for *porrecta;* distinctly ribbed, one or more ribs following dorsal line of pronotum from convexity to apex; surface deeply punctate.

Tegmina typically with only one small discoidal cell.

Color varying from light brown with cream markings to dark brown with black and light-green markings; usually a small colorless transparent area in front of dorsal convexity and a smaller one behind. Abdomen dark brown to black. Legs light brown.

Male: Short rounded prominence in place of erect horn. In other respects similar to the female.

Type, ♀, Jiutepec (Xiutepec), Morelos, December 24, 1933.

Allotype, ♂, same locality and date.

Described from 23♂♂ and 17♀♀ taken January 1, 1932, and December 24, 1933, by sweeping tall, dry grass near Jiutepec, Morelos. Type, allotype, 10♀♀ and 10♂♂ paratypes in author's collection. Two ♀♀ and 2♂♂ paratypes in collection of W. D. Funkhouser.

Some females have horns longer than that shown (Fig. 16). The pronotal characters for this species are good and show that it is distinct from *porrecta*. In a series of 37 specimens, 33 had one discoidal cell, 1 had two discoidal cells, and 3 had none in the tegmina. Out of 74 specimens of *porrecta*, 73 had two discoidal cells and 1 had three discoidal cells in the tegmina.

Fowler's *porrecta* has never been figured and is given here for the first time. He stated that the pronotal horn was not a sexual difference (*ibid.*, p. 132), but all the author's material shows that only the female bears a horn on the pronotum. Funkhouser made a similar observation on the specimens in his collection from other localities. Most of the females of *porrecta* have a semicircular bright green area on the pronotum above the base of the tegmina (Fig. 19). This area becomes yellow in old specimens. There is no similar area on the pronotum of the male.

The short, rounded prominence of the male that replaces the pronotal horn of the female of *erecta* is constant in size and form, but in *porrecta* it varies considerably, as shown in figures 20, 21, and 22.

Platycentrus ramosicornis new species. (Figs. 23–25)

Close to *acuticornis* Stål, but less stout and smaller. Readily distinguished from *acuticornis* and *obtusicornis* Stål by the single prong on posterior face of each suprahumeral horn about 1 mm. from the apex. Length from front of head to tip of tegmina, 7 mm.; width between horns, 7.5 to 8 mm.

Head shining, punctate, not rugulose, very finely pubescent; ocelli nearer to each other than to the eyes; base arcuate at margins, the central half straight.

Pronotum with each suprahumeral horn straight, slightly curved and acute at apex, directed upward and outward on an angle that varies from that of *obtusicornis* to that of *acuticornis*, the apex as much as 1.5 mm. distant from a horizontal extension of the plane of the face and metopidium, triquetrous, a single sharp prong on posterior face about 1 mm. from apex, rugose only on upper surface; posterior process slightly broader than in *acuticornis*, enlarged, with percurrent ridge and almost straight sloping sides, apex acute; punctate.

Color light to dark brown; large number of dirty-cream to gray-green callosities on dorsum of pronotum; distal half of suprahumerals dark brown to black with brunneous rugosities only on upper surface, rugosities at proximal end lighter in color; posterior process dark brown to black; pronotum finely covered with short yellow hairs; exposed portion of scutellum cream-colored. Black markings on margins of face. Thorax and abdomen light brown. Tarsi black. Tegmina translucent, brown marked with black; venation distinct.

Type, ♀.

Described from 3♀♀ taken on mesquite at San Geronimo, Oaxaca, by W. E. Stone, April 26, 1932. Type and 2 paratypes in collection of author.

PLATE XXVII

Ceresa mexicana, n. sp.

Figure 1. Side view.
Figure 2. Dorsal view.
Figure 3. Front view.
Figure 4. Male genitalia and aedeagus.

Poppea longicornis, n. sp.

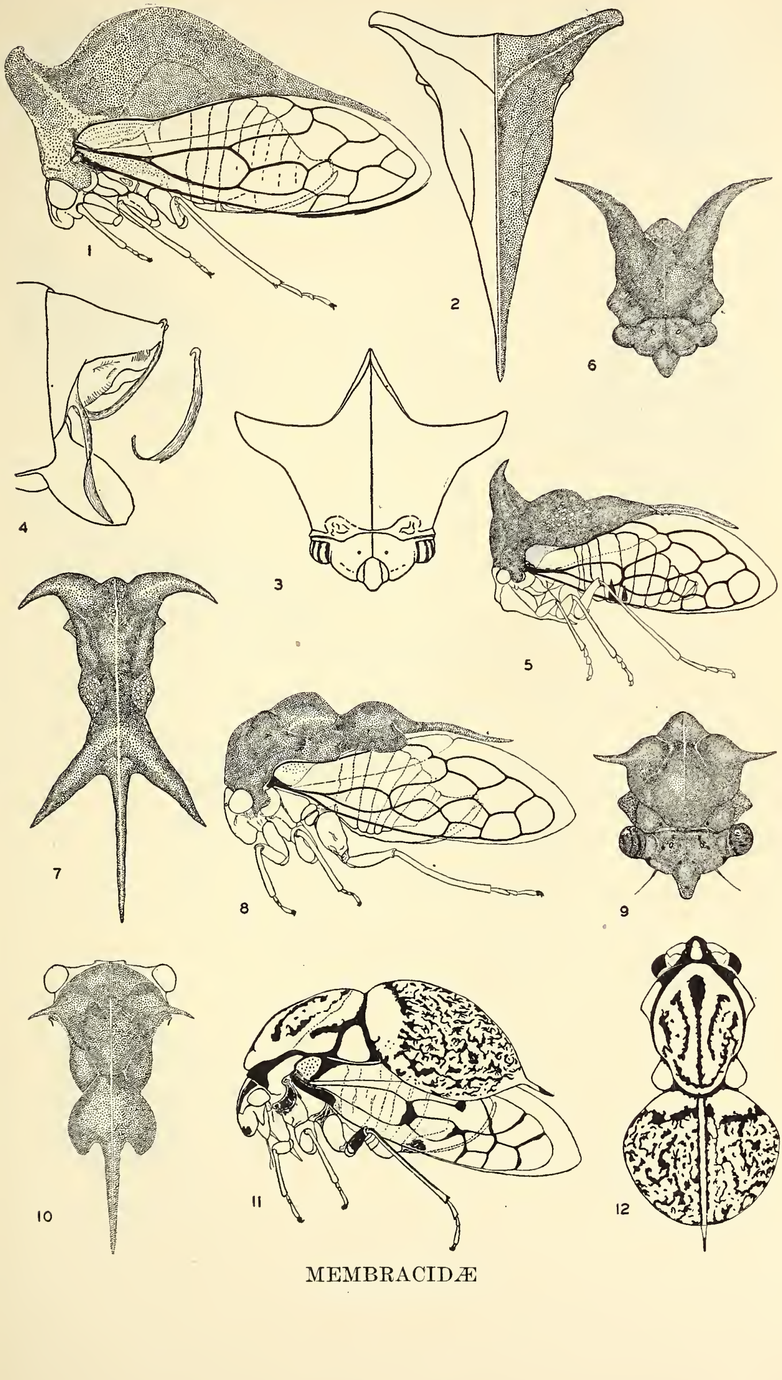
Figure 5. Side view.
Figure 6. Front view.
Figure 7. Dorsal view.

Antonae evelyna, n. sp.

Figure 8. Side view.
Figure 9. Front view.
Figure 10. Dorsal view.

Parantonae ornata, n. sp.

Figure 11. Side view.
Figure 12. Dorsal view.



MEMBRACIDÆ

PLATE XXVIII

Xolonia variegata, n. sp.

Figure 13. Side view.
Figure 14. Dorsal view.
Figure 15. Front view

Publilia erecta, n. sp.

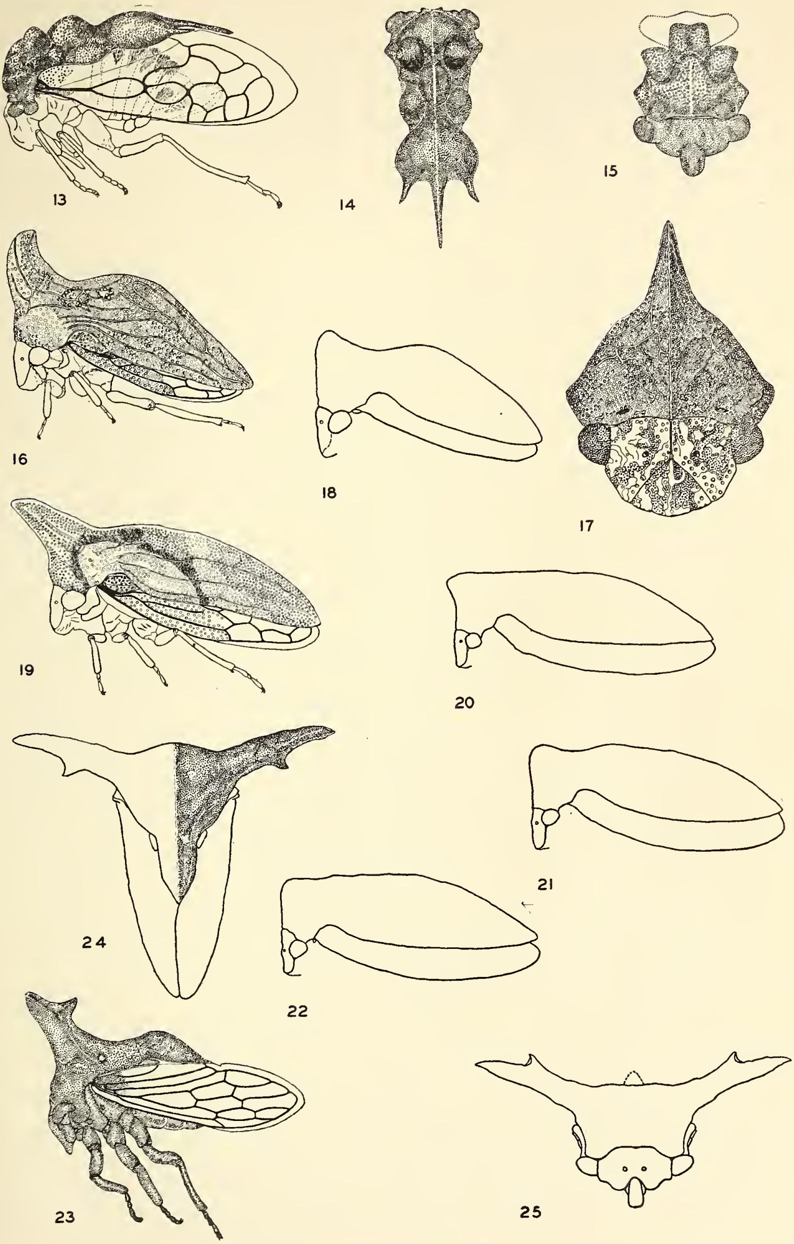
Figure 16. Side view, ♀.
Figure 17. Front view, ♀.
Figure 18. Side view, ♂.

Publilia porrecta Fowler

Figure 19. Side view, ♀.
Figures 20, 21, and 22. Side views, ♂ ♂.

Platycentrus ramosicornis, n. sp.

Figure 23. Side view.
Figure 24. Dorsal view.
Figure 25. Front view.



MEMBRACIDÆ

NORTH AMERICAN TWO-WINGED FLIES OF THE GENUS DORYPHOROPHAGA, (TACHINIDÆ, DIPTERA)

BY H. J. REINHARD
COLLEGE STATION, TEXAS

A synopsis of the tachinid genus *Doryphorophaga* with key to species and descriptions of four apparently new species are presented on the following pages. Types of the new species are in my collection.

Townsend described *Doryphorophaga* (Proc. Ent. Soc. Wash., Vol. 14, 1912, p. 164), with *Lydella doryphoræ* Riley[1] as the type and sole species. The description is largely in the form of a comparison with related genera and since few of the essential characters are mentioned the genus is briefly recharacterized below. The type species, *doryphoræ,* is widely distributed in the United States and is known as a rather common parasite of the Colorado potato beetle, *Leptinotarsa decemlineata* Say.

The only other known species is *D. aberrans* Townsend (Ent. News, Vol. 27, 1916, p. 217). It is also a parasite of the same beetle and was described from the male only. In 1931 Townsend designated *aberrans* the type species of *Adoryphorophaga,* new genus, (Revista Entomologia, Vol. 1, 1931, p. 469). The female differs from *doryphoræ* mainly in lacking a piercer and stout recurved spines on the middle coxæ. However there are apparently no structural characters of generic importance to distinguish the males.

The generic characters of *Doryphorophaga* (from the type species) may be briefly given as follows: Vibrissal axis of head much shorter than antennal; eyes hairy, often indistinctly so; facial ridges bristled on lower half to two-thirds; parafacials bare; ocellars distinct, proclinate; front moderately wide to vertex and two pairs of orbital bristles in both sexes; frontal bristles extending about to apex of second antennal segment; antennæ a little shorter than face; arista practically bare, basal

[1] First Report, Insects of Missouri, 1869, p. 111.

segments short; vibrissæ nearly on level with front edge of mouth; palpi normal in size; proboscis short. Propleura and metanotal slopes beneath calypters bare; prosternum haired at sides. Abdomen with small discals on intermediate segments, often lacking on one or both; female genitalia with an exposed strongly bowed and sharp-tipped piercer; inner forceps in male ordinary but outer ones unusually slender and elongated. Claws and pulvilli short in both sexes; middle coxæ in female bearing a comblike row of about five heavy spines. Wing venation normal; bend of fourth vein without a stump; apical cell open well before extreme wing tip; veins bare except base of third; costal spine small.

KEY TO SPECIES OF DORYPHOROPHAGA

1. Female with a distinct piercer and a comblike row of heavy recurved spines on middle coxæ; outer forceps in male very slender and about one-fourth longer than inner pair .... *Doryphorophaga* 2
   Female genitalia not adapted for piercing, the middle coxæ without any unusual bristles; outer forceps in male barely exceeding length of inner ones .... *Adoryphorophaga* 4
2. Parafacial distinctly wider than third antennal segment 3
   Parafacial narrower below, with at most subshining gray pollen; front in both sexes about equal eye width; third antennal segment four to six times longer than second; male with patches of fine short hairs on venter of third and fourth abdominal segments, (Texas, Ohio, Michigan, Iowa) .... *macella*, new species.
3. Sides of front and face silvery or gray, (United States, widespread) *doryphoræ* Riley.
   Sides of front and face with shining brownish pollen in male, usually paler or yellowish-gray in female, (Texas) .... *australis*, new species.
4. Mesonotum with dense pollen and conspicuously vittate; hairs on abdominal segments two and three depressed 5
   Mesonotum blackish and subshining, showing no well defined stripes; abdominal hairs suberect; outer forceps in male very slender; hind tibia bearing a row of long closely spaced cilia; male only, (Ohio, Texas) *sedula*, new species.
5. Fourth abdominal segment without well differentiated discals; antennæ usually reddish; ocellars small or vestigial; outer forceps in male rather broad to apex in profile; female genitalia retracted, terminating in a tapering blunt-tipped organ, (New England to Missouri). *aberrans* Townsend.
   Fourth abdominal segment bearing a row of strong discals; antennæ wholly black; ocellars distinct; female genitalia laterally compressed

with the apex broadly rounded as viewed from the side; eyes very indistinctly haired; female only, (Ohio, Texas) ....*patrita,* new species.

Doryphorophaga doryphoræ Riley

Lydella doryphoræ Riley, First Report, Insects of Missouri, 1869, p. 111.

Doryphorophaga doryphoræ Townsend, Proc. Ent. Soc. Wash., Vol. 14, 1912, p. 164.

There are numerous other references to the species in literature. Except in the Southwest it is apparently the commonest member of the genus. The species is very similar to *australis,* described below, but as indicated in the key differs in having the sides of the face and front silvery-gray. These items with the characters mentioned in the generic description seem sufficient to readily place the species. At College Station, it has been taken from April to October but in fewer numbers than the following species.

Doryphorophaga australis new species

MALE.—Sides of front and face including cheeks with shining brownish-yellow pollen the posterior orbits paler or yellowish-gray; front quite uniform in width and not very prominent below, at vertex 0.286 of the head width (five specimens measured: 0.28; 0.29; 0.28; 0.28; 0.30); parafrontals sparsely short-haired; median stripe red, about as wide as one parafrontal except on lower extremity; ocellar bristles well developed; orbitals two pairs, proclinate; inner verticals strong, outer ones about one-half as large; frontal rows diverging beneath antennæ to base of third segment, uppermost two bristles reclinate; parafacials bare, distinctly wider than third antennal segment; face moderately excavated, gray pollinose, its ridges strongly diverging downward, bearing bristles on about lower two-thirds; antennæ black, reaching to lowest fourth of face, third segment about four times longer than second; arista blackish, thickened on proximal fourth to third; eyes varying from practically bare to distinctly hairy; proboscis short and thick; palpi yellow becoming blackish basally, beset with black hairs on apical half; cheeks red in ground color, moderately black-haired below, about one-fifth the eye height; back of heat flat, gray pollinose, sparsely clothed with short whitish hairs.

Thorax black, gray pollinose; mesonotum marked with four black subshining stripes before the suture and five behind, outer ones widest and interrupted at suture; scutellum black, gray pollinose, disk bearing numerous erect short hairs. Chætotaxy: acrostichal 3,3; dorsocentral 3,3; intraalar 3; supraalar 3; humeral 3; posthumeral 2; presutural 2; notopleural 2;

postalar 2; pteropleural 1 (small); sternopleural 2,1; scutellum with 3 marginal, 1 smaller upturned apical and 1 discal pair; propleura and sides of postnotum bare; calypters whitish or faintly tawny.

Abdomen black, with gray pollen extending to apical third or fourth of intermediate segments and interrupted on median line by a narrow dark stripe; anal segment polished beyond the narrow basal pollen band which tapers toward side margin; ventral surface of segment four bearing large patches of fine short hairs extending upward on sides; discal bristles on intermediate segments variable, frequently absent on one or both; basal segments each with a pair of rather short median marginals; third bearing a row of ten or twelve; fourth with a discal and a marginal row; genital segments of moderate size, reddish-black; outer forceps slender from base to tip, about one-fourth longer than inner ones which are of an ordinary type, divided beyond middle but not divergent; fifth sternite deeply incised, lobes black, bearing a few long slender hairs.

Legs black; middle tibia bearing one strong bristle on outer front side near middle; hind tibia with a row of somewhat uneven bristles on the outer posterior margin; pulvilli and claws shorter than last tarsal segment.

Wings grayish hyaline; fourth vein with a rounded stumpless bend, thence approaching costa in a diagonal direction narrowing first posterior cell which is open shortly before extreme wing tip; third vein bearing two or three setulæ at base; hind cross vein oblique to fourth which it joins a little nearer bend than small cross vein; costal spine inconspicuous; epaulets black.

FEMALE.—Sides of face and front usually paler yellow than in male; front at vertex 0.316 of the head width (five specimens measured: 0.32; 0.31; 0.32; 0.31; 0.32); eyes inconspicuously short-haired; piercer of moderate length, strongly bowed forward tapering to an acute tip and grooved behind; middle coxæ bearing a row of five rather blunt-tipped backwardly directed spines; otherwise similar to male.

Length, 6.5 to 9 mm.

Described from 164 specimens (both sexes) collected at College Station, Texas, May to October, 1917–1934 (H. J. Reinhard); 1 female, San Antonio, January 28, 1929 (H. B. Parks); and 1 female Comanche Co., June 8, 1928 (V. A. Little).

Although the present species may be readily distinguished from *doryphoræ* by the brownish-yellow face and front, the structural differences in these forms are very slight. It has been reared at College Station from *Leptinotarsa decemlineata* Say and *L. defecta* Stal.

Doryphorophaga macella new species

MALE.—Front at vertex 0.325 of the head width (four measured: 0.34; 0.32; 0.31; 0.33), hardly any wider at base of antennæ; parafrontals gray pollinose to vertex and practically bare outside of frontal rows; median stripe dark red or blackish, wider than one parafrontal on upper half; verticals two pairs, outer ones divergent, about one-half the size of inner pair; ocellars well developed, proclinate; frontal bristles in a single row reaching to base of third antennal segment, uppermost bristle considerably shorter than preceding one and both reclinate, others directed inward; orbitals two pairs, proclinate; antennæ black, reaching almost to mouth, third segment five to six times the length of second and about as wide as parafacial on lower part; arista shorter than antennæ, blackish and finely pubescent, thickened on basal third, middle segment short; face gray pollinose, its ridges bristled on lower three-fourths; vibrissæ on level with mouth; parafacials with subshining gray pollen, bare; proboscis short and thick, labella fleshy; palpi yellow infuscated basally; cheeks gray pollinose, sparsely haired on lower margin, about one-fifth the eye height; eyes practically bare, back of head thinly clothed with pale hairs.

Thorax black, dusted with gray pollen which is interrupted by four narrow black stripes on the mesonotum; scutellum wholly black, with rather thin dull gray pollen extending from base to apex. Chætotaxy as in *australis,* but with only one posthumeral bristle present; postscutellum normal, gray pollinose; infrasquamal hairs absent; calypters opaque, white usually tinged with yellow.

Abdomen shining black, with broad basal bands of gray pollen on intermediate segments, interrupted along median line and somewhat changeable behind; fourth segment with a defined silvery pollen band which extends to basal fifth at middle above tapering towards the side, remainder of upper surface highly polished; venter with patches of soft short hairs on anal segment which extend forward on hind margin of third; discal bristles usually weak and sometimes absent on third segment; basal segments each with one pair of median marginals (small or vestigial on first); third bearing a marginal row of about eight; fourth with a discal and a marginal row; genitalia as in *doryphoræ.*

Legs black; claws and pulvilli short; middle tibia with one large anterodorsal bristle; hind tibia bearing a row of uneven bristles on outer posterior side with one near middle stouter.

Wings grayish hyaline; costal spine small; venation as in *doryphoræ.*

FEMALE.—Front at vertex 0.338 of the head width (five measured as follows: 0.33; 0.35; 0.32; 0.35; 0.34), widening slightly downward; third antennal segment about five times longer than second; abdomen shining black, basal third of last three segments with silvery pollen bands; first segment without median marginals and discals usually absent on segments two and three; genitalia and spines on middle coxæ as in *doryphoræ.*

Length, 5 to 6 mm.

Described from 44 specimens as follows: Four males (including holotype) and 33 females, College Station, Texas, April–October, 1917–35 (H. J. Reinhard); 2 males, San Antonio, Texas, January 28, 1929, and November 30, 1930 (H. B. Parks); 2 males and 1 female, Amherst, Ohio, July 1933–4 (H. J. Reinhard); 1 male, Iowa, June 2, 1932 (Barker); and 1 male, Ag. Coll. Michigan, September 6, 1922 (L. G. Gentner).

The wider front, longer third antennal segment, and narrower parafacials distinguish the species from *doryphoræ,* to which it seems closely related. The male shows an additional difference in having patches of fine short hairs on the ventral side of the third abdominal segment as well as on the fourth.

Doryphorophaga aberrans Townsend

Doryphorophaga aberrans Townsend, Ent. News, Vol. 27, 1916, p. 217.

Adoryphorophaga aberrans Townsend, Revista Entomologia, Vol. 1, 1931, p. 469.

The species was originally described from four male specimens reared from *Leptinotarsa decemlineata* Say and *Blepharida rhois* Forst. at Blacksburg, Virginia. A more complete description, including both sexes, was published by Smith in 1917 (Proc. Ent. Soc. Wash., Vol. 19, p. 124). Throughout its range of distribution the species seems most common in the northeastern states. There are two males in my collection from Atherton, Missouri, and Amherst, Ohio, besides a female from Harrisburg, Pennsylvania. In the latter sex the terminal part of the genitalia, although tapering and slightly projecting, is blunt or rounded on the apex. The ocellars are small or vestigial in both sexes; eyes indistinctly haired, and the third antennal segment reddish on basal part. In the male the two pairs of genital forceps are ordinary and about of equal length; inner pair gradually tapering outward, contiguous to the tip; outer ones rather broad and somewhat bowed, with the apex rounded as viewed from the side.

Doryphorophaga sedula new species

MALE.—Front (before vertex) 0.252 of the head width (average of four: 0.23; 0.25; 0.28; 0.25), widening uniformly downward, parafrontals gray pollinose becoming brownish near vertex, moderately clothed with fine black hairs which extend close to margin of eye on upper part; median stripe dark brown, much narrower than one parafrontal on the entire length, extending on either side of triangle to vertex; inner verticals and two proclinate orbitals well developed; ocellars of almost normal size, divergent and proclinate; frontal bristles descending to base of third antennal segment, upper two bristles reclinate the others directed inward; antennæ nearly as long as face, black, third segment tinged with red on extreme base and fully four times longer than second; arista with short basal segments, thickened on proximal third, blackish and finely pubescent; parafacial bare, with gray or almost silvery pollen, on narrowest part but little wider than third antennal segment; facial ridges bearing weak bristles on lower third; vibrissæ on level with mouth; proboscis short and fleshy, labella large; palpi ordinary, yellow beyond the infuscated base and beset with numerous black hairs; cheeks red in ground color, thinly gray pollinose and clothed with fine black hairs, about one-sixth the eye height; eyes indistinctly haired; back of head moderately clothed with rather short pale hairs.

Thorax black, thinly gray pollinose; mesonotum subshining but showing traces of stripes in a flat rear view; scutellum wholly black, lightly sprinkled with changeable gray pollen, disk clothed with erect hairs. Thoracic chætotaxy as mentioned under *australis*, but the apical scutellars are almost horizontal; infrasquamal hairs present; postscutellum normal, pale membranous above; calypters opaque, white.

Abdomen broadly reddish on the sides; last three segments wholly covered with grayish-white pollen, the hind edges of each in certain angles appearing darker; hairs on the upper surface erect; intermediate segments with a pair of moderate-sized discals, and the basal ones each with one pair of median marginals; third bearing a marginal row of ten or twelve; fourth with the entire upper surface bristly except along basal margin; inner forceps slender, divided beyond middle but not divergent, flat and densely pubescent behind almost to tip; outer ones reddish, very slender and a trifle longer than inner pair; fifth sternite deeply divided, the lobes black.

Legs rather slender, black; all claws and pulvilli shorter than last tarsal segment; middle tibia with one bristle on the outer front side near middle; hind tibia ciliated with one slightly stouter but not much longer bristle beyond middle of row.

Wings subhyaline; costal spine minute; fourth vein with a rounded stumpless bend, thence oblique toward costa and slightly bowed outward before the tip; apical cell open well before extreme wing tip; veins bare except third which bears two setules at base; hind cross vein bicurved, oblique to fourth and joining it distinctly nearer bend than small cross vein.

Length, 6.5 mm. Female unknown.

Described from twelve specimens as follows: 10 males (including holotype), Amherst, Ohio, July-Aug., 1934–35 (H. J. Reinhard); 1 male, Paris, Texas, June 27, 1926 (H. J. Reinhard); and 1 male, Canadian, Texas, May 3, 1931 (S. E. Jones).

Without reference to the genitalia the species might be confused with *aberrans,* which it resembles in general appearance except that the mesonotum is blacker and shows no defined vittæ and the abdomen is broadly reddish on the sides. Additional differences are mentioned in the key and descriptions.

Doryphorophaga patrita new species

Similar to *sedula,* from which it differs in the following characters: Front in female at vertex 0.306 of the head width (average of five: 0.31; 0.30; 0.30; 0.32; 0.30), widening gradually toward antennæ, the sides sparsely haired; outer verticals three-fourths as long as inner ones; facial ridges bearing bristly hairs on lower third or less; cheek densely gray pollinose and about one-fifth the eye height. Eyes practically bare. Thorax with dense gray pollen above, showing four narrow but distinct stripes before suture and five behind; chætotaxy as in *australis,* but the apical scutellars horizontal. Abdomen wholly black and subshining; hairs on dorsal surface depressed; last three segments with grayish pollen showing reflecting spots on either side of median line on the middle segments which change from light to dark when viewed in opposite angles; genitalia distinctive, somewhat compressed laterally and consisting of two convex plates which appear united along the median line behind with a slitlike opening near the anterior end, in profile this organ is broadly rounded and not fitted for piercing. Middle coxæ without any unusual spines. Hind tibia bearing a row of about ten fairly even bristles on the outer posterior side, one near middle considerably stouter.

Length, 6.5 mm. Male unknown.

Described from ten specimens from Amherst, Ohio, July–August, 1933–35 (H. J. Reinhard).

The species differs from all the forms here included in the structure of the female genitalia. In most details it agrees with *aberrans,* but the ocellars are normal in size and the eyes are more indistinctly haired.

THREE NEW SPECIES OF TIPHIA FROM EASTERN ASIA

BY L. B. PARKER[1]

ASSISTANT ENTOMOLOGIST, DIVISION OF JAPANESE AND ASIATIC BEETLE INVESTIGATIONS, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, U. S. DEPARTMENT OF AGRICULTURE

INTRODUCTION

In 1930 Allen and Jaynes, who were studying the taxonomy of Asiatic *Tiphia,* submitted certain specimens from China and Korea to A. B. Gahan for comparison with types in the British Museum. Gahan reported that, except for being somewhat smaller, the females seemed to be the same as the type female of *T. malayana* Cameron,[2] the male at that time being unknown. Allen and Jaynes subsequently published a description of the male together with descriptive notes on the female, under the name of *T. malayana* Cam.[3]

In the course of the rearing work at the Yokohama laboratory with *Tiphia* from Japan proper, which the author and his associates at first thought to be the same as the species from Chosen (Korea) known as *T. malayana* Cam., differences in their biology were observed which distinguished them from specimens from Chosen that had been considered to be the same form. These differences in habit prompted a closer investigation of the characters and characteristics of the two. These studies led to the discovery of differences between those from Chosen, designated as *T. malayana* Cam., by Allen and Jaynes, and specimens from Japan thought to be that species. Comparative studies made of

[1] Grateful acknowledgment is made of the assistance of H. W. Allen, whose suggestions, criticisms, and advice have been indispensable. Thanks are also due to K. Sato, who first pointed out the existence of differences between the Japanese and Chosenese species mentioned herein, and to C. H. Hadley and J. L. King for their counsel and encouragement during the preparation of this paper.

[2] *Tiphia malayana* Cameron, Entom. Runds., 27 Jahrg., p. 130. 1910.

[3] Contribution to the Taxonomy of Asiatic Wasps of the Genus Tiphia. (Scoliidae). H. W. Allen and H. A. Jaynes. No. 2814—From the Proceedings of the United States National Museum, Vol. 76, Art. 17, pp. 1–105, pls. 1–4. 1930.

specimens from Japan, Chosen, and China revealed differences by which material from the three regions could be distinguished. After making a close study of Gahan's notes on the type female of *T. malayana* Cam. from Borneo, the author concluded that none of the three species which were being identified as *malayana* actually belonged to that species. This conclusion is supported by the general fact that related species of the genus are believed to have rather limited distribution. In order that the three species discussed in this paper may be more readily distinguished from one another and less likely to be confused with *T. malayana* Cam., the author has described the distinguishing characters of each.

Since the description of *frater,* as given herein, applies specifically to the specimens from Chingkiang, China, the author wishes to point out that specimens which he examined from Kuliang, China, and which were originally included by Allen and Jaynes under the name *malayana,* though identical with *frater* in most characters, have not been included in the species. The reason for this discrimination is based upon the existence of characters which, in the writer's opinion, should be given more study in the light of possible new species before they are permitted to complicate one just established. The description of the male by Allen and Jaynes, under the name *malayana,* was based upon a selected specimen from Kuliang, China. As this is now known to be different from both the true *malayana* from Borneo and *frater* from Chinkiang, it naturally follows that neither of those names can be correctly applied to the species which this specimen represents. All three of the new species described here key out to couplet 28 in the key by Allen and Jaynes, but may be separated further by the use of the character differences given in the accompanying key.

As the terminology and phraseology used in this manuscript follow those used by Allen and Jaynes in "Contribution to the Taxonomy of Asiatic Wasps of the Genus Tiphia. (Scoliidæ)," reference to that publication should be made for definition of terms.

KEY FOR SEPARATION OF SPECIES

Females

A. Propodeal areola with sides parallel .... *T. frater,* n. sp.

Propodeal areola with sides not parallel ....B

B. Punctures of punctate transverse discal band of pronotum noticeably differentiated; punctate area on dorsum of pronotum divided by a narrow medial prolongation of the impunctate apex..*T. satoi*, n. sp.

Punctures of punctate transverse discal band of pronotum not differentiated; punctate area on dorsum of pronotum not divided by a prolongation of the impunctate apex..........................*T. sternata*, n. sp.

Males

A. First sternite with distance from escutcheon to posterior sulcus two-thirds as long as sulcus ....*T. frater*, n. sp.

First sternite with distance from escutcheon to posterior sulcus at least slightly greater than length of sulcus..B

B. First tergite with preapical band of punctures narrow, seldom abruptly impressed on anterior margin, all medial punctures in band differentiated ....*T. sternata*, n. sp.

First tergite with preapical band of punctures narrow, usually abruptly impressed on anterior margin, with punctures differentiated only on posterior border ....*T. satoi*, n. sp.

Tiphia frater new species

Tiphia malayana Allen and Jaynes, not Cameron (in part).

FEMALE.—Vertex with primary punctures largely of third-degree density, with medial patch slightly denser than patches on either side; several minute punctures on medial line near posterior declivity. Front lightly shagreened on lower half; usually no impunctate stripe; primary punctures of first-degree density from eye to eye on lower third and upward to vertex along inner orbits, of third-degree density in front of ocelli; upper half with interspaces distinctly larger than ocellus. Clypeus slightly bilobate; length of impunctate margin nearly one-half as great as the distance from apex of clypeus to edge of antennal fossa. Antenna with third joint distinctly shorter than its greatest width; flagellum fulvous beneath. Dorsum of pronotum with primary punctures of uniform size and well differentiated from secondaries, of first-degree density except for small latero-discal spots; transverse discal band not differentiated. Transverse carina obsolete medially. Side of pronotum with a deep continuous groove across the center, but lacking other conspicuous sculpturing. Metanotum with the largest punctures much finer than those of scutellum. Legs with major calcarium of hind tibia distinctly widest at bend near middle; hind basitarsus with a shallow groove at least half the length of the joint, outside with a row of three long, lanceolate spines, one of which is apical. Tegula red to black, semitransparent, inner posterior angle produced and densely pilose, with several suberect hairs rising above the tegula when viewed from across the dorsum. Wings faintly smoky; stigma more than twice as long as wide, extending distally in a broad curve from junction with radius. Propodeal areola with sides parallel; from two to two and one-half times as long as wide; carinæ sharp and narrow, bordered with well developed grooves; median carina extending nearly to the transverse carina. Lower portion of sides of propodeum shagreened, usually with a large patch of very minute setigerous punctures. Posterior aspect of propodeum with carina flattened, bordered by shallow impressions. First abdominal tergite with apical band consisting of punctures about one row wide at center, widening at sides into depressed patches of coalesced punctures. First sternite with lateral grooves on posterior three-fourths; other fourth coriaceous; disk lacking the usual dense minute punctures posteriorly. Tergites with preapical setigerous punctures becoming more nearly discal medially where impunctate nonmembranous apices are at least four times width of near-by primary punctures; row of minute punctures appearing on sides, but not on dorsum back of the row of preapical setigerous punctures. Pygidium reticulo-punctate on basal half, with a conspicuous median impunctate identation; apex smooth. Length 7.5 to 10.5 mm.

MALE.—Vertex with primary punctures in dense medial patch of first-degree density. Front strongly shagreened; preocellar area with primary punctures of regular second-degree and third-degree density and with interspaces much broader than an ocellus; secondary punctures nearly lacking, though primaries gradually diminish in size toward base of antennæ. Antennocular distance less than the width of antennal fossa. Clypeal extension with its apical width two-thirds as great as distance from apex of clypeus to edge of antennal fossa; disk conspicuously shagreened; apex without impunctate border, distinctly emarginate. Antenna with flagellum often broadly infuscated beneath. Pronotum faintly shagreened; primary punctures small and largely of third-degree density; several secondary punctures antero-medially. Side of pronotum striate, with strong groove, more or less interrupted by diagonal rugulæ, crossing center in broad curve; several punctures along upper border. Mesepisternum shagreened; primary punctures diminishing in size and density away from prepectus; secondary punctures conspicuously less numerous than primaries over a vaguely defined area in center anterior to spiracle. Scutellum without impunctate apex as wide as hindmost primary punctures. Metanotum variable. Tibiæ and femora sometimes partly reddish. Tegula polished, varying from translucent reddish to opaque black. Wings subhyaline, with radial cell exceeding second cubital cell in apical extension. Propodeum with its transverse carina extending far forward medially; areola about twice as long as its posterior width, its sides slightly convergent caudad, the groove on outer borders of lateral carinæ somewhat crenulate; median carina tapering to apex, which is situated just before transverse carina; enclosed area flat, granulate; lower portion of sides of propodeum densely striate, not finely hairy or punctate; posterior aspect densely hairy, punctate except on the conspicuous, polished, impunctate spots above, with a median carina present on lower half or less. First tergite with preapical band narrow, usually abruptly impressed on anterior margin, with punctures differentiated only on posterior border. First sternite with disk polished, impunctate, the lateral grooves extending forward a variable distance, sometimes to anterior apex; constricted portion with an elongate median keel; distance from escutcheon to posterior sulcus one-third greater than length of sulcus. Tergites 3 to 5 with punctures not clearly outlined, apical ones larger than the more densely grouped anterior ones; impunctate margins narrow, scarcely twice as wide as width of largest adjacent primary punctures. Length 5 to 7 mm.

Distribution.—Chinkiang, China.

The following specimens were in the series studied for the descriptive work.

Type and allotype.—No. 50740 U. S. National Museum type, female, and allotype, male, Chinkiang, China, July 7, 1924 (H. A. Jaynes).

Paratypes.—In the U. S. National Museum: One female from Chinkiang, China, July 20, 1924 (J. F. Illingworth); one male from Chinkiang, China, July 7, 1924. Deposited in the collection of the Academy of Natural Sciences of Philadelphia: One female from Chinkiang, China, July 20, 1924 (J. F. Illingworth); one male from Chinkiang, China, July 7, 1924. Retained in the collection of the Japanese and Asiatic beetle laboratory: One male from Chinkiang, China, July 4, 1924; one female from Chinkiang, China, July 7, 1924 (H. A. Jaynes); one female from Chinkiang, China, July 20, 1924, and one male from Chinkiang, China, July 7, 1924 (J. F. Illingworth).

Tiphia sternata new species

FEMALE.—Vertex with primary punctures largely of third-degree density, with medial patch slightly denser than patches on either side; several minute punctures on median line near posterior declivity. Front slightly shagreened on lower half, usually no impunctate stripe; primary punctures of first-degree density from eye to eye on lower third and upward to vertex along inner orbits, of third-degree density in front of ocelli, several interspaces as wide as an ocellus. Length of impunctate margin of clypeal extension nearly one-half as great as distance from apex of clypeus to edge of antennal fossa. Antennæ with third joint slightly shorter than its greatest width; flagellum fulvous beneath. Dorsum of pronotum distinctly though not heavily shagreened in punctate area, with primary punctures of uniform size and well differentiated from secondaries, of first-degree density except for small latero-discal spots; transverse discal band not differentiated. Side of pronotum with a deep, continuous groove across the center, but lacking other conspicuous sculpturing. Metanotum with the largest punctures much finer than those of the scutellum. Legs with major calcarium of hind tibia distinctly widest at bend near middle; hind basitarsus with shallow groove at least half the length of joint, outside with a row of three long, lanceolate spines, one of which is apical. Tegula reddish to black, rarely transparent; inner posterior angle produced and densely pilose with several suberect hairs rising above tegula when viewed from across dorsum. Wings faintly smoky; stigma more than twice as long as wide, extending distally in broad curve from junction with radius. Sides of propodeal areola distinctly concave, broader anteriorly, from two to three times as long as its posterior width; carinæ sharp and narrow, bordered with well developed grooves; median carina ending just before transverse carina. Lower portion of sides of propodeum shagreened, usually with a large patch of very minute setigerous punctures. Posterior aspect of propodeum with median carina flattened, bordered by shallow impressions, and extending to transverse carina. First abdominal tergite with preapical band consisting of punctures about one row wide at center, widening at the sides into depressed patches of coalesced punctures. First sternite with lateral grooves on posterior three-fourths, ending in a series of interrupted impressions; other fourth coriaceous; disk with punctures microscopic and sparse. Tergites with preapical setigerous punctures becoming more nearly discal medially where impunctate, nonmembranous apices at least four times width of near-by primary punctures; a row of minute punctures appearing on sides, but not on dorsum back of preapical row of setigerous punctures. Pygidium uniformly reticulo-punctate on basal half, with a conspicuous median impunctate indentation; apex smooth. Length 8 to 10 mm.

Male.—Vertex with primary punctures in dense medial patch of first-degree density. Front strongly shagreened; preocellar area with primary punctures of regular second-degree and third-degree density and usually with interspaces as broad as an ocellus; secondaries nearly lacking though primaries diminishing in size toward base of antennae. Antennocular distance about one-half width of antennal fossa. Clypeal extension with its apical width seldom as great as distance from apex of clypeus to edge of antennal fossa; disk perceptibly convex and broadly shagreened; apex distinctly roundly emarginate, without impunctate border. Antennæ wholly black. Pronotum faintly shagreened; primary punctures small, and largely of third-degree density; several secondary punctures antero-medially. Side of pronotum striate, with strong groove, more or less interrupted by diagonal rugulæ, crossing center in a broad curve; several punctures along upper margin. Mesepisternum conspicuously shagreened, primary punctures diminishing in size and density away from prepectus, everywhere of third-degree density; secondary punctures conspicuously less numerous than primaries over a vaguely defined area in center anterior to spiracle. Scutellum without impunctate apex as wide as lowest primary punctures. Metanotum variable. Legs with tibiæ and femora usually black. Tegula opaque black, polished and faintly shagreened. Wings subhyaline with radial cell exceeding second cubital cell in apical extension. Propodeum with its transverse carina extending far forward medially; areola about one and one-half times as long as posterior width, its sides slightly convergent caudad; the groove on outer borders of lateral carinæ somewhat crenulate, median carina tapering to apex, which is situated just before transverse carina; enclosed area flat, granulate; lower portions of sides of propodeum densely striate, not finely hairy or punctate; posterior aspect densely hairy, punctate except on the conspicuous, polished, impunctate spots above, with a median carina present on lower half or less. First tergite with preapical band seldom impressed on anterior margin, all medial punctures in band differentiated. First sternite with distance from escutcheon to posterior sulcus about one and one-half times length of sulcus; disk polished, impunctate, with lateral grooves on posterior half; constricted portion with elongate median keel. Tergites 3 to 5 with punctures not clearly outlined, apical ones larger than the more densely grouped anterior ones; impunctate margins at most about three times as wide as width of largest adjacent primary punctures. Length 5 to 7 mm.

Distribution.—Obuse, Shimajima, Ueda, and Kamisuwa in Nagano prefecture, Japan; Kagamigahara in Gifu prefecture, Japan; Nasu in Tochigi prefecture, Japan; Tokyo, Japan; Hashimoto and Yokohama in Kanagawa prefecture, Japan; Yukuhashi, Kyushu, Beppu, Kujyu, Asaji, Makiguchi, Shimabara, and Unzen on the Island of Kyushu, Japan.

The following specimens comprised the series used for the descriptive work.

Type and allotype.—No. 50741 U. S. National Museum type, female, Yokohama, Japan, May 19, 1931, (S. Fujii). Allotype, male (reared), Yokohama, Japan, November 10, 1932 (L. B. Parker).

Paratypes.—In the collection of the U. S. National Museum: Three females, Yokohama, Japan, May 19, 1931 (S. Fujii); one male (reared), Yokohama, Japan, November 5, 1932. Deposited in the collection of the Academy of Natural Sciences of Philadelphia: Two females, Yokohama, Japan, May 9, 1931, and 1 female, Hashimoto, Japan, June 9, 1931 (S. Fujii); one male (reared), Yokohama, Japan, October, 1932. Retained in the collection of the Japanese beetle laboratory: One female, Hashimoto, Japan, June 9, 1931; one female, Yokohama, Japan, May 19, 1931 (S. Fujii); one female (reared), Yokohama, Japan, October 31, 1931; one male (reared), Yokohama, Japan, October,

1932. At the time the previously mentioned descriptive notes by Allen and Jaynes were written this species was not known. It now appears, however, that *sternata,* while a separate species, more closely resembles *frater* from Chinkiang, China, than *satoi* from Chosen. *T. sternata* has been known to workers on the Japanese and Asiatic Beetle Investigations as *Tiphia* sp. No. 6-b.

Tiphia satoi new species

Tiphia malayana Allen and Jaynes, not Cameron (in part).

Female.—Vertex with primary punctures largely of third-degree density, with medial patch slightly denser than patches on either side, several minute punctures on medial line near posterior declivity. Front usually polished but with no impunctate stripe; primary punctures of first-degree density from eye to eye on lower third and upward to vertex along inner orbits, of third-degree density in front of ocelli, with several interspaces as wide as an ocellus. Length of impunctate margin of clypeal extension nearly one-half as great as the distance from apex of clypeus to edge of antennal fossa. Antenna with third joint distinctly shorter than its greatest width; flagellum fulvous beneath. Pronotum with primary punctures on dorsum of uniform size and well differentiated from secondaries, usually slightly less dense in an area just anterior to the transverse discal band except where a narrow medial prolongation of the impunctate apex divides the punctate area, reaching to the transverse discal band, rarely separated from it by the width of one puncture. Side of pronotum with a deep, continuous groove across the center, but lacking other conspicuous sculpturing. Metanotum with the large punctures much finer than those of scutellum. Legs with major calcarium of hind tibia distinctly widest at bend near middle; hind basitarsus with a shallow groove at least half length of joint, outside with a row of three long lanceolate spines, one of which is apical. Tegula polished, black, with a translucent reddish border; inner posterior angle produced and densely pilose. Wings faintly smoky; stigma more than twice as long as wide, extending distally in a broad curve from junction with radius. Sides of propodeal areola at most slightly concave, areola expanded anteriorly, ''keystone'' shaped, from two and one-half to three times as long as posterior width; carinæ sharp and narrow, bordered by well developed grooves; median carina ending just before transverse carina. Lower portion of side of propodeum shagreened, usually with a large patch of very minute setigerous punctures. Posterior aspect of propodeum with median carina flattened, bordered by shallow impressions, and extending from the lower transverse carina to the upper transverse carina. First abdominal tergite with apical band consisting of punctures about one row wide at center, widening at sides into depressed patches of coalesced punctures. First sternite with lateral grooves on posterior three-fourths; other fourth coriaceous; disk with punctures becoming sparse and microscopic posteriorly. Tergites with preapical setigerous punctures becoming more nearly discal medially where impunctate nonmembranous apices are at least four times width of near-by primary punctures; a row of minute punctures appearing on sides, but not on dorsum, back of preapical row of setigerous punctures. Pygidium uniformly reticulo-punctate on basal half, with a conspicuous median impunctate indentation; apex smooth. Length 8 to 10.5 mm.

MALE.—Vertex with primary punctures in dorso-medial patch of first-degree density. Front strongly shagreened; preocellar area with primary punctures of regular second-degree and third-degree density and with interspaces broader than an ocellus; secondary punctures nearly lacking, though primaries gradually diminishing in size toward base of antennæ. Antennocular distance almost as great as width of antennal fossa. Clypeal extension with its apical width distinctly less than the distance from apex of clypeus to edge of antennal fossa; disk perceptibly convex; apex roundly emarginate, without impunctate margin. Antennæ wholly black. Pronotum faintly shagreened dorsally, with primary punctures small and largely of third-degree density; several secondary punctures antero-medially. Sides of pronotum striate, with strong groove more or less interrupted by diagonal rugulæ, crossing center in a broad curve; several punctures along upper margin. Mesepisternum conspicuously shagreened; primary punctures diminishing in size and density away from prepectus, everywhere of third-degree density; secondary punctures conspicuously less numerous than primaries over a vaguely defined area anterior to spiracle. Scutellum without impunctate apex as wide as hindmost primary punctures. Metanotum variable. Tibiæ and femora sometimes partially reddish. Tegula polished black. Wings subhyaline, with radial cell exceeding second cubital cell in apical extension. Propodeum with its transverse carina extending far forward medially; areola about twice as long as its posterior width; sides convergent caudad, the groove on outer borders of lateral carinæ somewhat crenulate; median carina tapering to apex, which is situated just before transverse carina; enclosed area flat, granulate; lower portion of sides of propodeum densely striate, not finely hairy or punctate; posterior aspect densely hairy, punctate except on the conspicuous, polished, impunctate spots above; median carina usually complete though faint posteriorly. First tergite with preapical band narrow, usually abruptly impressed on anterior margin, and with punctures differentiated only on posterior border. First sternite with disk polished, impunctate, with lateral grooves usually on lower half; constricted portion with an elongate median keel; distance from escutcheon to posterior sulcus slightly greater than length of sulcus. Tergites 3 to 5 with punctures not clearly outlined, apical ones larger than the more densely grouped anterior ones; impunctate margins at most about three times as wide as width of largest adjacent primary punctures. Length 5 to 7 mm.

Distribution.—Keisho Nan Do, Chusei Nan Do, and Keiki Do, Chosen (Korea).

The following specimens comprised the series studied for the descriptive work.

Type and allotype.—No. 50742 U. S. National Museum, type, female, and allotype, male, Gumpojo, Chosen, May 10, 1932 (L. B. Parker).

Paratypes.—Placed in the U. S. National Museum: One female, Gumpojo, Chosen, May 10, 1932; two females, Gumpojo, Chosen, May 9, 1932; and three males, Gumpojo, Chosen, May 11, 1932 (L. B. Parker). Deposited in the collection of the Academy of Natural Sciences of Philadelphia: One male and one female, Gumpojo, Chosen, May 9, 1932 (L. B. Parker); one female, Suigen, Chosen, June, 1931, and one male, Gumpojo, Chosen, May 9, 1932 (K. Sato). Retained in the collection of the Japanese beetle laboratory: One female, Suigen, Chosen, May 4, 1931 (H. Sugiura), and one female, Suigen, Chosen, May 4, 1931 (K. Sato); two males, Suigen, Chosen, May 5, 1931 (K. Sato). This species has been known to workers on the Japanese and Asiatic beetles project as *Tiphia* sp. No. 6-a.

PRELIMINARY STUDIES ON THE DISEASES OF LARVÆ OF THE JAPANESE BEETLE (POPILLIA JAPONICA NEWM.)

BY I. M. HAWLEY
SENIOR ENTOMOLOGIST,
AND
G. F. WHITE
SENIOR PATHOLOGIST, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE, UNITED STATES DEPARTMENT OF AGRICULTURE

Early in investigations on the Japanese beetle (*Popillia japonica* Newm.) it was found that many of the larvæ, both in the field and in storage cellars, became diseased and soon died. Disease became so rampant that sometimes fully 50 per cent of the larvæ collected and stored for biological studies and parasite rearing died. Besides causing loss to experimental work, it was soon realized, when systematic surveys of the larval population in the field were undertaken, that disease might be at least partially responsible for the observed variations in numbers of the insect in the infested area.

For the past seven years, at least, the Japanese beetle has been decreasing in abundance in the older infested area centering around Riverton, N. J., where it was first found in this country. This decrease has taken place when the insect has not only been abundant, but increasing in numbers in more recently infested areas. Entomologists working with the insects have put forth several theories to explain the reduction in the older area. It is now well established that shortage of rainfall at the times when eggs and small larvæ predominate in the soil causes a reduction in larval population. However, shortages of rainfall alone can not explain the general trend occurring during the entire period of reduction. Other possible agencies, such as birds, predatory and parasitic insects, soil treatments to destroy the larvæ, and spraying operations to kill the adults, contribute to this reduction to a a minor degree.

PREVIOUS STUDIES

The earliest studies on the diseases of Japanese beetle larvæ were made by the late George E. Spencer, at the Japanese beetle laboratory of the Bureau of Entomology, from 1926 to 1927. When healthy larvæ were inoculated by the puncture method with pure bacterial cultures isolated from diseased larvæ, it was plainly shown that some of the organisms were highly pathogenic. In some preliminary experiments Spencer attempted to determine the methods of infection under normal field conditions, and found that injured larvæ acquire the disease more readily than normal ones.

It has already been stated that a high mortality often occurs among larvæ stored in a cool place for winter experimental work. Such larvæ are placed in large tubs with soil. Larvæ crowded thus often bite or nip one another, and wounds so produced may conceivably aid in the spread of disease from a few affected individuals in storage containers to healthy larvæ near-by. If disease were due mainly to crowding, it would be expected to be more prevalent in fields having a high larval population, but from our recent field surveys there is no clear evidence that this is the case.

Spencer found that larvæ are attacked to some extent by fungi. Though relatively scarce under field conditions, fungus-infected larvæ have at times been commonly found in experimental rearing cages. Through the efforts of Dr. L. O. Howard, two cultures of *Isaria densa* Auct., a pathogen of *Melolontha,* were obtained from France. When 94 healthy Japanese beetle larvæ were placed in soil contaminated with this fungus, a fungous growth developed on 48 of them. Of 12 larvæ placed in pure cultures of the fungus, 5 became diseased.

In 1928 studies on the diseases of larvæ were renewed at the Japanese beetle laboratory by Dr. Henry Fox, the work being undertaken in cooperation with Dr. R. W. Glaser of the New Jersey Department of Agriculture. Bacterial cultures from black or brown diseased larvæ were obtained and used in field treatments. The treated plots were frequently examined and no diseased larvæ were found. As this work was getting under way, a promising parasitic nematode, *Neoaplectana glaseri* Steiner, was encountered, on which attention was thereafter concentrated.

PRESENT STUDIES

In September 1933 studies on the diseases of the larvæ were renewed at the Japanese beetle laboratory in cooperation with the junior author.

Diseases of the Larvæ

The sick and the dead larvæ taken in the field were classified tentatively into three groups, the black group, the white group, and the fungous group. Preliminary studies on these groups indicated that there are more than three diseases affecting the larvæ.

Black group.—Dead larvæ the remains of which become black, dark gray, or brown constitute the majority of the diseased grubs found. The remains of larvæ of this group were crushed and suspended in distilled water. This suspension was strained and used to inoculate healthy larvæ by puncture, by dipping the larvæ, by treating the food of larvæ, and by treating blotting paper with which the tin rearing containers were lined. The resulting mortalities were but little higher than those found in untreated checks. In a series of tests, however, in which a diseased larva was placed in a tin salve box with a healthy one, there resulted a mortality of 40 per cent at the end of 3 weeks. Two checks showed mortalities of 4 and 8 per cent, respectively.

While microscopic examinations of dead larvæ of this group showed numerous bacteria, only a few species occurred on agar plates inoculated with material from the decaying remains. Among these were spore-bearing species forming colonies having an opaque frosted appearance, non-spore-producing species forming gray colonies, and others forming bluish ones.

Pure cultures of three of these species were used for inoculating healthy larvæ by the puncture method.[1] Larvæ used for checks were punctured with a sterile needle. All larvæ were kept singly in sterilized tin salve boxes lined with moistened blotting paper. Wheat was added as food. Of the 10 larvæ in each of the three series, 5, 7, and 8, respectively, were dead after 2 weeks. All check larvæ were alive. The diseased larvæ ex-

[1] A. R. Rolfs, of the Japanese beetle laboratory, made these inoculations and ably assisted in carrying out these tests.

hibited a variety of symptoms. In one series the 5 larvæ that died turned dark while sick and after death became jet black. The head was discolored, the body wall was flabby, and there was no odor. In the second series the 7 larvæ that died became whitish gray at first and later turned black. The head was not discolored and there was no odor. The discoloration appeared first on the thorax at the point of puncture. Some black watery fecal matter exuded from the anus. In the third series the larvæ that died showed a grayish discoloration at first, black patches then appeared, and the entire body became a dull black within a week after death. Each of the three cultures showed considerable virulence. All the larvæ that died finally became black, though there was some variation in the earlier symptoms. Although the different symptoms noted for this group may be due to the presence of different species of bacteria during decay of the remains, it seems quite as probable that more than one disease may be present in this group.

White group.—At times larvæ that have an unnatural milky-white appearance are found in the field. These are frequently alive when encountered. Tissues escaping from the torn body wall of larvæ sick or recently dead of this disease are filled with a microorganism in pure or nearly pure culture. Attempts to grow this species on the usual as well as special media have not yet been successful. It seems likely that an infectious disease is present in this group and that the organism present in large numbers is the exciting cause.

Fungous group.—Larvæ have been found which bear tufts of fungous growth along their sides, invading the tissues and extending outward through the sclerotized integument. These larvæ may be alive when found. Other larvæ were dead when found, and these larvæ were firm, brittle, and invaded with mycelial growth. Probably more than one disease is present in this group.

Studies to Determine the Cause of Mortality in Field and Greenhouse Plots

On the laboratory grounds at Moorestown, N. J., many field-plot experiments have been carried on. In some of the plots, largely checks in soil-treatment experiments, there have been attempts in recent years to increase the normal larval population by adding larvæ to these plots, but such attempts have often been unsuccessful, as the larvæ died rapidly.

In an effort to explain this situation samples of soil were gathered from several sources. One sample was taken from a plot on the laboratory grounds where larvæ had failed to develop, a second sample from a bed in a rose greenhouse in which larvæ had shown a high mortality, a third sample from a field in northern New Jersey beyond the present range of the Japanese beetle, a fourth sample from a local field and disinfected by heating, and a fifth sample from the same field as the fourth but untreated. Six-ounce tins were sterilized and fitted with wire-screen partitions to divide each tin into four compartments. In each test 25 such tins were filled with the soil to be tested and a healthy larva was placed in each compartment. The mortality for each soil tested is based, therefore, on 100 larvæ. Wheat was added for food. These tests were started on December 5, 1933, and continued for 44 days before the final check up was made.

The mortality was 14 per cent in the soil from the field plot where larvæ failed to survive, 65 per cent in soil from the rose house, 15 per cent in soil obtained outside the infested area, 15 per cent in the disinfected field soil, and 16 per cent in untreated field soil. The mortalities were surprisingly close in all the soils except that from the rose house. In this sample some of the dead larvæ showed a fungous growth, while others turned a chocolate brown, being flabby at first and later watery, and disintegrating rapidly with an unpleasant odor. The organisms causing these disease conditions have not been determined.

Incidence of Disease in Infested Areas

During 1933 and 1934 larval surveys in grass sod were made weekly at eight stations in the older infested area under the direction of Dr. Henry Fox. The percentage of diseased larvæ found in the soil population is given in Table 1.

At some of these stations the percentage of diseased larvæ was unusually high, while at others great fluctuations occurred from month to month. The data show, however, that the incidence of

Table 1.—Percentage of diseased Japanese beetle larvæ found in larval surveys made at eight stations in New Jersey and Pennsylvania, 1933 and 1934

Month	Diseased larvæ	
	1933 Per cent	1934 Per cent
January	0.0	1.7
February	0.2	no record
March	1.3	1.4
April	2.2	1.4
May	5.4	1.8
June	10.2	1.0
July	0.4	0.1
August	0.5	1.5
September	1.6	3.1
October	3.0	......
November	2.2	......
December	2.8	......

disease is relatively low in July, when the old brood is scarce in the soil and the new brood consists largely of eggs and newly hatched larvæ. There is a gradual increase during the summer, fall, and spring, the high point being reached in May or June, when the larvæ are mature. In June 1933, 10 per cent of all larvæ found were diseased. At one station this month 29 per cent were dead or dying from disease. It is also evident from Table 1 that diseased larvæ formed a much larger proportion of the soil population in 1933 than they did in 1934. The reason for this difference is not now apparent. The data show further that the reduction in the larval population between the fall of 1933, as indicated by the average of all surveys made in September and October, and the early part of June 1934 was only 17 per cent, whereas the average reduction for this period during the past seven years, as determined by Dr. Fox, has been 34 per cent. It is impossible to draw definite conclusions from two years' data, but from the evidence at hand it would seem that the diseases of the larvæ, by their greater prevalence some years than others, may be largely responsible for the fluctuation of the beetle population from year to year.

Larval surveys show that disease is now present in some degree in most of the area infested by the Japanese beetle. In the fall of 1933 and the spring of 1934 diseased larvæ were found in considerable numbers at certain points in Delaware, New Jersey, and Pennsylvania where beetles have been abundant for only a few years. A study of the survey data from 27 stations widely scattered in New Jersey and Pennsylvania in the spring of 1934 shows no consistent relationship between the extent of disease and the age of an infestation or the density of the larval population. At these 27 stations from 0 to 12 per cent of the larval population were diseased at the time the surveys were made.

FURTHER STUDY PLANNED

The two outstanding problems relative to the larval diseases at the present time are (1) to devise means by which larvæ for biological study and for parasite rearing may be protected from infection and (2) to determine whether the diseases of this insect can be used in its control. Both these problems need to be thoroughly investigated. This is almost an untouched field for study. On July 1, 1934, under a cooperative arrangement between the New Jersey Agricultural Experiment Station and the Japanese beetle laboratory of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, a thorough study of the entire disease problem, both in the laboratory and in the field, was begun.

SUMMARY

Diseases cause a high mortality among Japanese beetle larvæ. Among larvæ used for experimental work this mortality sometimes reaches 50 per cent.

For purposes of the present paper these diseases are classified from gross appearance of the affected larvæ into three groups—the black group, the white group, and the fungous group. The majority of the dead larvæ found in the field belong to the black group. The cause of the disease or diseases of this group is not known. Probably only one disease is present among larvæ of the white group. The tissues of the sick and dead larvæ of this group are filled with a microorganism, in pure or nearly pure culture, which is probably the causal agent of the disease. The infectiousness of the disease or diseases of the larvæ in the fungous group has not yet been determined.

In an effort to explain the high larval mortality in field plots at the Moorestown laboratory in recent years, larvæ were placed in soil from several sources. It was found that the mortality was nearly the same in soil from the laboratory grounds where larvæ had failed to develop, in soil from beyond the present infested area, in locally gathered field soil disinfected by heating, and in soil from the same source as the last but untreated. In soil from a rose greenhouse the mortality was much higher. Many of the larvæ from this source showed evidence of disease.

The disease among larvæ in the present infested area varies greatly from year to year and at different times during the year. Disease is usually highest in May or June just before pupation and lowest when the new brood appears in July. Larval surveys in 1933 and 1934 show no consistent relationship between the extent of disease and the age of infestation or density of the larval population.

MOVEMENTS OF LARVÆ OF THE ORIENTAL BEETLE THROUGH SOIL

BY HAROLD C. HALLOCK
ASSOCIATE ENTOMOLOGIST, DIVISION OF JAPANESE AND ASIATIC BEETLE INVESTIGATIONS, BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE[1]

The movements of the larvæ of the oriental beetle (*Anomala orientalis* Waterhouse) in the soil were studied in Nassau County, N. Y., during the seasons of 1927 to 1933, inclusive. This paper deals with both the vertical and horizontal movements of the larvæ and some of the biological and environmental influences which affect these movements.

In order to secure some preliminary data in regard to movements of the oriental beetle larvæ in the soil, glass-sided cages[2] (17 inches long, 11 inches high, and $\frac{3}{4}$ inch wide, inside dimensions) were constructed. Ten of these cages, which had been filled with compacted, sifted soil, were kept side by side in a box so that they were always in darkness except when the larvæ were being observed. Throughout the experiment they were kept in the laboratory at a temperature of approximately 70° F. Five of the cages contained growing wheat as food for the larvæ while the soil in the others was allowed to remain fallow. Ten third-instar larvæ, one having been placed in each of the cages, were observed and their positions in the soil charted three times daily for a period of three months. During this time the average distance moved by the larvæ in the fallow-soil cages was 32.9 feet, as compared with 13.9 feet for the larvæ in the cages with the growing wheat. The greatest recorded distance moved by a larva in the fallow soil was 47 feet and in a cage with growing wheat, 19.4 feet.

[1] The work reported in this paper was conducted under the general supervision of I. M. Hawley. The writer desires also to acknowledge the assistance of W. C. Phelon, F. W. Fletcher, C. E. Jennings, T. N. Dobbins, and C. R. Jones, who were formerly connected with the sublaboratory at Westbury, on Long Island.

[2] The glass-sided cages were designed and first used by W. E. Fleming in the study of larvæ of the Japanese beetle.

Observations on the movements of these larvæ have shown that they do not move in the same direction for any great length of time. The movements within a single day were generally both vertical and horizontal, and a larva often doubled back on its general course several times. The five larvæ in the cages containing food matured to adult beetles, but the development of the larvæ in the fallow cages was considerably retarded and two failed to mature.

VERTICAL MOVEMENT OF LARVÆ

Nearly all the data on vertical movements of larvæ in the soil have been obtained from the regular larval surveys made at Jericho, N. Y., during the seasons of 1927 to 1933, inclusive. Approximately 10 holes (12 inches square by 12 inches deep) were dug in sod land each week during the season when oriental beetle larvæ were active and the numbers of larvæ found at each inch in depth were recorded. The total number of larvæ recorded ranged from 3,000 to nearly 8,000 per season.

The curves in Figure 1 show the proportions of the total number of larvæ found at specified depths at 10-day intervals and thus indicate the vertical movements of the larvæ in the soil in 1928, a representative year, when 5,300 individuals in the immature stages were recorded in the diggings during the season. The dark areas in the lower part of Figure 1 represent the occurrence of the stages of the oriental beetle.

The most noticeable vertical movement of the larvæ is their seasonal downward movement in the fall for hibernation and their return in the spring to a position near the surface. This downward movement generally starts in October, when the mean soil temperature at the 3-inch level has fallen to approximately 50° F., and continues during November (Fig. 1). It has been observed during the past six winters that the larvæ pass the winter at depths ranging from 8 to 17 inches and that the greatest number are found around the 12-inch level. In the latitude of New York City the entire winter is generally passed in a quiescent condition, but occasionally during an exceptionally warm period in the winter months a slight upward movement has been observed. In January, 1932, there were three weeks of warm weather when the mean soil temperature at the 3-inch level was 43° F. and a maximum temperature as high as 48.5° was reached. There were 4 days during this period when the mean soil temperature was approximately 45° F. Larval activity was

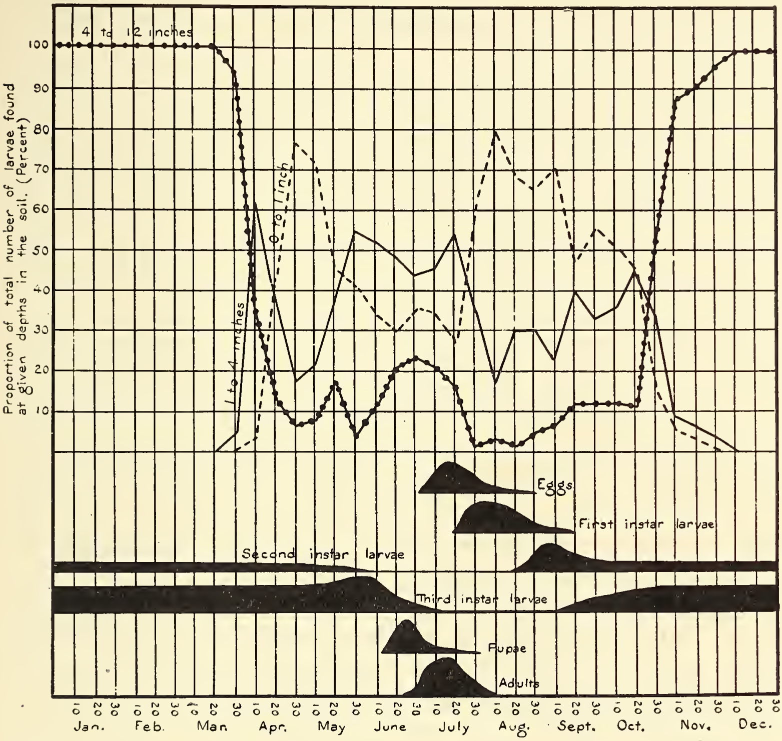


Figure 1.—Upper part: Vertical movement of oriental beetle larvæ in the soil, as indicated by the percentages of the total found at specified depths at 10-day intervals during the year 1928. Depth of larvæ in the soil: 0 to 1 inch, broken line; 1 to 4 inches, solid line; 4 to 12 inches, dotted line.

Lower part: Seasonal distribution of the different instars of the oriental beetle as they occurred in the field.

resumed and as a result larvæ moved upward to a position 4 to 6 inches below the surface, and a few even reached the second inch before the return of colder weather stopped this movement.

Normally, when the soil temperature at the 3-inch level has reached a mean of about 43° F. during the last part of March or first part of April, the larvæ start to move toward the upper layers of soil, but they do not reach their feeding position just beneath the surface in any numbers until the mean 3-inch soil temperature has become approximately 50° F. This is usually about the middle of April.

There is also a less pronounced vertical shifting of position throughout the time that larvæ are normally active. As will be explained later, this movement is due in part to changes in the soil moisture. A few oriental beetle larvæ can be found as much as 7 to 12 inches beneath the surface of the ground even during the real warm part of the year, but at that time the percentage of the larvæ occurring at any given depth decreases with the increase in depth in the ground (Fig. 1).

The female beetles oviposit in the ground at depths ranging from 1 to 11 inches. Most of the eggs are found at depths of 2 to 6 inches. Data secured during the season of 1932 as to the position in the soil of 1,590 eggs showed that 42 per cent were located in the soil below 4 inches. The young larvæ that hatch at these lower depths soon migrate upward to a position near the surface of the ground, where they feed on organic matter and the roots of plants.

When the larvæ have nearly completed their development in each of the three larval instars they generally move somewhat deeper into the ground before transforming to the next stage. This downward movement is more noticeable just before pupation than at the time of either of the two earlier larval molts (Fig. 1). The depth in the ground of 504 prepupæ and pupæ was noted while making surveys, and the precentages occurring at the various depths by inches were as follows: first, 0; second, 3; third, 4; fourth, 17; fifth, 20; sixth, 26; seventh, 14; eighth, 9; ninth, 3; tenth, 1; and eleventh inch less than 1 per cent.

Observations during the past seven years have shown that from 5 to 15 per cent of the oriental beetle larvæ fail to complete their development the first year. These fully developed larvæ move down to depths of 8 to 14 inches in the soil, where they remain until June of the following year before transforming to pupæ.

Surveys made in a cultivated garden at Jericho, N. Y., seem to show that the oriental beetle larvæ feed at greater depths in cultivated areas than in sod land. The diggings made in this garden in 1931 and 1932 showed 742 larvæ present in the area examined, and the percentage of the total found at the various depths were as follows: first inch 31, second to fourth inches 44, and fifth to tenth inches 25. Diggings were also made in a part of this garden where the ground was covered with a mulch consisting of straw and weeds. This cover caused the ground to remain moist beneath the mulch, and it was observed that as a result the larvæ were closer to the surface. Some of the larvæ were even on the surface of the ground just beneath the mulch. Where this mulch was present, 65 per cent of the larvæ were in the first inch of soil, 32 per cent in the second to fourth inches, and 3 per cent in the fifth to seventh inches. It would appear, therefore, that the moist soil condition near the surface under the mulch tended to cause the larvæ to move upward in the ground to a position similar to that found in the more moist situations, such as usually occur beneath grass sod.

This vertical movement in the soil must be considered when control measures are applied. Soil fumigations have often failed to kill 100 per cent of the larvæ when care has not been taken to reach the larvæ which have migrated temporarily to the lower depths. Chemicals, such as lead arsenate, are very effective, as they remain in the soil and kill the larvæ when they return and feed in the surface layer where the chemical is present.

HORIZONTAL MOVEMENT OF LARVÆ

The study of the horizontal movement of oriental beetle larvæ has been conducted primarily in cages, but some information has been obtained from field observations. Three types of cages were used in this study during the seasons of 1927 to 1933, inclusive. These consisted of a small movable cage and two types of larger field cages.

SMALL-CAGE EXPERIMENTS

The small cages were useful in studying the movements of the larvæ during short periods of time. The inside dimensions were 12 inches wide, 10 inches deep, and approximately 42 inches long. The sides of the cages were constructed of wood, the bottom of 2 layers of wire screen (6 and 18 mesh), and the top of 18-mesh wire screen (Figs. 2 and 3). This cover allowed the free passage of moisture but prevented oriental beetles from entering and ovipositing. Eight inches of sifted soil were placed in the cages and compacted. In order that the soil moisture might be as nearly as possible in a natural condition, the cages were sunk in the ground to such a depth that the soil within the cage was at the same level as that outside (Fig. 3). Wheat was grown in some of the cages and the soil in others was kept fallow. Within 2 inches of one end of each cage 100 oriental beetle larvæ were placed at a depth of about 2 inches. The experiments in the small cages were carried on during the late summer and fall months, when the larvæ were feeding actively, in the years 1927 to 1932, inclusive.

When the data from these tests were compiled it was found that the larvæ had moved slightly farther when the ground was fallow

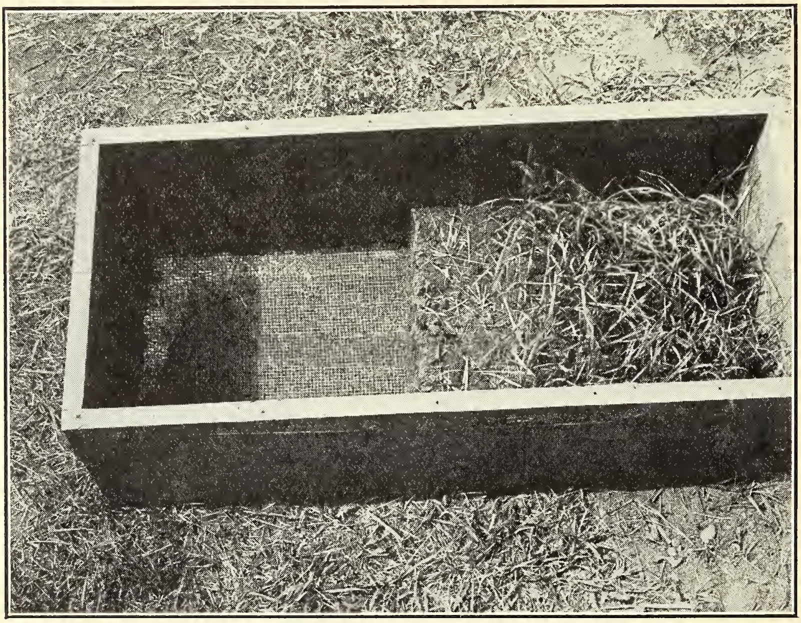


Figure 2.—Small migration cage, showing part of soil removed.

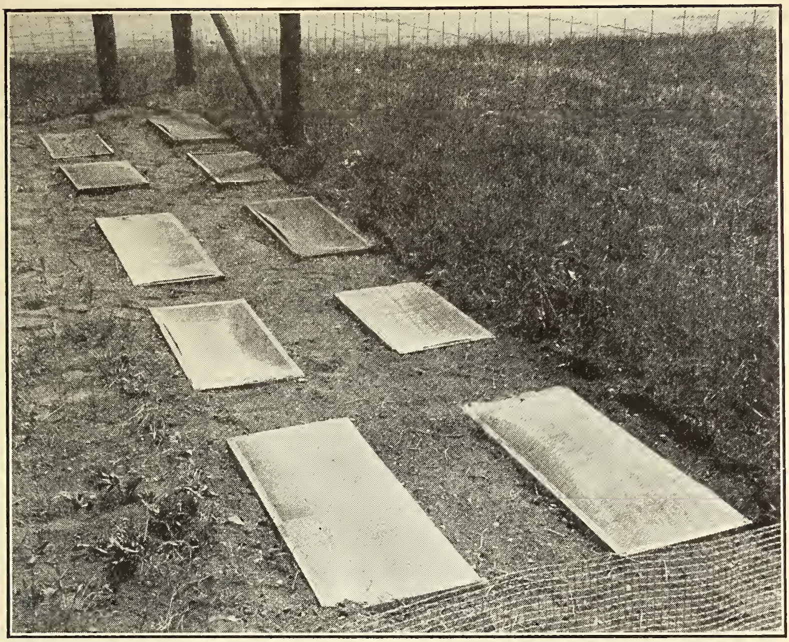


Figure 3.—A group of small migration cages.

TABLE 1

HORIZONTAL MOVEMENT OF ORIENTAL BEETLE LARVÆ IN SMALL CAGES

Length of test in days	Total number of grubs recov-ered	Condition of cage	Proportion of larvæ, given in per cent, recovered at specified distances in inches from starting point						Greatest from starting point distance
			0–2	2–5	5–10	10–20	20–30	30–40	Inches
1–2	275	fallow	32	24	17	14	7	5	35
3–5	167	fallow	24	20	18	15	12	11	35
3–5	351	wheat	22	20	22	24	7	2	34
7–10	319	fallow	8	17	18	32	16	9	40
7–10	253	wheat	19	28	24	17	10	0	33
14	236	fallow	5	9	12	43	24	7	34
14	117	wheat	5	26	33	23	10	1	33
21	154	wheat	24	25	27	19	3	0	24

than with wheat present, but that the total distance traversed was not great under either condition. The data on horizontal movement of larvæ in small cages are summarized in table 1.

EXPERIMENTS IN LARGE FIELD CAGES

The experiments with large field cages were started in 1932 and continued during 1933. The first of these tests was conducted in a cage 4 feet wide and 24 feet long. The sides of this cage were constructed of wood and were sunk in the ground to a depth of 11 inches. The cage did not have a bottom, and the top was covered with 18-mesh wire screening to exclude all oriental beetles. The soil in the cage was fumigated with 6 pounds of carbon disulphide to 100 square feet, as recommended by Fleming and Baker,[3] in order to destroy any larvæ which might be present in the soil, and was kept in a fallow condition throughout the test. A trench about 4 inches deep was dug across the center of the cage at a position 12 feet from each end. Three hundred third-instar larvæ were placed in this trench and covered with soil. This experiment was started during the last week of May. When the experiment was closed on June 28, one larva was recovered 25 inches from the center of the cage, but the remaining larvæ had moved much shorter distances. The distribution of the 232 larvæ surviving at the close of the experiment was as follows: 14 per cent were in the original central 2-inch strip, 50 per cent had moved from the center of the cage 1 to 5 inches, 25 per cent had travelled from 5 to 10 inches, and only 1 per cent was found between 20 and 25 inches from the starting point.

During the summer of 1932 two cages, each 24 feet square, were built. The sides of these cages were constructed of wood and were sunk in the ground 11 inches. The cages were without bottoms, but the top of each cage was covered with cheesecloth during the beetle season. The top of one cage was elevated 24 inchs above the ground and the side portions were also covered with cheesecloth, thus allowing for the growth of plant material as food (Fig. 4). The soil in the cages was fumigated with

[3] Fleming, W. E., and Baker, F. E. Treatment of soil to destroy the Japanese beetle. Jour. Econ. Ent. 23: 502–508. 1930.

carbon disulphide by using the material as described in the previous field-cage experiment. Wheat was sown in the cage with the elevated top, and the soil in the other was allowed to remain fallow. Three hundred oriental beetle larvæ were placed in the center of each of the cages early in September 1932. In each cage the larvæ were evenly distributed over a central area with a radius of 18 inches.

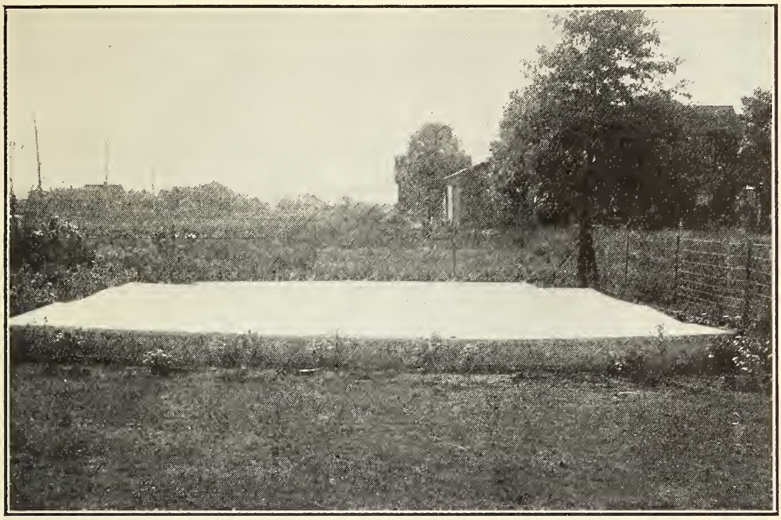


Figure 4.—Field migration cages.

The cages were examined in 1933, and the position of each of the 100 larvæ surviving in the wheat cage and the 174 larvæ surviving in the fallow cage was recorded. One fourth of each cage was examined during the first part of April 1933 before the spring migration started. The remaining three fourths were examined about June 15, after the horizontal movement of both fall and spring had taken place. The data obtained in this test are summarized in table 2.

There was but little difference in grub movement in the two cages. The larvæ included in the first column (0–18 inches) did not move beyond the starting area. There was no evidence of a greater movement in the fallow cages as was noted in tests

TABLE 2

HORIZONTAL MOVEMENT OF ORIENTAL BEETLE LARVÆ IN LARGE FIELD CAGES

Period of movement	Condition of cage	Proportion of larvæ, given in per cent, recovered between various distances in inches from center of cage					Greatest distance from center
		0–18	18–30	30–40	40–50	50–66	Inches
Fall	fallow	29	60	8	2	0	49
Fall	wheat	35	30	27	5	2	52
Fall and spring	fallow	14	33	23	28	1	57
Fall and spring	wheat	14	30	37	12	7	66

with small cages. Under the conditions of the experiment, some larvæ moved approximately 4 feet between September and June. It should be noted that though the fallow cage was kept free of grass and weeds, there was sufficient decomposed plant material present to furnish food for the larvæ, and as a result they were apparently not stimulated to move about as much as they were in the sifted soil in the small cages.

FIELD OBSERVATIONS ON HORIZONTAL MOVEMENT OF LARVÆ

During the years of 1930 to 1932, inclusive, there was an infestation of larvæ of the oriental beetle in a strawberry bed at Jericho, N. Y., which increased in intensity each year, until by 1932 at least 80 per cent of the strawberry plants in this bed had been killed. Each year the destruction of the strawberry plants in a gradually enlarging area, as the larval season advanced, showed that some horizontal movement of larvæ had occurred. As a result of this severe injury to the plants, the strawberry bed was plowed up in September 1932 and the ground left fallow during the fall. After the strawberry plants had been killed, the migration into an adjoining red raspberry bed was very noticeable. No injury to the roots of the raspberry bushes was observed until after the strawberry plants had been destroyed and the bed plowed up. In fact, diggings made in the red raspberry bed during 1931 and 1932 disclosed almost no larvæ present at the time that the adjoining strawberry bed was heavily populated. Late in the fall of 1932 and during the spring of 1933 a gradually increasing arc of dying red raspberry bushes appeared on the side of the bed which had been adjacent to the strawberry bed. The area of destroyed bushes increased until it extended inward as far as 10 feet in some places. The larval migration was so pronounced that approximately one-fifth of the raspberry bushes in this bed, 20 feet by 250 feet, were killed by the feeding of oriental beetle larvæ, and as many as 50 larvæ were present around the roots of a single bush.

Although the roots of lawn grasses are attacked by the oriental beetle larvæ more often than those of any other plant, it is extremely difficult to judge the amount of the horizontal movement of larvæ in lawns. The injured areas in lawns which have appeared in the late summer or fall during recent years range in size from a few square inches to 3 or 4 acres. In most cases, especially in the smaller areas, the larvæ tend to be more numerous in the living grass at the edge of the killed sod than they

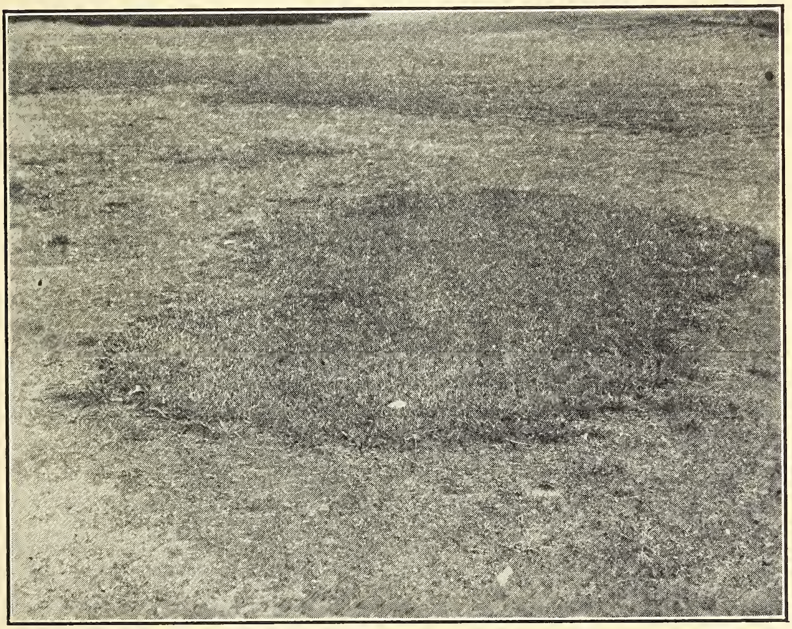


Figure 5.—Grass in central area growing on ground treated with 15 pounds lead arsenate per 1,000 square feet. The turf around this area was untreated.

are in the areas where the grass has already been killed by larval feeding. As was found to be the case in cage tests, the extent of the movement from the injured area is apparently governed by the amount of organic matter present and available as food.

When chemicals are applied to turf for the control of larvæ, it is important to keep in mind that areas surrounding the spots where plants have been killed are generally heavily infested, as the larvæ tend to move from such areas because of a scarcity of food. There have been several instances where gardeners have overlooked this migration and have treated only those parts or patches of a lawn where the turf has been killed. In these cases the application of lead arsenate at the rate recommended by the United States Department of Agriculture[4] killed the larvæ remaining in the treated area, but most of the larvæ that brought about the destruction of the turf were already feeding on more succulent food several feet away. By the following year it was evident that lawn protection had been secured in the treated patches, but grass was often extensively injured around these small treated areas (Fig. 5).

SUMMARY AND CONCLUSION

Larvæ of the oriental beetle have been found to move downward in the soil to depths of from 8 to 17 inches when the soil temperature at the 3-inch level has reached 50° F. In the spring after hibernation the return upward starts at a soil temperature of about 43° F. and is completed at 50° F.

Oviposition by the oriental beetle takes place at depths of 1 to 11 inches. Larvæ temporarily move deeper in the soil just before changing from one instar to the following instar or stage. Larvæ are usually found deeper in cultivated ground than in grass sod. This is often due to a smaller amount of soil moisture at the surface in the former situations.

There is good evidence that larvæ move horizontally in the soil. In large field cages some larvæ moved approximately 4 feet, and there was little difference in the extent of the movement as influenced by the presence or absence of wheat as food.

[4] Fleming, W. E., and Osburn, M. R. Control of larvæ of the Japanese and the Asiatic beetles in lawns and golf courses. U. S. Dept. Agr. Cir. 238, 10 pp., illus. 1932.

Field observations indicate that larvæ feed on the roots of plants until they are killed and then move on to other plants. The extent of the outward movement depends to some extent on the decomposed material in the soil that is available as food.

Where the fact of larval movement in the soil has been overlooked when insecticides were applied, there has been failure to protect turf from the oriental beetle larvæ.

A Contribution to a Bibliography of the Described Immature Stages of North American Coleoptera. By J. S. Wade, Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D. C. Mimeographed. p. 1–114. Sept., 1935.

This is the first bibliography on this subject since 1891, at which time Beutenmuller published one of fifty-two pages in the Journal of the New York Microscopical Society. Mr. Wade states that his work should be regarded as preliminary and that it will be continued and augmented in the future.

It seems trite to dwell upon the usefulness of bibliographies. Every research worker knows how valuable they are and that if they are not available he has to compile his own after a fashion. Entomology should have more bibliographies such as Mr. Wade has completed, and it is too bad that so many entomologists are concerned so exclusively with their own immediate problems that they have no time or sympathy for the broader or more general aspects of their science.—H.B.W.

NEW MEMBRACIDÆ IN THE IMPERIAL INSTITUTE COLLECTION

By W. D. FUNKHOUSER
UNIVERSITY OF KENTUCKY

Through the courtesy of Sir Guy A. K. Marshall, Director of the Imperial Institute of Entomology, the writer has had the privilege of studying a considerable collection of Membracidæ in the collection of that Institute.

In this collection were found ten new species which are here described as follows:

1. **Leptocentrus albescens** sp. nov. (Fig. 1)

Small black with dense snow-white tomentose patches on the sides of the pronotum, on the scutellum and on the sides of the thorax and abdomen. Punctate, sparingly pubescent; suprahumerals strong, sharp, extending directly outward; posterior process slender, curved, well arched above scutellum, then turning downward and extending just to tips of tegmina; tegmina hyaline with prominent brown veins; legs black.

Technical description:

Head subquadrate, wider than long, black but with white pubescence around clypeus, finely punctate; base arcuate; eyes large, brown; ocelli large, brown, prominent, equidistant from each other and from the eyes and situated about on a line drawn through centers of eyes; clypeus extending for half its length below inferior margins of genæ.

Pronotum black, finely punctate, sparingly pubescent; metopidium straight; median carina percurrent; suprahumeral horns a little longer than the distance between their bases, tricarinate, compressed dorso-ventrally, extending almost directly outward, tips acuminate; posterior process long, sinuate, well elevated above scutellum, then curving downward and impinging on tegmina for its apical third, tricarinate, tip sharp and just reaching tips of tegmina. Scutellum entirely exposed, longer than wide, tip bifurcate. Sides of pronotum below suprahumerals, base of scutellum and entire lateral surfaces of thorax densely white tomentose.

Tegmina wrinkled hyaline, base black, coriaceous and punctate; veins heavy and brown; limbus wide; five apical and two discoidal areas.

Legs black; tarsi brown.

Length from front of head to tips of tegmina 5.8 mm.; width between tips of suprahumerals 4 mm.

Type: female.

Type locality: Sierra Leone.

Described from two females and one male all taken at Bauninia, Sierra Leone, by E. Hargreaves, September 24, 1932. Type and allotype in Imperial Institute collection; paratype in collection of the writer.

2. **Leptocentrus brunneus** sp. nov. (Fig. 2)

Slender, brown, punctate, pubescent, tomentose; suprahumerals triquerate, projecting outward; posterior process sinuate, not reaching tips of tegmina; tegmina translucent brown; undersurface of body brown; legs brown.

Technical description:

Head subquadrate, about as wide as long, brown, finely punctate, densely pubescent with long silvery hairs; base arcuate and sinuate; eyes large, brown; ocelli large, white, glassy, prominent, a little farther from each other than from the eyes and situated about on a line drawn through centers of eyes; genæ rounded; clypeus extending for half its length below inferior margins of genæ, tip rounded and pilose.

Pronotum brown, finely punctate, densely pubescent; metopidium wider than high, narrowly convex; median carina strongly percurrent; humeral angles strong; triangular, extending outward farther than the eyes; suprahumeral horns strong, triquerate, a little longer than the distance between their bases, extending outward, very slightly upward, flattened dorso-ventrally, tips blunt; posterior process slender, sinuate, arising well above the scutellum, then bending downward and impinging on tegmina, tip reaching a point half-way between interior angles and tips of tegmina, triquerate, tip gradually acuminate; scutellum entirely exposed, longer than wide, tip bifurcate; sides of pronotum behind horns and sides of scutellum narrowly white tomentose.

Tegmina long, narrow, wrinkled, translucent, brown; base narrowly dark brown, coriaceous and punctate; veins strong, reddish brown; limbus broad; five apical and two discoidal areas.

Undersurface of body brown; sides of thorax densely white tomentose; femora dark brown; tibia and tarsi reddish brown.

Length from front of head to tips of tegmina 6.8 mm.; width between tips of suprahumeral horns 3.2 mm.

Type: male.

Type locality: Nairobi, Africa.

Described from a single specimen collected in January, 1921. Type in Imperial Institute collection.

3. **Evanchon sinuatus** sp. nov. (Fig. 3)

Small, brown, punctate, pubescent; metopidium very convex; suprahumerals long, slender, sharp, extending directly outward; posterior process strongly sinuate and reaching just beyond internal angles of tegmina; tegmina hyaline with a brown fascia across middle; undersurface and legs brown.

Technical description:

Head twice as wide as long, brown, roughly sculptured, finely punctate, densely pubescent; eyes large, very dark brown, extending outward as far as the humeral angles; base strongly arcuate and sinuate; ocelli large, very prominent, white, pearly, as far from each other as from the eyes and situated about on a line drawn through centers of eyes; genæ transverse, curved; clypeus extending for two-thirds its length below inferior margins of genæ.

Pronotum brown, finely punctate, sparingly pubescent; metopidium strongly convex; median carina strongly percurrent; humeral angles small, triangular; suprahumeral horns narrow, triquerate, very sharp, extending directly outward, a little longer than the distance between their bases; posterior process strongly sinuate, arising high about scutellum, then turning downwards to touch the tegmina, then upward, the tip very sharp and reaching just beyond internal angles of tegmina; scutellum entirely exposed, as wide as long, tip notched.

Tegmina hyaline; base narrowly brown, coriaceous and punctate; a brown fascia extending across the tegmen just behind the middle; limbus wide; five apical and two discoidal cells.

Legs and undersurface of body brown.

Length from front of head to tips of tegmina 5.3 mm.; width between tips of suprahumerals 2.8 mm.

Type: male.

Type locality: Uganda, Africa.

Described from two adults and a nymph. The male was collected at Kampala, Uganda, by H. Hargreaves on April 14, 1932. Mounted on the same card is a nymph, presumably of the same species but not here described. The female was taken by the same collector at Noala, Sierra Leone, in April, 1933.

Type and nymph in collection of Imperial Institute; allotype in author's collection.

4. **Gargara rufula** sp. nov. (Fig. 4)

Large, robust, bright reddish-brown, punctate, pubescent; posterior process broad, blunt, extending just to apical angles of tegmina; tegmina opaque, bright reddish-brown; front of head and sides of thorax black; eyes, legs and undersurface uniformly reddish-brown.

Technical description:

Head black with reddish margins, finely punctate, sparingly pubescent; base feebly arcuate; eyes large, reddish-brown, extending outward half as far as the humeral angles; ocelli small, inconspicuous, reddish, twice as far from each other as from the eyes and situated well above a line drawn through centers of eyes; genæ sinuate; clypeus very broad, extending for one-third its length below inferior margins of genæ, base broadly truncate and pilose.

Pronotum bright reddish-brown, finely punctate, sparingly pubescent; metopidium sloping, twice as broad as high; median carina obsolete; humeral angles large, robust triangular, blunt; posterior process broad, heavy, nearly flat, almost straight, tip slightly depressed, blunt and just reaching internal angles of tegmina; scutellum narrowly exposed.

Tegmina opaque, bright reddish-brown; base broadly coriaceous and punctate; veins indistinct; limbus narrow; five apical and two discoidal cells.

Sides of thorax black; undersurface of body reddish-brown; femora dark brown; tibiæ and tarsi bright reddish-brown.

Length from front of head to tips of tegmina 4.3 mm.; width between humeral angles 2.5 mm.

Type: female.

Type locality: Aburi, Gold Coast, Africa.

Described from two specimens, a female and a male, both taken at the type locality by W. H. Patterson in 1912–13. The male is similar to the female but is smaller and the pronotum is black instead of red.

Type in the Imperial Institute collection; allotype in author's collection.

Genus **Takliwa** gen. nov.

Bearing a strong superficial resemblance to the South American genus *Lycoderes* Germar. Pronotum swollen, flattened laterally and foliaceous. Scutellum exposed. Front and middle tibiæ strongly foliaceous. Tegmina broad, tip pointed, apical cell petiolate. Suprahumeral horns long, strong, heavy, projecting outward. Posterior process very heavy at base, rising in a high arch above scutellum, then narrower and decurved and impinging on tegmina. Type: *Takliwa carteri* sp. nov.

5. **Takliwa carteri** sp. nov. (Fig. 5)

Large, yellow, punctate, not pubescent; suprahumerals long, broad, projecting outward with tips depressed; posterior process very heavy at base, slightly bulbous, strongly foliaceous, rising high above scutellum, then narrower, sinuate, tip depressed and reaching almost to tips of tegmina; tibiæ of front and middle legs strongly foliaceous; tegmina broad, translucent, bases punctate, tips pointed, five apical and four discoidal cells.

Technical description:

Head wider than long, yellow, finely punctate, not pubescent; base strongly arcuate; eyes small, yellow, extending outward half as far as the humeral angles; ocelli large, yellow, equidistant from each other and from the eyes and situated well above a line drawn through centers of eyes; margins of genæ foliaceous; clypeus extending for half its length below inferior margins of genæ, tip pointed.

Pronotum yellow, coarsely punctate, not pubescent, roughly sculptured; metopidium about as wide as high; median carina strongly percurrent; humeral angles large, triangular, blunt; suprahumeral horns very large, swollen, twice as long as the distance between their bases, extending outward with tips curved downward, somewhat compressed dorso-ventrally, tips blunt; posterior process rising from behind horns, very thick and heavy at base, rising in a high arch over scutellum, then curving downward to touch tegmina, then sinuate with tip depressed and extending almost to tips of tegmina; scutellum well exposed.

Tegmina yellow, semi-opaque, broad, wrinkled; base narrowly coriaceous, brown and punctate; apical third brown; veins indistinct; tips pointed; limbus narrow, five apical and four discoidal cells.

Sides of thorax and undersurface of body yellow. Tibiæ of first and second legs flattened.

Length from front of head to tips of tegmina 7.5 mm.; width between tips of suprahumerals 7 mm.

Type: male.

Type locality: Gold Coast, Africa.

Described from a single specimen collected by G. S. Cotterell in 1921–22. Type in Imperial Institute collection.

6. **Otinotoides elevatus** sp. nov. (Fig. 6)

Large, rough, black, punctate; suprahumerals long, strong, extending outward and upward; posterior process heavy, sinuate with a high elevation at base; tegmina brown, semi-opaque; sides of thorax grayish tomentose; legs and undersurface of body brown.

Technical description:

Head subquadrangular, wider than long, black, roughly sculptured, coarsely punctate, sparingly pubescent; base strongly and regularly arcuate; eyes large, grayish-brown, extending outward half as far as the humeral angles; ocelli small, inconspicuous, amber-colored, farther from each other than from the eyes and situated well above a line drawn through centers of eyes; margins of genæ curved; clypeus strongly trilobed at tip, extending for half its length below inferior margins of genæ.

Pronotum rough, black, coarsely punctate, sparingly pubescent; metopidium sloping, wider than high; median carina obsolete; humeral angles large, triangular, blunt; suprahumeral horns long, heavy, strong, somewhat flattened dorso-ventrally, as long as the distance between their bases, extending outward and upward, tips subtruncate with posterior angles sharp; posterior process heavy, greatly thickened at base where it forms a strong elevation, impinging on scutellum and tegmina, apical half slender, sinuate, tip sharp and extending to a point half way between internal angles and tips of tegmina; scutellum narrowly exposed.

Tegmina brown, wrinkled, semi-opaque; base broadly coriaceous, black and punctate; basal costal margin black and punctate; limbus narrow; veins heavy, brown, indistinct; five apical and four discoidal cells.

Sides of thorax grayish tomentose; legs and undersurface of body uniformly dark brown.

Length from front of head to tips of tegmina 7 mm.; width between tips of suprahumeral horns 4.7 mm.

Type: female.

Type locality: Bougainville, Solomon Islands.

Described from a single specimen collected by H. W. Simmonds. No date is given on the label.

7. **Otinotoides minuticornis** sp. nov. (Fig. 7)

Small, brown, punctate, pubescent; suprahumerals only very slightly produced, in males sometimes entirely absent; posterior process long, slender, sinuate, reaching almost to tip of abdomen; tegmina hyaline with brown bases and subapical spots; sides of thorax white tomentose; undersurface of body dark brown; femora brown; tibiæ and tarsi flavous.

Technical description:

Head subquadrangular, broader than long, finely punctate, densely pubescent with long silvery hairs; base regularly arcuate and sinuate; eyes large, gray, extending outward almost as far as the humeral angles; ocelli small, gray, inconspicuous, equidistant from each other and from the eyes and situated about on a line drawn through centers of eyes; inferior margins of genæ rounded; clypeus strongly trilobed, extending for more than half its length below inferior margins of genæ.

Pronotum brown, finely punctate, densely pubescent; metopidium sloping, wider than high; humeral angles strong, triangular, blunt, extending outward much farther than minute suprahumerals; median carina faint; suprahumeral horns very small, appearing only as minute elevations; posterior process slender, sinuate, tectiform, tip sharp and extending to a point about half way between internal angles and tips of tegmina; scutellum narrowly exposed, densely white tomentose.

Tegmina wrinkled hyaline; base broadly coriaceous, brown and punctate; a brown spot just behind internal angles; apical limbus narrow and brown; veins heavy and brown; five apical and three discoidal cells.

Sides of thorax densely white tomentose; undersurface of body dark brown; femora brown; tibiæ and tarsi flavous.

Length from front of head to tips of tegmina 5 mm.; width between humeral angles 2.2 mm.; width between tips of suprahumerals 1.5 mm.

Type: female.

Type locality: Su'u, Mala, Solomon Islands.

The males are smaller, darker, with the horns even less developed than in the females, but otherwise similar.

Described from a long series of nineteen females, fourteen males and one nymph all collected by R. A. Lever. Sixteen females, thirteen males and the nymph were taken at the type locality on May 24, 1934; three females and one male taken by the same collector are labeled merely "British Solomons."

Type, allotype, twenty-seven paratypes and the nymph in the collection of the Imperial Institute; four paratypes in author's collection.

8. **Otinotoides brevicornis** sp. nov. (Fig. 8)

Similar to preceding but larger, with horns slightly more prominent, infuscate tegmina and differing particularly in the high metopidium with strong, keeled carina.

Black, punctate, pubescent; suprahumerals very small; posterior process sinuate and impinging on tegmina; clypeus three-lobed; sides of thorax densely white tomentose; tegmina hyaline mottled with brown; undersurface and legs brown.

Technical description:

Head subtriangular, black, finely punctate, sparingly pubescent; base feebly arched and strongly sinuate; eyes large, brown, extending outward almost as far as the humeral angles; ocelli large, prominent, glassy, twice as far from each other as from the eyes and situated well above a line drawn through centers of eyes; margins of genæ curved; clypeus strongly trilobed, extending for two-thirds its length below inferior margins of genæ.

Pronotum black, finely punctate, sparingly pubescent; metopidium high, sloping; humeral angles strong, triangular, blunt; median carina percurrent, elevated, keeled; suprahumeral horns very small, not extending outward as far as the eyes and not nearly to the humeral angles; posterior process slender, sinuate, impinging on tegmina, tip acute and reaching beyond tip of abdomen and almost to tips of tegmina; scutellum narrowly exposed.

Tegmina wrinkled hyaline; base broadly brown, coriaceous and punctate; a transverse brown fascia across center, a brown spot at internal angle and apical limbus brown; five apical and four discoidal cells.

Sides of thorax densely white tomentose; legs and undersurface of body brown.

Length from front of head to tips of tegmina 5.5 mm.; width between humeral angles 2.2 mm.; width between tips of suprahumerals 1.6 mm.

Type: male.

Type locality: British Solomons.

Described from a single specimen collected by R. J. A. W. Lever in January, 1932. Type in Imperial Institute collection.

9. **Rhexia rubra** sp. nov. (Fig. 9)

Brilliant red, smooth, shining; pronotum convex, posterior apex reaching tip of abdomen; scutellum entirely covered; tegmina entirely exposed, one discoidal cell; ocelli farther from each other than from eyes; legs flavous.

Technical description:

Head subtriangular, broader than high, smooth, shining, red, not punctate, not pubescent; base weakly sinuate; eyes triangular, bright red; ocelli large, conspicuous, red, farther from each other than from the eyes and situated well above a line drawn through centers of eyes; clypeus not extending below genæ but continuing the smooth outline of the inferior margin of the genæ.

Pronotum bright red, shining, smooth, not punctate, not pubescent; regularly and smoothly convex over the entire body; metopidium smooth, sloping, twice as broad as high; humeral angles very prominent, heavy, triangular, blunt; median carina faintly percurrent; posterior portion of pronotum not restricted into a distinct process but gradually narrowed to tip which is depressed, blunt, extending just to end of abdomen and reaching a point about half way between internal angles and tips of tegmina; scutellum entirely hidden.

Tegmina reddish hyaline; entirely free; base narrowly red, coriaceous and punctate; veins red; limbus broad; five apical and one discoidal cell.

Under surface of body red; femora reddish; tibiæ and tarsi flavous.

Length from front of head to tips of tegmina 5.5 mm.; width between humeral angles 3.5 mm.

Type: female.

Type locality: Kurupakari, British Guiana.

Described from a single specimen which bears the label "British Guiana. Cattle Trail Survey. Kurupakari. R. Essequibo. August, 1920. A. A. Abraham. Coll."

Type in collection of Imperial Institute.

10. **Tynelia cerulea** sp. nov. (Fig. 10)

Brilliant shining greenish-blue; head greatly projected forward; pronotum convex, unarmed, much swollen on both sides in posterior portion; posterior process produced in sharply angulate, triangular shield-like point; tegmina more than half covered by sides of pronotum, veins heavy, strong and brown; legs and undersurface of body black.

Technical description:

Head greatly produced forward, subtriangular, greenish-blue, roughly sculptured, finely punctate, not pubescent; base gradually arched; eyes extremely large, gray; ocelli very large, gray, much closer to each other than to the eyes and situated well above a line drawn through centers of eyes; clypeus large, swollen, with transverse striæ, extending for one-third its length below inferior margins of genæ, tip pilose.

Pronotum shield-shaped; brilliant shining greenish-blue; finely punctate, not pubescent, unarmed; metopidium sloping, broader than high; humeral angles large, heavy, triquerate; no median carina; posterior part of pronotum bulbous and swollen on each side; posterior process cut out on each side in a semicircular arc to form a triangular point with sharp angles, the tip reaching beyond the end of the abdomen but not reaching tips of tegmina.

Tegmina hyaline with heavy brown veins, more than half covered by overhanging sides of pronotum; cells very irregular; limbus broad.

Legs and undersurface of body black.

Length from tip of clypeus to tips of tegmina 7.5 mm.; width between humeral angles 4 mm.

Type: male.

Type locality: Canister Falls, British Guiana.

Described from two specimens, a male and a female, both collected at the type locality by A. A. Abraham in June, 1920. Type in Imperial Institute collection; allotype in author's collection.

PLATE XXIX

Figure 1. *Leptocentrus albescens* sp. nov.—Lateral outline.
Figure 2. *Leptocentrus brunneus* sp. nov.—Lateral outline.
Figure 3. *Evanchon sinuatus* sp. nov.—Lateral outline.
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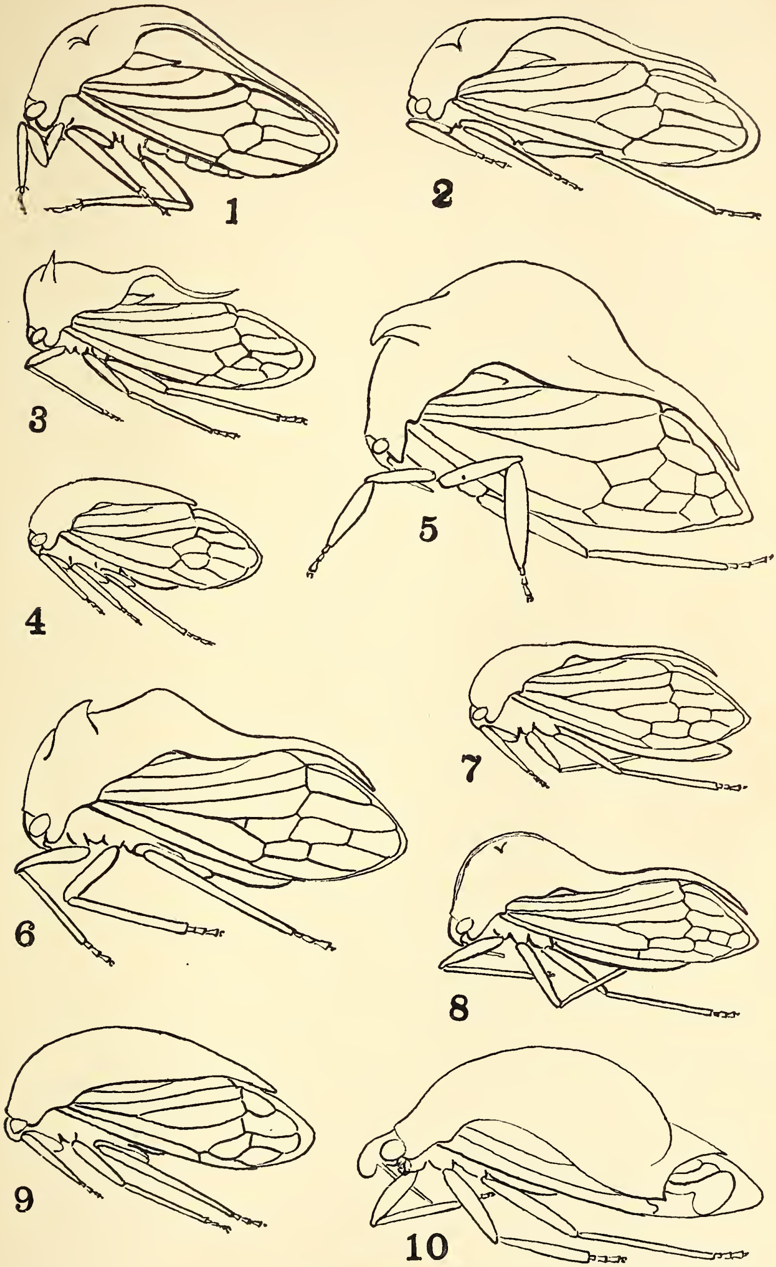
Figure 5. *Takliwa carteri* sp. nov.—Lateral outline.
Figure 6. *Otinotoides elevatus* sp. nov.—Lateral outline.
Figure 7. *Otinotoides minuticornis* sp. nov.—Lateral outline.
Figure 8. *Otinotoides brevicornis* sp. nov.—Lateral outline.
Figure 9. *Rhexia rubra* sp. nov.—Lateral outline.
Figure 10. *Tynelia cerulea* sp. nov.—Lateral outline.



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Generic names begin with capital letters. New genera, subgenera, species, subspecies, varieties and new names are printed in italics.

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