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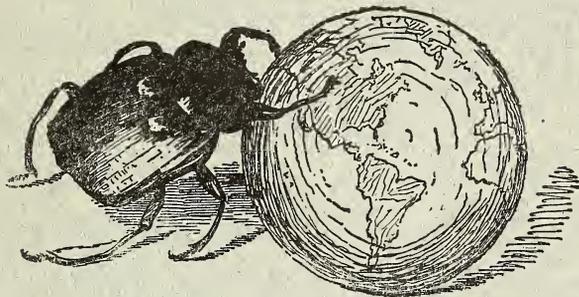
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MARCH, 1926

No. 1

THE SEMINAL RECEPTACLES AND ACCESSORY GLANDS OF THE DIPTERA, WITH SPECIAL REFERENCE TO THE ACALYPTERAE

BY A. H. STURTEVANT

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(Continued from Vol. XXXIII, page 215)

SCIOMYZIDÆ. Subfamily Sciomyzinæ. Wesché described two spermathecae in *Pherbellia cinerella* (Fallén) [*Sciomyza*], "remarkably horny, covered with short barbs, and with strongly chitinized stalks." I have seen *Pherbellia nana* (Fallén), which has two spherical black spermathecae, with relatively short ducts.

SUBFAMILY TETANOCERINÆ. Dufour described *Sepedon spehegus* (Fabricius), *Limnia stictica* (Fabricius) [*Tetanocera*], and *Elgiva albisetata* (Scopoli) [*Tetanocera aratoria*]. In *Limnia* and *Elgiva* he reported three chitinized spermathecae, and in the latter two parovaria. In *Sepedon* there were two non-chitinized bodies, enlarged near their bases and narrower at the apices. Dufour identified these as parovaria, but was unable to find spermathecae—which he suggested were nevertheless present.

I have dissected *Dictya umbrarum* (Linné), *Hoplodictya setosa* (Coquillett), *Limnia saratogensis* (Fitch), and *Sepedon (armipes* Loew?). In the first three, representing the old genus *Tetanocera*, there are two chitinized spermathecae, subspherical, and each enclosed in a separate envelop of the usual type of columnar

cells. But in all three genera there is a brown envelop surrounding both the columnar ones, so that at first sight both spermatheca appear to be enclosed in a single envelop. In *Dictya* and in *Hoplodictya* there are two rounded parovaria, somewhat larger than the spermatheca, and each with a large central cavity. Active sperm were found in the spermatheca of *Hoplodictya*. *Sepedon* also has two subspherical chitinized spermatheca, and two parovaria. There is no common spermathecal envelop, and the parovaria resemble those described by Dufour for *S. sphaeus* rather than the others that I have observed in the subfamily. Each has a rather thick basal duct, then a swollen region that gradually tapers to a diameter about that of the duct. Then follows another swollen region that gradually tapers to the slender cylindrical apex of the gland. The whole organ is somewhat longer than the spermathecal ducts, and the two swollen regions are each about the size of a spermatheca with its columnar-cell envelop.

PSILIDÆ. Dufour described *Loxocera ichneumonea* (Linné) and *Chyliza permixta* Rondani [*leptogaster*]. In the former he recorded two subsessile chitinized spermatheca and a single stalked parovarium. For the latter he stated that the parovaria were oval, with long ducts.

I have dissected *Pseudopsila collaris* (Loew) and *Psila lateralis* Loew. In both genera the spermatheca have the curious form shown in figure 9. Each duct bears a single branched tube that is surrounded by the usual envelop cells. In *Pseudopsila* no type of branching other than that figured was found in the specimens studied. One of the three specimens of *Psila* had spermatheca of just the same type, another had one of the four branches forked near its apex, while in the third three branches were thus forked. In *Pseudopsila* the ventral receptacle resembles a spermathecal duct in size and shape. Sperm were found in it and also in the spermathecal ducts. The large ventral uterine pouch shown in the figure was observed in both genera. Its walls are muscular like those of the uterus. Two small parovaria occur in *Pseudopsila*, but only one was observed in *Psila*—the other may have been overlooked.

DIOPSIDÆ. I have studied *Sphyracephala brevicornis* Say. There are three chitinized spermathecae, attached to two rather short ducts, and two pear-shaped parovaria with ducts that are longer than those of the spermathecae. No ventral receptacle was observed, so if one is present it is probably not heavily chitinized.

SEPSIDÆ. Dufour described *Themira putris* (Linné) [*Cheligaster*] as having three spermathecae. He suspected that a parovarium was present, but failed to find it. Two of the supposed spermathecae were described and figured as stalked, the third one as sessile. The latter and one of the stalked ones were chitinized, but the second stalked one was not. From my own observations on this genus it is clear that the non-chitinized body was really the parovarium, and that both spermathecae are stalked (*i.e.*, have longish ducts), but are adherent to the oviduct. Dufour also described *Nemopoda cylindrica* (Fabricius). He stated that there were three spermathecae, but that only one of them was chitinized, and that a single parovarium was present. My own dissection of this species has yielded a different result (see below).

I have dissected *Nemopoda cylindrica* (Fabricius), *Saltella scutellaris* (Fallén), *Sepsis* spp., and *Themira* sp. In all cases there are two spherical chitinized spermathecae, equal in size except in *Nemopoda*, where one is clearly larger than the other. In all four genera the spermathecal ducts are bent down toward the oviduct, and in all except *Saltella* the spermathecal envelopes are adherent to the oviduct just anterior to the insertion of the ducts. Sperm were present in the spermathecae of *Sepsis* and *Themira*. The parovaria are subspherical and about the same size as the spermathecal envelopes. Two were found in *Nemopoda* and *Themira*, one in *Saltella* and *Sepsis*. No ventral receptacle was detected in this group.

PIOPHILIDÆ. Dufour described *Piophilila casei* (Linné) [*petasionis*] as having a single large sessile chitinized spermatheca and two pairs of parovaria, the members of one pair being ovoid and stalked, those of the other long, curved, and attached to fine

ducts. I have not studied this species; but, judging from the forms described below, the sessile chitinized body was the ventral receptacle, while one pair of supposed parovaria was really a pair of spermathecae.

I have dissected two undetermined species of *Piophila*, and *Prochyliza xanthostoma* Walker. In these forms there are two chitinized spermathecae, elliptical in *Prochyliza*, spherical and telescoped basally in one species of *Piophila*, and curved and tapering in the second *Piophila*. The parovaria are two in number, and are hollow and oval. A very weakly chitinized ventral receptacle is present in all three forms. In *Prochyliza*, at least, its apex is directed posteriorly. Sperm were found in this group only in the spermathecae of *Prochyliza*. In *Piophila* the ventral wall of the uterus is very thick and muscular, much as in the Sapromyzidæ.

ODINIIDÆ. *Traginops irrorata* Coquillett has two spherical chitinized spermathecae and a backward curved ventral receptacle that is chitinized only on its anterior face. Sperm were found in the ventral receptacle. No parovaria were found, but a single parovarial duct was present.

CHIROMYIIDÆ. I have a cleared preparation of *Chiromyia* sp. that shows two chitinized spermathecae, telescoped at each end very much like those of *Aulacigaster*.

SAPROMYZIDÆ. Dufour stated that *Sapromyza rorida* Fallén has two spermathecae, of which one has two pockets—i.e., there are three, but only two ducts.

I have studied *Camptoprosopella vulgaris* (Fitch), *Lauxania cylindricornis* (Fabricius), *L. trivittata* Loew, *Minettia longipennis* (Fabricius), *M. lupulina* (Fabricius), *M. valida* (Walker), *Sapromyza bispina* Loew, and *S. compedita* Loew. These forms all have three chitinized spermathecae attached to two ducts. In *Minettia longipennis* it is clearly the right duct that is branched. The organs are pear-shaped in *M. longipennis* and *M. valida*, spherical in all the others. Sperm were found in them in *M. lupulina*. The parovaria are small, and oval in

shape. Two (or at least two ducts) were found in each genus examined. In all these species the ventral wall of the uterus is very thick, muscular, and opaque. A chitinized ventral receptacle is not present; but sections of *Lauzania trivittata* show that there is a non-chitinized one that contains sperm. It is probably present throughout the group.

OCHTHIPHILIDÆ. I have dissected *Leucopis* spp. and *Ochthiphila polystigma* Meigen. In each genus there are two spermathecal ducts, each bearing two spherical chitinized spermathecae. No ventral receptacle nor sperm were found. *Leucopis* has two parovaria, but only one has been found in any of the numerous dissections of *Ochthiphila*. Sections of *Ochthiphila* have not been found to show a ventral receptacle; but as this species is parthenogenetic (Sturtevant, 1923), the organ may still be present in other members of the group.

HELOMYZIDÆ. Dufour described *Helomyza ferruginea* Meigen [*rufa*] as having two ducts, each with two spermathecae—as in the *Conopidæ* and *Ochthiphilidæ*. Wesché reported four spermathecae in *Helomyza similis* Meigen.

I have examined *Anorostoma marginata* Loew, *Helomyza quinquepunctata* Say, *Leria pectinata* (Loew), and *Oecothea fenestralis* (Fallén). In *Helomyza* there are two ducts and four chitinized spermathecae, as described by Dufour. In the present species the spermathecae are corkscrew-shaped. In the other three genera there are three chitinized spermathecae, attached to two ducts. The organs are spherical in all three genera, but have a small apical papilla in *Leria*. In *Leria* there is a large dorsal pouch to the uterus, from the apex of which arise the spermathecal ducts. Just posterior to the pouch arise the ducts of the two oval parovaria. The only other parovarium found in the group was a single one in *Oecothea*. A small non-chitinized ventral receptacle much like that of the *Chloropidæ* was found in *Anorostoma* and in *Leria*. In both of these genera sperm were found both in the ventral receptacle and in the spermathecae.

TRIXOSCELIDÆ. A cleared preparation of *Trixoscelis frontalis* (Fallén) shows three chitinized spermathecae.

CLUSIIDÆ. I have studied *Clusia lateralis* (Walker), *Clusiodes johnsoni* Malloch, and *Heteromeriugia nitida* Johnson. In all these there are two chitinized spermathecae, spheroid in shape, and, in *Clusiodes*, strongly telescoped at each end. In all three cases the envelop is much thinner apically than over the rest of the spermatheca. The ducts are very short in *Clusiodes* and *Heteromeriugia*, longer in *Clusia*. *Clusia* has two large cylindrical parovaria, each of which has a weakly chitinized duct throughout its length. In *Clusiodes* a single small pear-shaped parovarium was found. The ventral receptacle is a large thick-walled organ, not chitinized, in *Clusia*. In *Clusiodes* it is longer, and the apical region has an enlarged cavity with a chitinized floor. In *Heteromeriugia* the organ is still longer, and is tightly curled up as in some Drosophilids. In this last genus it also has a basal enlargement, in which sperm were found. Sperm were present both in the spermathecae and in the ventral receptacle of *Clusia*.

CÆLOPIDÆ. Wesché reported three chitinized spermathecae in *Cælopa* sp. I have dissected *Cælopa parvula* Haliday. Three chitinized spermathecae, telescoped basally, were present. The specimen was not fresh, and it was not found possible to trace the ducts. A single parovarium was found. No ventral receptacle was seen.

ANTHOMYZIDÆ. I have dissected *Anthomyza variegata* (Loew) and *Mumetopia occipitalis* Melander. In the former there are two ovoid chitinized spermathecae with long slender ducts. One parovarial duct was found. No sperm nor ventral receptacle were seen. *Mumetopia* also has two chitinized spermathecae. They are spherical, with the basal halves covered with basally directed papillae. The two parovaria are spherical, each with a short swollen duct. These ducts are inserted laterally with respect to the spermathecal ducts, rather than posterior to them. There is present a small weakly chitinized ventral receptacle. Sperm were found in the spermathecae and in the ventral receptacle.

OPOMYZIDÆ. Wesché reported two chitinized spermathecae in *Geomyza combinata* (Linné) [*Balioptera*] and in *G. tripunctata* Fallén. I have a cleared preparation of *Opomyza germinationis* (Linné) (collected in England) that likewise has two chitinized spermathecae.

DIASTATIDÆ. I have dissected *Diastata repleta* (Walker) [= *pulchra* Loew]; and have a cleared preparation of *Curtonotum gibba* (Fabricius), which seems to me to be best placed in this family. In *Curtonotum* there are two slender chitinized spermathecae; no chitinized ventral receptacle appears. In both genera the rectal glands are heavily chitinized, thimble-shaped, and covered with small spines. They are mentioned here because they can easily be mistaken for spermathecae in cleared specimens, and because they serve to strengthen the conclusion that the two genera should be placed close together. In *Diastata* there are two short spermathecal ducts with unusually heavy internal spiral thickenings. Each duct ends blindly, and the usual spermathecal envelop cells are present at its apex. That is, the spermathecae themselves are entirely missing, just as in the Ephyridæ. There is a large heavily chitinized ventral receptacle, in which sperm were found. This receptacle differs from that of the Ephyridæ in that it curves posteriorly and then dorsally, making almost a complete circle. The apex is somewhat enlarged, and is slightly telescoped.

PERISCOLIDÆ. I have studied *Periscelis annulata* (Fallén) and *Sphyroperiscelis wheeleri* Sturtevant. Both genera are anomalous among the Acalypteræ in that only a single spermathecal duct is present, while this duct bears at its apex three spherical chitinized spermathecae. In *Sphyroperiscelis* two pear-shaped parovaria were observed, each gland being about the size of a spermathecal envelop. In *Periscelis* only one parovarial duct was seen; the gland itself was not found. There is a rather long non-chitinized ventral receptacle in *Periscelis*, which is unusual in that it lies along the ventral side of the oviduct. The only sperm found in the group were in this organ.

In both genera the mature eggs are dark brownish-black, resembling those of Ochthera.

DROSOPHILIDÆ. Wesché reported two chitinized spermathecae in *Drosophila funebris* (Fabricius). Unwin (1907) verified this, and also saw the ventral receptacle, but did not correctly interpret it. Nonidez (1920) has given a full account of the genital organs of both sexes of *Drosophila melanogaster* Meigen, with brief notes on the ventral receptacles of *D. obscura* Fallén and *D. virilis* Sturtevant. I have figured (Sturtevant, 1921) the spermathecae of many species of the family, studied from cleared material.

I have dissected *Amiota leucostoma* Loew, *Chymomyza amœna* (Loew), *C. procnemis* (Williston), *Drosophila affinis* Sturtevant, *D. busckii* Coquillett, *D. funebris* (Fabricius), *D. immigrans* Sturtevant, *D. melanogaster* Meigen [*ampelophila* Loew], *D. obscura* Fallén, *D. quinaria* Loew, *D. repleta* Wollaston, *D. robusta* Sturtevant, *D. simulans* Sturtevant, *D. testacea* Roser [*putrida* Sturtevant], *D. transversa* Fallén, *D. virilis* Sturtevant, *D. willistoni* Sturtevant, *Leucophenga maculosa* (Coquillett), *Mycodrosophila dimidiata* (Loew), *Scaptomyza adusta* (Loew), *S. graminum* (Fallén), and *Stegana vittata* (Coquillett). In addition I have cleared preparations of *Leucophenga varia* (Walker), *Zaprionus vittiger* Coquillett, *Zygothrica dispar* (Wiedemann), and a series of additional species of *Drosophila*.

All of these have the same type of female genitalia. There are two chitinized spermathecae. In *Chymomyza*, *Drosophila*, *Mycodrosophila*, and *Scaptomyza* they are more or less spherical and are telescoped at the base (rarely also at the apex). In *Amiota* and *Leucophenga* they are cylindrical, not telescoped, and have external transverse thickenings similar to those of *Lonchæa* and *Scatophaga*. In *Stegana* the spermathecae are nearly spherical, not telescoped, and the chitin is perforated by numerous small holes. In this genus there is also a slender non-chitinized tube that arises from the apex of each spermatheca, passes through the envelop, and reaches a length greater than that of the spermatheca plus its short duct. Sperm were found in the spermatheca here, but were not present in this apical tube. No similar structure has been seen elsewhere among the Acalyptera.

Two parovaria were observed in *Chymomyza procnemis*, in ten species of *Drosophila*, in *Amiota*, and in *Scaptomyza graminum*;

a single one was seen in *Stegana*. It is probable that two occur throughout the group. In form the glands are subspherical, with a more or less distinct central lumen. They are usually smaller than a spermathecal envelop—in several species smaller than the chitinized spermatheca itself. The ducts are in nearly all cases shorter than the spermathecal ducts, and have internal spiral thickenings that are very faint in most species.

A non-chitinized ventral receptacle is present in all the species dissected. In *Drosophila obscura* and in *Amiota* it is a broad recurved pocket; in *D. melanogaster* and *D. simulans* it is longer, narrower, and lies in a loose coil of about two turns; in *D. busckii* it is still longer and narrower, and lies in a coil of about three turns; *D. affinis* and the two species of *Scaptomyza* show it still longer and in a somewhat more complex coil—roughly three superposed U's in *D. affinis*; in *D. willistoni*, *Leucophenga*, and *Mycodrosophila* it has become extremely long and narrow, and lies in a very tight coil; in *Chymomyza*, *D. funebris*, *D. immigrans*, *D. quinaria*, *D. repleta*, *D. robusta*, *D. testacea*, *D. transversa*, *D. virilis*, and *Stegana* it is quite as long and narrow as in the preceding group, and does not lie in a single definite coil, but is very tightly curled and closely bound together in a complex tangle. When drawn out straight in *D. robusta* (one of the largest species) it was found to be about twice the length of the entire fly.

Active sperm were found in the spermathecae of *Stegana*; in the ventral receptacle of *Mycodrosophila* and *Scaptomyza*; and in both organs in *Chymomyza procnemis* and ten of the species of *Drosophila*. There can be no doubt that both organs function as sperm reservoirs in all the genera here described.

I have previously discussed (Sturtevant, 1921) the eggs of various Drosophilids. I may here add that anterior filaments are lacking in *Amiota*, *Leucophenga*, and *Stegana*. Four rather short tapering filaments are present in *Mycodrosophila*. Incidentally it may be noted that there are four long slender anterior filaments on the eggs of *Desmometopa m-nigrum* (Milichiidae), that two very short ones occur in *Parallelomma* (Cordyluridae), and that in *Sepsis* sp. (Sepsidae) there is a single very long slender apical one. No special attempt was made to examine the eggs

of the various Acalypterae dissected, but in no other instances outside the Drosophilidæ were any filaments noticed.

EPHYDRIDÆ. Dufour dissected *Ochthera mantis* (Degeer), and noted the blackish color of the fully grown ovarian eggs (a point that I have verified), but did not describe the receptacles and accessory glands. Wesché recorded a single chitinized receptacle in all the members of the family he examined, mentioning specifically *Hydrellia griseola* Fallén and *Parydra coarctata* Fallén. From his descriptions and the figure of the latter species, compared with my own dissections in both these genera, it is clear that the single body Wesché saw was the ventral receptacle, not the spermatheca as he naturally supposed it to be.

I have dissected the following species: *Dichaeta caudata* (Fallén), *Dimecænia spinosa* (Loew), *Discocerina leucoprocta* Loew, *D. obscurella* (Fallén), *Ephydra subopaca* Loew, *Gastrops nebulosus* Coquillett, *Glenanthe* sp., *Gymnopa tibialis* Cresson, *Hydrellia formosa* Loew, *H. hypoleuca* Loew, *Ilythea spilota* Curtis, *Notiphila* sp., *Ochthera mantis* (Degeer), *Paralimna appendiculata* Loew, *Parydra* sp., *Philygria debilis* Loew, *P. opposita* Loew, *Psilopa atrimana* Coquillett, *P. fulvipennis* Hine, *Scatella* sp., *Scatophila mesogramma* (Loew).

There is no apparent relation between the current subdivisions of this group, based on external characters, and the structure of the parts here studied. Accordingly the group will be discussed as a whole. There is great uniformity in the essential features of the seminal receptacles here. All the forms examined have two short spermathecal ducts, with rudimentary spermathecae; and a large heavily chitinized ventral receptacle which is essentially a short hollow tube, bent forwards near its base. These characters not only occur in all the Ephydridæ examined, but no combination at all similar occurs elsewhere except in *Diastata*. It is true that only one spermatheca was found in *Gastrops*, *Ilythea*, and *Parydra*, and none in *Paralimna*; but in these genera only one or a very few specimens each were examined, and these were not altogether satisfactorily dissected. The Ephydrid spermathecal duct ends blindly, without any constriction or enlargement at its apex, and the usual type of columnar envelop

cells radiate from this apex. The only other type of spermatheca observed in the family was in *Discocerina obscurella* (*D. leuco-procta* being normal). In this form there is a long fine crooked duct, at least twice as long as the usual heavier duct that is basal to it; around this fine duct the envelop cells form a large cylinder, similar to that found in the Psilidæ. In all cases the spermathecal ducts are relatively short, have a large lumen, and show clearly the internal spiral thickenings. In both species of *Hydrellia* they are much swollen in the middle portion of their length.

Two spherical or oval parovaria were seen in *Dichæta*, *Discocerina*, *Ephydra*, *Hydrellia*, *Ilythea*, *Notiphila*, *Ochthera*, and *Psilopa*; only one was found in *Dimecænia*, *Glenanthe*, *Gymnopa*, *Philygria*, *Scatella*, and *Scatophila*. In *Hydrellia* the ducts are of the same length and structure as those of the spermathecae (though they are not swollen in the middle as are the spermathecal ducts of this genus), and the glands themselves are nearly the same shape and size as the spermathecal envelops. The two types of organ can thus be distinguished only from the appearance of the envelop cells and the insertion of the ducts on the uterus. In the other forms studied the parovaria were in most cases smaller than the spermathecal envelops; if they were of the same size their ducts showed less conspicuous spiral thickenings.

The heavily chitinized ventral receptacle has a large thimble-shaped apical cap on it in *Dichæta*, *Gastrops*, *Gymnopa*, *Hydrellia*, *Notiphila*, *Ochthera*, *Paralimna*, *Parydra*, *Psilopa*, *Scatella*, and *Scatophila*; a smaller apical cap in *Dimecænia*, *Ephydra*, and *Ilythea*; and no cap at all but only an enlarged apex in *Discocerina*, *Glenanthe*, and *Philygria*. Sperm have been found in this organ in *Dimecænia*, *Discocerina*, *Hydrellia*, *Ilythea*, and *Philygria*. In no case in this family have any sperm been found in any other part of the female reproductive system.

In each species of *Discocerina* examined there is a large ventral uterine pouch, as large as the uterus itself or nearly so, and with muscular walls of the same type as those of the uterus. It arises just posterior to the opening of the ventral receptacle into the uterus. This structure is quite similar to the ventral pouches that occur in the Psilidæ and Tethinidæ.

CANACEIDÆ. I have dissected *Canace* sp. There are two chitinized spermathecae, and two pear-shaped parovaria. No ventral receptacle was identified with certainty, though a small non-chitinized one is perhaps present. Sperm were found in the spermathecae. It will be seen that this form is quite distinct from the Ephydridæ, with which it has often been united.

TETHINIDÆ. I have studied *Pelomyia mallochii* Sturtevant, *Tethina albula* (Loew), and *T. parvula* (Loew). There are two spheroidal chitinized spermathecae, attached to short ducts, and two short cylindrical parovaria that taper basally to their insertions on the uterus. The spermathecae of *Pelomyia* are telescoped both basally and apically. In *Tethina parvula* there is almost certainly a small non-chitinized ventral receptacle. In the other two species there is a large muscular-walled ventral receptacle like that of the Psilidæ or of Discocerina.

BORBORIDÆ. Dufour described *Borborus equinus* (Fallén) as having two chitinized spermathecae and two tubular parovaria. Wesché stated that *Borborus* has two spermathecae, *Leptocera* three. I can confirm both these results.

I have dissected *Borborus equinus* (Fallén), *B. (Borborillus) sordidus* (Zetterstedt) [*brevisetus* Malloch], *Leptocera (Coproica) ferruginata* (Stenhammar), *L. (Scotophilella) sp.*, *L. (Thoracochæta) brachystoma* (Stenhammar), *Sphærocera pusilla* (Fallén), and *S. subsultans* (Fabricius). In *Borborus* and *Sphærocera* there are two chitinized spermathecae, more or less spherical in shape and attached to short ducts. In all except *Borborillus* the envelop is drawn out into an apical process. In *Leptocera* one of the spermathecae is double—i.e., one duct bears two, and these two are heavily chitinized down to a common base. Two parovaria occur in all three genera. In *Coproica* each gland is oval; in the other forms studied the glands are long, slender, and cylindrical. No ventral receptacle was found, but the small size and muscular surroundings of the uterus render this result of little significance. Sperm were present in the spermathecae of *Coproica* and *Sphærocera*.

AULACIGASTER. I have been unable to find any satisfactory group to receive *Aulacigaster leucopeza* Macquart, and shall therefore describe it and the following genus as appendices to the Acalyptera.

In *Aulacigaster* there are three telescoped chitinized spermathecae, attached to two relatively short ducts. There are two parovaria, with ducts that are slightly longer than the spermathecal ducts. The parovaria themselves are about as long as their ducts; each has a narrow crooked weakly chitinized central tube, about which are grouped large cells with huge vacuoles, forming a cylinder similar to that found in the Agromyzidae, but without a sac-like enlargement. No ventral receptacle was observed in the eight specimens dissected; four of them had sperm in the spermathecae, but no sperm could be found elsewhere. Sections have also failed to show any ventral receptacle.

CRYPTOCHÆTUM. *Cryptochætum iceryæ* (Williston) (bred from *Icerya* collected in California, and received through the kindness of Dr. S. H. Schrader) has proved to have very puzzling internal genitalia. There are two non-chitinized spermathecae and two parovaria—but it remains doubtful which is which. The small pear-shaped organs are typical parovaria, but no spermathecae at all like the large organs have been seen elsewhere. The small size of the fly prevented an accurate determination of the insertion points of the ducts, and no sperm were seen; so it is necessary to merely guess that this identification is correct. As shown in the figure, these supposed spermathecae are cylindrical, each with an apical papilla. No envelop cells were identified. What appears to be a small weakly chitinized ventral receptacle is present, but its structure could not be made out satisfactorily. A large muscular pouch, that apparently may contain at least one egg at times, arises from the posterior ventral region of the uterus.

THE CLASSIFICATION OF THE ACALYPTERÆ

It is my opinion that systems of classification can be justified only on grounds of convenience. A classification has an excuse for existence if it serves to simplify the task of learning and remembering the characteristics of a series of organisms, or if

it serves as a guide to the probable nature of those characters of an organism that are not yet investigated. From this point of view, the ideal classification is the one that brings together most closely those species that are similar in the largest number of diverse kinds of characters, and in which the successively larger groups indicate correspondingly fewer agreements in such diverse characters.

This view of the nature and object of classification differs from the traditional one, *i.e.*, that the classification should correspond to the genetic relationship of the forms concerned—to their phylogeny. It is, of course, obvious that the two points of view will usually lead to similar results. But, at least in the absence of large series of fossil forms, phylogenies must always remain wholly hypothetical. Accordingly it seems to me more desirable to base systems of classification frankly on grounds of convenience.

It is for these reasons that the following discussion is not concerned with the question of which are the "highest" groups, nor with the construction of hypothetical family trees. All that is attempted is to offer some suggestions as to methods of making the classification of the group more useful as a mnemonic scheme and for purposes of prediction.

Frey's (1921) classification of the group, based chiefly on mouth-parts, may be summarized as follows:

Series 1. Conopiformes.

Conopidæ, Neriidæ, Micropezidæ, Chloropidæ, Milichiidæ.

Series 2. Ortalidiformes.

Agromyzidæ, Lonchæidæ, Ortalidæ, Richardiidæ, Ulidiidæ, Pterocallidæ, Tanypezidæ, Pyrgotidæ, Platystomidæ, Tephritidæ.

Series 3. Scioomyzæformes.

The 28 remaining subfamilies—Rhopalomeridæ to Borboridæ.

Hendel (1922) has proposed a somewhat different arrangement, as follows:

I. Scioomyzomorphæ.

1. Scioomyzoidea. (Rhopalomeridæ, Scioomyzidæ, Dryomyzidæ, Neottiophilidæ.)

2. Sepsoidea. (Megameridæ, Sepsidæ, Diopsidæ, Pio-philidæ, Thyreophoridæ, Psilidæ.)

II. Tephritomorphæ.

3. Tyloidea. (Micropezidæ, Neriidæ.)
4. Tephritoidea. (Lonchæidæ, Tanypezidæ, Ulidiidæ, Pterocallidæ, Ortalidæ, Platystomidæ, Richardiidæ, Phytalmyidæ, Tephritidæ, Tachiniscidæ, Pyrgotidæ.)

III. Lauxaniomorphæ.

5. Lauxanioidea. (Lauxaniidæ, Celyphidæ, Ochthiphilidæ.)
6. Helomyzoidea. (Cœlopidæ, Helomyzidæ, Trixoscelidæ.)
7. Anthomyzoidea. (Chiromyidæ, Clusiidæ, Anthomyzidæ, Opomyzidæ.)

IV. Drosophilomorphæ.

8. Ephydroidea. (Canaceidæ, Ephydridæ, Borboridæ, Tethinidæ.)
9. Drosophiloidea. (Drosophilidæ, Astiidæ, Periseelidæ.)
10. Milichioidea. (Odiniidæ, Agromyzidæ, Carnidæ, Milichiidæ.)
11. Chloropoidea. (Chloropidæ.)

My own views, based in part on the new data presented in the present paper, are in some respects a compromise between these two systems. I agree with Hendel that Frey's "Conopiformes" do not form a convenient group, and that the Conopidæ are probably best treated as not belonging to the Acalyptera. That the Neriidæ and Micropezidæ are to be placed in the "Ortalidiformes" or "Tephritomorphæ" seems to me also a reasonable view. But I cannot agree that the remaining two groups—Chloropidæ and Milichiidæ—should be placed near the other forms included in Hendel's "Milichioidea." The rudimentary seminal receptacles with long fine ducts, and the pocket-like ventral receptacle indicate that these two groups are close to each other and remote from the Agromyzidæ and the other members of Hendel's "Drosophilomorphæ." In my opinion a special group ("Chloropiformes"), corresponding to Frey's "Conopi-

formes," should be made for the reception of these two groups. In that they possess coiled spermathecal ducts, the Milichiidæ are more like the Botanobiinæ than like the Chloropinæ.

The "Ortalidiformes" or "Tephritomorphæ" are clearly marked off from the rest of the Acalypteræ by the structure of the ovipositor. On this basis the group should include the Agromyzidæ—as it does in Frey's system—and also the Micropezidæ, as it does in Hendel's scheme. On the same basis, the Odiniinæ must be removed from the Agromyzidæ—a conclusion that is clearly borne out by the internal female reproductive organs. I have followed Frey and Hendel not only in this latter respect, but also in separating *Periscelis* from the Lonchæidæ, to which I formerly referred it. It does not have the Ortalidiform ovipositor, and also has a unique spermathecal apparatus.

Frey's group Sciomyzæformes is made up simply of the rest of the families after the exclusion of the groups just discussed. Hendel has formed three series and eight superfamilies of this assemblage. This treatment does not seem to me altogether satisfactory; more data on various characters will be needed to elaborate a satisfactory system. For the present I shall merely discuss the indications derived from my own work.

The Sapromyzidæ (Lauxaniidæ of Hendel and others) and Ochthiphilidæ are often placed near each other, and have even been united. The external characters usually used for classification do in fact suggest that the groups are very close, though the two groups may be separated by an examination of the pre-apical tibial bristles (well-developed in the Sapromyzidæ, minute or absent in the Ochthiphilidæ). Frey reports differences in the mouth-parts; and the accounts above show that there are three spermathecae and a thick muscular uterine wall in the Sapromyzidæ, but four spermathecae and a normal uterine wall in the Ochthiphilidæ. Another striking difference occurs in the males. The Ochthiphilidæ (*Leucopis* and *Pseudodinia* examined) have two simple unbranched paragonia, or accessory reproductive glands. This is the usual condition among the Acalypteræ, as among the Diptera in general. I have observed it in the Agromyzidæ, Borboridæ, Drosophilidæ, Ephydridæ, Micropezidæ, Milichiidæ, Ortalidæ, Sciomyzidæ, Sepsidæ, and Uli-

diidæ. But in the Sapromyzidæ (genera Caliope, Camptoprosopella, Lauxania, Minettia, Sapromyza, and Steganolauxania examined) the paragonia are repeatedly branched, and form so dense a tangle that I have been unable to make out whether there are only two (*i.e.*, two insertion points), or many. It may be added that this is the only case in which I have found what appears to be a good diagnostic character for a large group in the soft parts of the male genitalia.

The old family Geomyzidæ has here been broken up, following Frey and Hendel, into the Opomyzidæ, Diastatidæ, Chiromyzidæ, Anthomyzidæ, Trixoscelidæ, and Tethinidæ. Of these, Hendel would include the Diastatidæ under the Drosophilidæ, ally the Trixoscelidæ with the Helomyzidæ, and the Tethinidæ with the Borboridæ and Ephydridæ, leaving the remaining three groups as related to each other and to the Clusiidæ. I have not sufficient data on the genital organs of the Opomyzidæ, Chiromyzidæ, or Trixoscelidæ to warrant a discussion of them. Diastata suggests the Ephydridæ rather than the Drosophilidæ in its female genitalia. But I should remove Curtonotum from the Drosophilidæ and place it with Diastata, on the basis of the peculiar rectal glands occurring in both, as well as the common external characters of pectinate costa, similar auxiliary vein, and bristly mesopleura. The female genitalia of the Anthomyzidæ do not specially suggest those of any other group. Those of the Tethinidæ certainly do not speak for Milichiid affinities, nor for Ephydrid ones. There are, however, suggestions of the Borboridæ in the shape of the parovaria, the short spermathecal ducts, and the shape of the spermathecal envelops.

One of the most distinct subfamilies, as judged by the female genitalia, is the Ephydridæ. The absence of spermathecæ, short spermathecal ducts, and heavily chitinized ventral receptacle occur together only in the Ephydridæ (where they were found in all 17 genera examined) and in Diastata; and Diastata differs from all the Ephydridæ in that its ventral receptacle curves posteriorly, so that the apex lies behind the base. Of these three characteristics, only the least important one (short duct) occurs in Canace, which has been referred to the Ephydridæ until recently. The erection of a family Canaceidæ is thus made still

more desirable. *Gymnopa* has been referred to the Chloropidæ; and Cresson (1922), in a recent account of the genus, has concluded that it is probably related to the Chloropidæ, Ephyridæ, and Agromyzidæ, but that it is doubtful if it can properly be included in any of these families. The female genitalia of *Gymnopa* are perfectly normal Ephyrid organs, and show no trace of Chloropid or Agromyzid characters. Frey's studies on the mouth-parts also indicate that the genus is a typical Ephyrid. It must surely be left in the group where it is now usually placed.

An unexpected result of these studies is the similarity that exists between the Clusiidæ and the Drosophilidæ. The ventral receptacle is much alike in the two groups—that of *Heteromeringia* being especially Drosophilid in appearance—and is not approached in any other family. The spermathecæ of *Clusiodes* are also of the telescoped type that is so frequent in the Drosophilidæ. However, the two families are scarcely to be placed near together, since they differ in most of the characters that are usually considered of primary importance in the Acalypteræ—postverticals, auxiliary vein, costal breaks, cruciate frontals, insertion of arista, and filter apparatus in the œsophagus.

The two unplaced genera—*Aulacigaster* and *Cryptochætum*—should probably be made the types of new subfamilies. An examination of the mouth-parts of a cleared specimen of *Aulacigaster* shows the following characters: filter-apparatus and palpi-feral bristles absent; five pseudotracheæ on each side, no common pseudotracheal duct; mentum with no median furrow. Among the forms described by Frey it agrees best with *Diastata*, from which it differs most obviously in the number of pseudotracheæ (ten to eleven in *Diastata*). The two forms agree in the structure of the stipes and galea (except that the latter is shorter in *Aulacigaster*), the mentum (including its six bristles), and in the small bristles of the fulcrum. The two forms are, however, too distinct in external characters and in female genitalia to be placed in the same family.

Melander (1913) referred *Cryptochætum* to the Agromyzidæ. I am unable to agree with his contention that the postverticals can be recognized among the numerous hair-like vertical bristles;

and the type certainly does not have an Agromyzid ovipositor. The genus has also been referred to the Chloropidæ and to the Oechthiphilidæ. It requires considerable modification of family characters to place it in either of these, or in any other group. No data on the mouth-parts are available, and the female genitalia are unique. My observations indicate that the antennæ do not lack an arista, as supposed. A single cleared and dissected specimen makes it probable that the third antennal joint is very small, and that what appears to be this joint is really the arista, which is a thin chitinized plate shaped like the cover of a book and completely enfolding the third joint.

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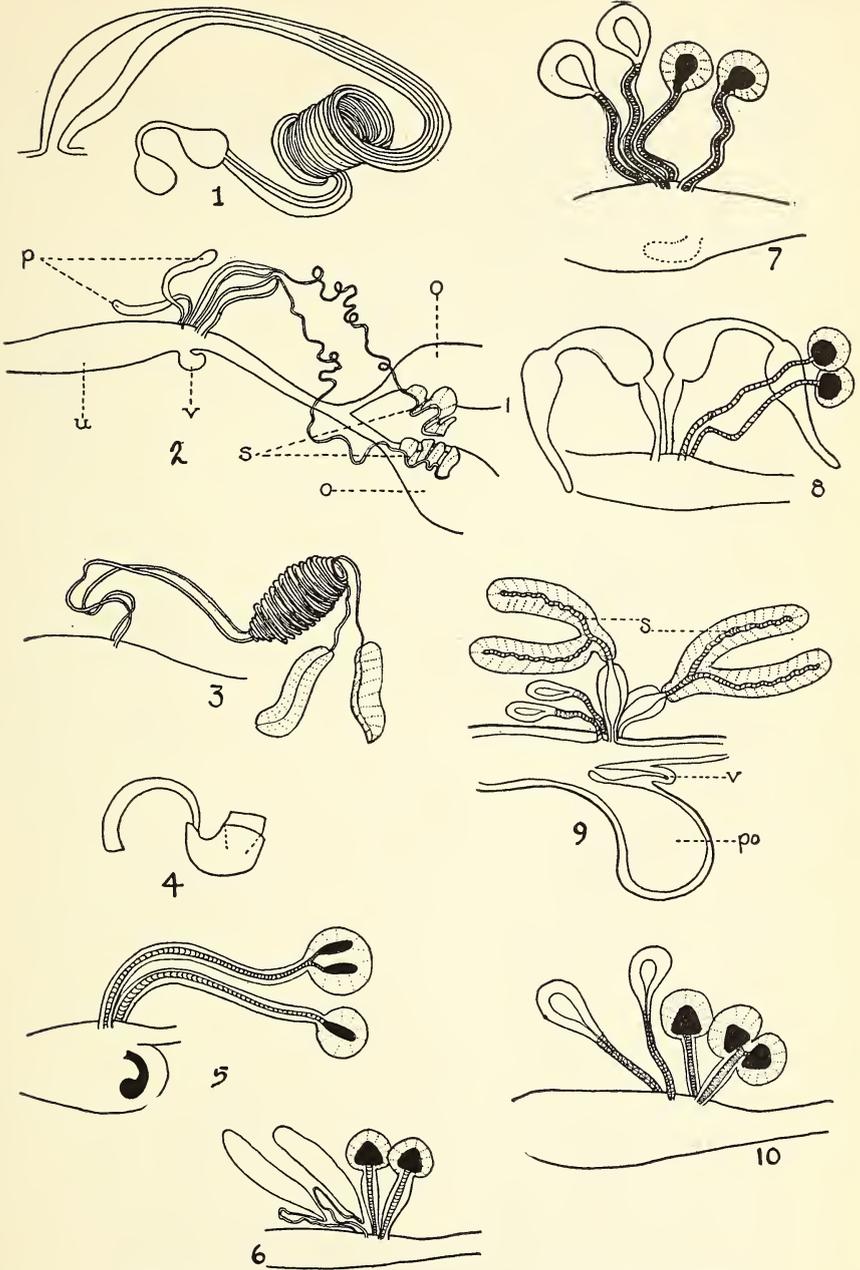
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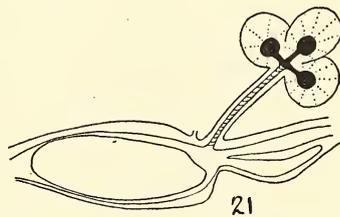
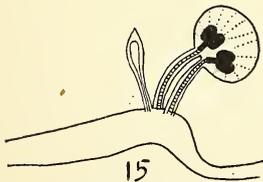
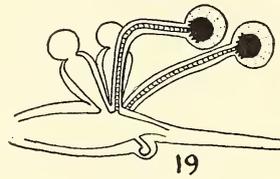
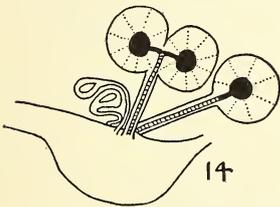
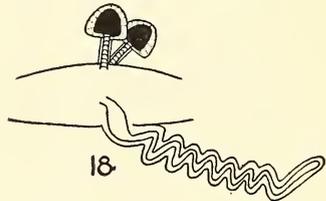
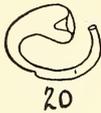
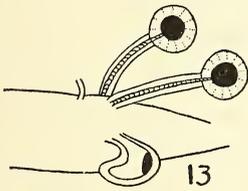
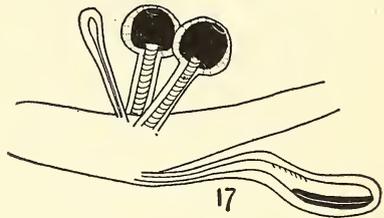
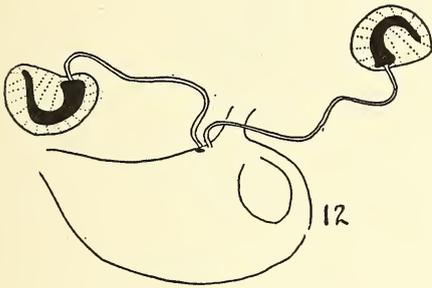
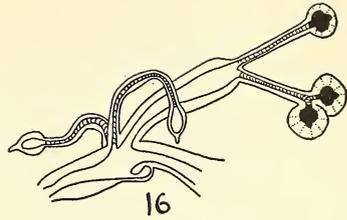
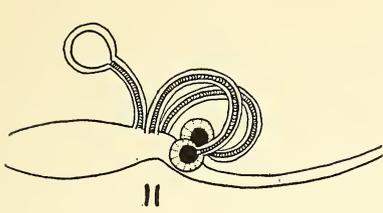
EXPLANATION OF PLATES I, II, III

- Figure 1. *Dolichopus* sp. Spermatheca and its duct.
- Figure 2. *Chloropisca glabra*. o, ovary; p, parovarium; s, spermatheca; u, uterus; v, ventral receptacle.
- Figure 3. *Phleomyia indecora*.
- Figure 4. *Phytomyza bicolor*. Ventral receptacle.
- Figure 5. *Lonchæa polita*.
- Figure 6. *Chætopsis apicalis*.
- Figure 7. *Straussia longipennis*.
- Figure 8. *Sepedon armipes*.

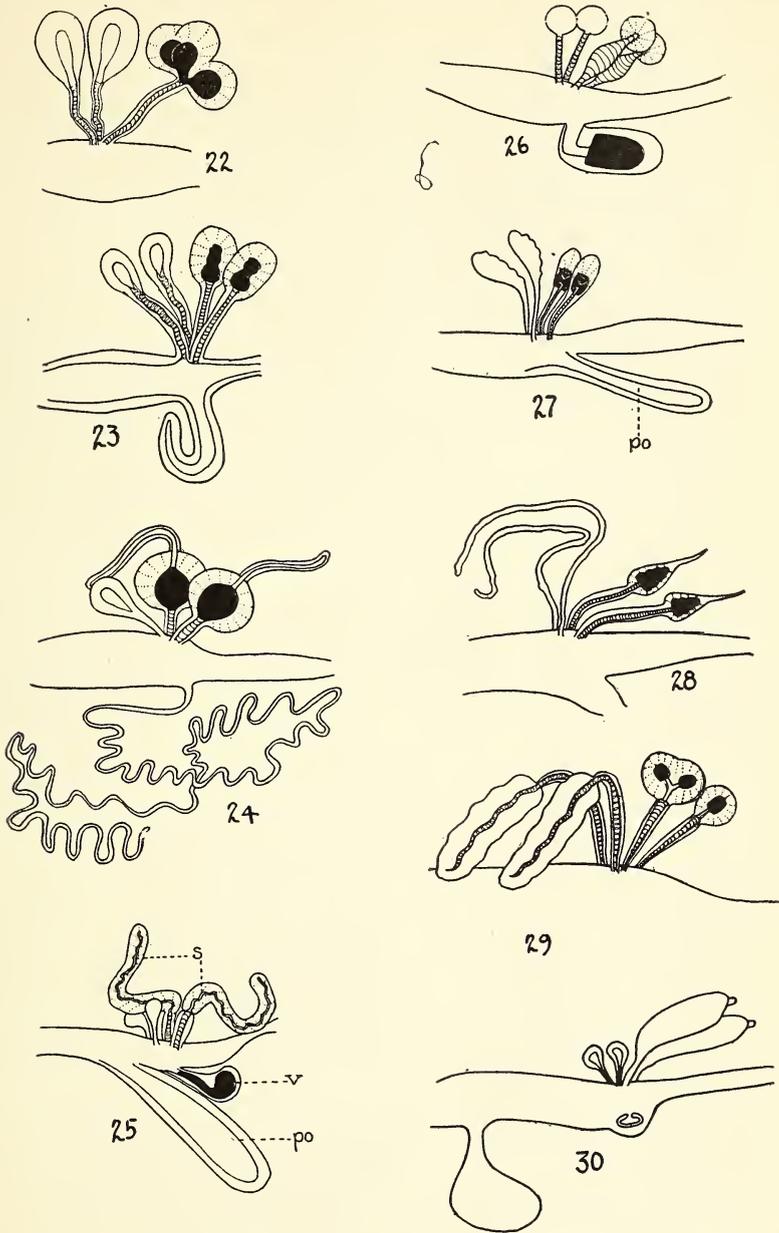
- Figure 9. *Pseudopsila collaris*. po, ventral pouch; s, spermatheca; v, ventral receptacle.
- Figure 10. *Sphyracephala brevicornis*.
- Figure 11. *Sepsis* sp.
- Figure 12. *Piophilila* sp.
- Figure 13. *Traginops irrorata*.
- Figure 14. *Minettia lupulina*.
- Figure 15. *Ochthiphila polystigma*.
- Figure 16. *Leria pectinata*.
- Figure 17. *Clusiodes johnsoni*.
- Figure 18. *Heteromeriugia nitida*.
- Figure 19. *Mumetopia occipitalis*.
- Figure 20. *Diastata repleta*. Ventral receptacle.
- Figure 21. *Periscelis annulata*. An egg is shown in the uterus.
- Figure 22. *Sphyroperiscelis wheeleri*.
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SEMINAL RECEPTACLES AND ACCESSORY GLANDS
OF THE DIPTERA



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LEWIS B. WOODRUFF,

From a photograph taken in the field, Lakehurst, New Jersey, May 12, 1917.

LEWIS BARTHOLOMEW WOODRUFF

It is with deep regret that we record the death of our fellow member, Lewis Bartholomew Woodruff. He was born in New York City, January 1, 1868, and died of typhoid fever on November 27, 1925, in the hospital at Torrington, Connecticut. His family long had a residence in the nearby town of Litchfield, whither Mr. Woodruff recently removed intending to make the ancestral house his permanent home. A lawyer by profession, he was, however, more interested in the natural sciences, and as soon as possible abandoned the law and devoted himself to the study of insects of which he had a large and carefully labeled collection. He was likewise interested in other branches of natural history, and had a collection of birds and some mammals. Both he and his brother, E. Seymour Woodruff, contributed to *The Birds of Connecticut*, published as No. 20 of the State Geological and Natural History Survey.

He joined the Linnean Society of New York in 1892, and served as its treasurer for 19 years, from March, 1902, to March, 1921. He was likewise a life member of the Staten Island Institute of Arts and Sciences.

On November 19, 1912, Mr. Woodruff was elected a member of the New York Entomological Society, and from that time attended many of its meetings. He served as vice-president of the Society during 1916 and 1917, and as president during 1918, 1919 and 1920. He became a life member April 1, 1924. He was much interested in the Membracidae and described nineteen forms as new to science; he also described the beetle *Polydrusus decoratus* from Alabama. Being interested in the Melandrydæ, he prepared the manuscript for that family for Leng's Catalogue of the Coleoptera of North America. The records of the meetings of the New York Entomological Society show that Mr. Woodruff contributed many items of interest about dragonflies, and had added a number of names to both the local list of New York City and the state list of Connecticut.

In addition to the numerous short notes to be found in the published minutes of the meetings of the Society, the following papers and miscellaneous notes are printed in its Journal:

1. *Neuronia pardalis* Walker near New York City (Trichoptera). Vol. 21, p. 163, June, 1913.
2. The Nymph of *Ophiogomphus Johannus* Needham. Illustrated. Vol. 22, pp. 61-63. March, 1914.
3. Some Dragonflies of a Connecticut Brook. Vol. 22, pp. 154-159. June, 1914.
4. A New Membracid from New York. With plate. Vol. 23, pp. 44-47. March, 1915.
5. The Occurrence of *Archips infumatana* Zell. in the Eastern United States. Vol. 24, p. 153. June, 1916.
6. Notes on Malachidæ (with Davis). Vol. 24, p. 154. June, 1916.
7. A Note on *Cremastochilus*. Vol. 26, p. 110. June, 1918.
8. Fall Notes on Some Alabama Butterflies. Vol. 27, pp. 159-161. June-Sept., 1919.
9. A Review of Our Local Species of the Membracid Genus *Ophiderma* Fairm. (Hemip.-Homop.). With plate. Vol. 27, pp. 249-260. Dec., 1919.
10. Further Notes on the Membracid Genus *Ophiderma* Fairm. (Hemip.-Homop.). Vol. 28, pp. 212-214. Sept.-Dec., 1920.
11. Lathridiidæ in the Heart of New York City (Coleop.). Vol. 29, pp. 178-179. Sept.-Dec., 1921.
12. A New Species of *Polydrusus* Germar (Coleop.). Vol. 31, pp. 155-157. Sept., 1923.
13. Supplementary Notes on *Ophiderma* Fairm. (Hemip.-Homop.). Vol. 31, pp. 188-189. Dec., 1923.
14. Critical Observations in the Membracid Genus *Cyrtolobus* Goding. (Hemip.-Homop.). Vol. 32, pp. 1-62, plates I-VI. March, 1924.

Recently Mr. Woodruff had become more closely associated with the American Museum of Natural History, and in the spring of 1925 accompanied a collecting expedition from that institution to the Virgin Islands.

We quote from the Litchfield *Inquirer* of December 3, 1925: "In accordance with Mr. Woodruff's wish there was no formal funeral service but a simple prayer, on Monday afternoon, at the family plot in Litchfield cemetery where his father, mother, three brothers and wife are all buried." He was the last of his family.

Since the foregoing was written, his executor has informed the Society, that Mr. Woodruff has very generously bequeathed \$10,000, the income from which is to be used by it in furthering the publication of papers on entomology.

WM. T. DAVIS.

AN ANNOTATED LIST OF THE DERMAPTERA AND
ORTHOPTERA COLLECTED IN MID-SUMMER
AT WINGINA, VIRGINIA, AND VICINITY

BY WM. T. DAVIS
STATEN ISLAND, N. Y.

Wingina is on the James River 104 miles above Richmond and about the same distance southwest of Washington. There are no towns within a long distance of the place, only villages. It is the summer home of Colonel Wirt Robinson and his house and museum overlook the low-land annually inundated by the river. This low-land has been used as corn-land since the settlement of the country by the whites, and before them by the Indians, whose stone hoes are still not uncommon objects in the fields.

Back from the river the land gradually rises to the first line of the Blue Ridge Mountains from six to ten miles away to the northwest, while close to the river to the south in Buckingham County there are some rugged forest-covered hills about 500 or 600 feet in height. There are also some isolated mountains in Buckingham County that appear unexpectedly in the otherwise more level country. Such are Spear's (1,500 ft.), Pluet's and Buck Mountains, all close together, while to the southeast, and about 15 miles away, there is Willis Mountain (1,159 ft.), a surprising pile of precipitous rocks. Willis Mountain was visited August 9, 1921, and Spear's Mountain and vicinity have been visited several times. On both sides of the river there are many miles of forested country, and many old and abandoned fields, the country being unsettled enough to protect a number of wild turkeys and some deer. The forests are mainly of a mixed growth of oaks and pines including among the five species of the latter the Table Mountain pine and a few white pines. The persimmon tree and the Spanish oak (*Quercus falcata*) are common; there are also sweet gums, and in the low-land a few willow oaks.

Colonel Robinson has helped me collect many of the eighty-four species mentioned in the list. He has often guided me through miles of forest in all directions from his home, and he is particularly expert in poling the boat in the river among its many shallows and rapids. Our visits to Spear's Mountain, where we stayed over night in a cabin, required two days each; one for the outward journey along the wood-paths or the almost equally tree-shaded roads where we came to but few dwellings, and the other for the return. We went slowly and were ever on the lookout for insects and whatever might be unusual in the natural history line. If these attractive localities could be visited in the fall, a considerable number of species would no doubt be added to the present list. It is presented, because few naturalists seem to have visited this part of the country, their collecting having been more confined to the mountains of Virginia, or to the low-lands near the sea.

There has, however, been a notable exception, for Dr. Henry Fox collected Orthoptera in 1914 and 1915 while at Charlottesville, Albemarle County, 35 miles northeast of Wingina. Both localities are in the Piedmont region, and about the same distance away from the Blue Ridge Mountains, but Wingina has evidently a more extensive Orthopterous fauna that has come to it from the coastal region up the valley of the James.

Dr. Fox in his Field Notes on Virginia Orthoptera (Pro. U. S. Nat. Mus., 1917), describes the country about Charlottesville as follows: "Altitude, 300 to 800 feet. Topography varied, but as a rule fairly rugged, with steep slopes near streams, but with more or less extensive level or slightly rolling interstream areas. Soils sandy loams and stiff red clays." This is a fair description of the vicinity of Wingina, but from the topographic map Wingina and the country across the James in Buckingham County, which we often visited, seems to be a little less rugged than that at Charlottesville. The Spear's Mt. region, to which we sometimes walked, is 6 or 7 miles across country from Wingina, but is only 4 miles from the James, which here has a considerable bend to the southward.

The sequence of the families used by Dr. Fox has been followed in the present list so that a ready comparison might be

made with his interesting paper, but we prefer the arrangement proposed by Prof. Albert P. Morse in his Orthoptera of New England (1920). Much use has been made of Dr. Blatchley's Orthoptera of Northeastern America, and also of several papers by Rehn and Hebard.

Order **DERMAPTERA**

Family **Forficulidae**

Vostox brunneipennis (Serville). Wingina, July 12, 1917, male and four females.

Labia minor (Linné). Wingina, July 23, 1924, four males and two females collected at light by Col. Robinson, and on Aug. 6 we collected a female in the same manner.

Doru aculatum (Seudder). This is the most common of the earwigs about Wingina and over the river in Buckingham Co. It may be found in the woods on the upland, but is most plentiful along the river on many of the plants. It is often common on the luxuriant Johnson grass, and may also be found in the silk of growing corn, and where the leaves join the stock. Nymphs as well as adults occur in mid-summer.

Order **ORTHOPTERA**

Family **Blattidae**

Ischnoptera deropeltiformis (Brunner). Represented in the collection by three adult females collected in July and August. At this time there were also nymphs, but no adult males, these being outlived by the females.

Parcoblatta uhleriana (Saussure). This is the most common of the roaches about Wingina, and some have been collected in molasses traps across the river. As with the last species no living males have been secured in July and August, though a number of dead ones were found in an old vase in the house. Nymphs found in June and later.

Parcoblatta virginica (Brunner). As in *uhleriana* the females live at least until the middle of August. Four have been collected but no males.

Parcoblatta divisa (Saussure and Zehntner). Buckingham Co., Aug., 1924, female from molasses trap set near the river in deep woods.

Parcoblatta pennsylvanica (De Geer). A male collected by Col. Robinson, June 24, 1923. The remaining five are females collected in August, one of them found as late as the 14th. They are usually under old logs.

Cryptocercus punctulatus Scudder. This interesting and wingless species has been found sparingly in rotten logs usually in the moist woods in the deep ravines leading down to the river. Six specimens have been collected in July and August. On Aug. 12, 1924, one was found in a molasses trap close to the river in Buckingham Co. As with the other wood-roaches, young and adults occur together in mid-summer. This insect is called the "Brown Wingless Cockroach" by Dr. Blatchley, which is a correct enough name for about thirty of the adults in the writer's collection from Georgia, North Carolina and West Virginia, but some examples from West Virginia and several of the series collected near Wingina in July and August, are shining black.

Family Mantidae

Stagmomantis carolina (Johannson). While this is a common insect about Wingina and in Buckingham Co., it matures rather late in the season, and all of the many seen in July and August have been about one third to one half grown.

Family Phasmidae

Diapheromera femorata (Say). Many immature individuals found, usually about one half grown, in the first part of August. When disturbed they often feign death. This habit of keeping perfectly quiet in the presence of danger must be of considerable

benefit to this stick-mimicking defenseless insect, but if persistently annoyed it generally makes off. Further north, with a shorter season, this species matures much earlier.

Family Tetrigidae

Nomotettix cristatus compressus Morse. One male and one female of the short-winged form, Wingina, June, 1919.

Acrydium ornatum Say. Wingina, July 8, 1917, male and female; Aug. 12, 1924, female on lowland near the river.

Acrydium arenosum angustum (Hancock). Of the five taken at Wingina in June, July and August, all were females. In Buckingham Co. a female taken June 21, and a male June 22, 1919. Another female, July, 1923.

Neottix femoratus (Scudder). Seven males and fifteen females collected in July and August, all of the short-winged form except two females.

Paratettix cucullatus (Burmeister). Common in many places along the river and near some of the lesser streams in June, July and August. Fifteen males and 27 females are in the collection.

Tettigidea lateralis (Say). This is the most common species of grouse locust to be found about Wingina and across the river. It generally occurs on moist ground. A pair of the long-winged form were found in copulation July 31, 1916. Of the 69 specimens collected, 54 are short-winged and 15 long-winged. In this species the sexes seem to be about evenly divided in mid-summer and there are also nymphs at the same season. On July 18, 1917, I saw one of the long-winged females jump into a shallow pool and stay under water about one half minute.

Family Acrididae

Tryxalis brevicornis (Linné). Found along the river and brooks where the ground is low and the vegetation rank. A con-

siderable number were collected in August, 1921, July, 1923, and August, 1924. The males are more uniform in color than the females, which latter may have both the tegmina and hind femora green; the tegmina partly green and brown and hind femora green, or the entire body brown. There are also specimens in which the dorsal stripe may be grayish or yellowish. The males usually have the dorsal surface green, sides brown from the head to end of tegmina, while the femora of all of the legs are green. Rarely there are all brown males.

It has generally been considered that the flight of this insect is noiseless and Blatchley so states in his interesting account of the species. Col. Robinson and I have, however, often heard the crackling flight of the males. On Aug. 16, 1921, at West Hampton, near Richmond, Va., in a wet place on the border of a pond, this grasshopper was quite common, and I again heard some of the males make a crackling noise in flight.

Syrbula admirabilis (Uhler). We often found this species in dry places among the little pines, grass, etc., by the side of the wood roads. On July 25, 1923, we found mature males, and immature females. On Aug. 1, 1916, four mature males and one female. Mostly mature by the first of August.

Eritettix simplex (Scudder). Two females were found on top of a grassy hill in Buckingham Co., near the river, on June 20, 1919. Three more females were collected the same year near Wingina, two on June 27 and one on July 8. One of those collected on June 20 has the usual pair of blackish stripes on the head and pronotum, the sides of the latter being green, while the other female collected at the same time lacks the supplementary carinae and also the stripes; it is variety *dorsalis* Blatchley. The remaining three specimens have the dorsal stripes but are not green on the sides of the pronotum.

Orphulella pelidna (Burmeister). Common and found in many places. Spear's Mt., Aug. 14-15, 1924. Females with the dorsum of the head, pronotum and folded tegmina green are less common than the brownish individuals. Occasionally a female

has the top of the folded tegmina quite reddish. The males are less strikingly variable.

Dichromorpha viridis (Scudder). On July 25, 1923, a few adult females that had just matured, some female nymphs, and some mature males were found near the Warminster Road, Wingina. The eleven males in the collection, found at various dates in July and August, are all of the green-backed variety; one of the females is green, and one brown.

Arphia xanthoptera (Burmeister). A number of adults collected at Wingina in August, and a nymph at Spear's Mt. July 30, 1923.

Arphia sulphurea (Fabricius). June, July and August, Wingina and Buckingham Co. An occasional individual showing a dorsal yellowish stripe on the closed elytra.

Chortophaga viridifasciata (De Geer). Common in June, July and August about Wingina and in Buckingham Co. Five males partly green in color, instead of the usual brown, have been collected. Greenish females are much more common, some of them colored very beautifully. As this insect lives over winter in the nymphal state, maturing in the spring, and as nymphs have been found at Wingina in July, it is probably double brooded.

Hippiscus phoenicopterus (Burmeister). A fairly common species in old pastures and at the edge of open woods in June, July and August. Also at Spear's Mt., July 30, 1923.

Hippiscus rugosus (Scudder). Frequent in old upland fields. Willis Mt., Aug. 9, 1921; both adults and nymphs, Spear's Mt., Aug. 14, 1924. In addition to the characters usually given the femora are much narrower in the males of this species than in *phoenicopterus*.

Dissosteira carolina (Linné). Adults in June, July and August, and some of them of the reddish tegmina variety.

Spharagemon bolli (Scudder). One of the most plentiful of grasshoppers in dry open woods, and found in June, July and August. Willis Mt., Aug. 9, 1921.

Trimerotropis citrina Scudder. Found on sandy ground, but more often on sand bars in the James River. Collected in June, July and August, but not abundant. Only three males and two females have been collected.

Schistocerca americana (Drury). Not infrequent in July and August.

Schistocerca alutacea (Harris). Buckingham Co., June 30, 1925 (Col. Robinson).

Schistocerca damnifica (Saussure). Buckingham Co., July 19, 1919, one female.

Paroxya clavuliger (Serville). In low ground along the river and like situations near brooks.

Melanoplus tribulus Morse. June, July and August. A female nymph Aug. 6, a pair in copulation Aug. 3, 1916; twenty-two specimens in the collection.

Melanoplus devius Morse. July and Aug. in Buckingham Co., some near the river. None have been found on the Wingina side of the river. Eight specimens in the collection.

Melanoplus scudderi (Uhler). Buckingham Co., Aug. 6, 1921, male.

Melanoplus walshii Scudder. Pass between Spear's and Pluet's Mountains, Buckingham Co., Aug. 14, 1924, female. The road between the mountains is narrow and deeply shaded by forest trees. The grasshopper was by the side of the road. It has been examined by Dr. Fox, who was surprised to find that the species occurred so far east of its heretofore known range in Virginia.

Melanoplus atlanis (Riley). This is the most common member of the genus as well as the most plentiful grasshopper at Wingina and across the river in June, July and August. A female of this species was collected by Col. Robinson, December 30, 1923, which suggests that mature individuals may occasionally survive the winter. Dr. Fox collected one male and five females at Charlottesville, December 5, 1913. As a species *atlanis* matures much earlier in the season than *femur-rubrum*, no adults of which have thus far been collected at Wingina.

Melanoplus confusus Scudder (minor). Wingina, June, July and August, but not very plentiful. Buckingham Co., June 20, male and female.

Melanoplus luridus (Dodge). Collected at numerous places in August, often along the margins of woods.

Melanoplus bivittatus femoratus (Burmeister). Plentiful in some localities in the low ground along the river, June, July, August.

Melanoplus punctulatus Scudder. Wingina, Aug. 4, 1916, male, and Aug. 4, 1921, male and female nymph. Found on the trunks of pines and sometimes on oaks.

Family Tettigoniidae

Scudderia curvicauda (De Geer). The most common species of the genus; found in old fields and along the edge of woods in July and August.

Scudderia furcata Brunner. Wingina, male on "sugared" tree trunk, Aug. 12, 1921. Buckingham Co., Aug. 6 and 13.

Symmetropleura modesta Brunner. Buckingham Co., close to James River, Aug. 7, 1924, male beaten from bush into umbrella by Col. Robinson. This extends the known range of this uncommon species somewhat northward along or near the coast.

Amblycorypha oblongifolia (De Geer). Wingina and Buckingham Co.; rather plentiful in July and August. Maturing chiefly in August.

Amblycorypha floridana carinata Rehn and Hebard. Buckingham Co., Aug., 1921, female.

Amblycorypha uhleri Stål. Wingina, Aug., 1916, male; Aug. 21, 1921, male, and Spear's Mt., July 30, 1923, male.

Amblycorypha rotundifolia (Scudder). Frequent; fifteen specimens collected in July and August. Aug. 2, 1923, one male of the brown form.

Microcentrum rhombifolium (Saussure). Wingina, Aug. 2, 1923, male just matured. Buckingham Co., Aug. 5, 1921; Aug. 7, 1924.

Microcentrum retinerve (Burmeister). Wingina, Aug., 1916, female, Aug. 4, 1921, female, and Aug. 3, 1923, male. This last near the museum.

Pterophylla camellifolia (Fabricius). Plentiful in places in July and August, but perhaps not as conspicuously in evidence as in the Pine Barrens of New Jersey, or on parts of Long Island, N. Y. In 1923 the first one heard by Col. Robinson was on July 20.

On the evening of July 25, 1923, a katydid in an apple tree close to Col. Robinson's house commenced to sing at 7:50 P. M., standard time. On July 26 it sang at 8 P. M.; July 27 at 8 P. M.; July 28 at 8 P. M.; July 29 at 8:10 P. M. On July 30 we went to Spear's Mt., but the apple tree katydid record was kept by Col. Robinson's aunt, and the insect sang at 8 P. M. On July 31 at 8:05 P. M.; Aug. 1, 8:10 P. M.; Aug. 2, a clear warm evening, at 8:06 P. M. A second male was first heard in the apple tree on Aug. 2. On Aug. 3, a rainy evening, the katydid (original), with a loud note, sang at 8:05, the other katydid in the same tree a little later. This last individual shortly disap-

peared. On Aug. 4, after a heavy rain, katydid sang at 7:45, stopped and then commenced to sing again at 7:50.

On August 5th the writer left for home and the record of the time when the apple tree katydid commenced to sing each evening was kept by Mr. and Mrs. Clifford Cabell, and is as follows: August 5th, 7:53; 6th, 7:50; 7th, 7:50; 8th, 7:53; 9th, 7:55; 10th, 7:46; 11th, 7:51; 12th, 7:50; 13th, 7:54; 14th, 8 P. M.; 15th, 7:45; 16th, 7:49; 17th, 8:20, cold and rainy; 18th, 8:15, cold and rainy; 19th, 7:45; 20th, 7:52; 21st, 7:47; 22nd, did not sing, too cold, down to 50°; 23rd, did not sing, too cold, down to 50°; 24th, 7:55; 25th, 7:15; 26th, 7:39; 27th, 7:25; 28th, 7:21; 29th, 7:21; 30th, 7:26; 31st, 7:20; September 1st, 7:25; 2nd, 7:31; 3rd, 7:17; 4th, 7:15; 5th, 7:30; 6th, 7:05; 7th, 7:38; 8th, 7:20; 9th, 7:01; 10th, 7:10; 11th, 7:05; 12th, 6:55; 13th, 6:57; 14th, 6:54; 15th, 16th and 17th, did not sing, too cold; 18th, 6:50, song very feeble. On Sept. 23, Mr. Cabell noted, "Has not sung since the 18th, so expect he has knocked off for good. Certainly kept it up for a long time."

The apple tree where this katydid made his home was four or five hundred feet from the woods where there were many of his kind. It was an ill-chosen locality for him. He sang with remarkable regularity as regards the time of evening, commencing somewhat earlier as the season advanced. As the nights grow colder, it is of quite common occurrence for these insects to sing in the sunny hours of an October day.

Neoconocephalus exiliscanorus (Davis). Frequent in the low ground along the river; also in Buckingham Co. The old bed of the one-time James River and Kanawha Canal is the habitat of *exiliscanorus* and other species partial to low ground.

Neoconocephalus robustus crepitans (Scudder). Both in the low land along the river and in the upland fields, July and August. Brownish colored individuals occasional. The specimens collected have the fastigium shorter than in *N. robustus robustus* from further north.

Orchelimum agile (De Geer). Wingina, Aug., 1921, female; Buckingham Co., Aug. 11, 1921, five males.

Orchelimum vulgare Harris. Wingina, Aug. 14, 1921, male, female and female nymph; Aug., 1924, male.

Conocephalus fasciatus (De Geer). Wingina and Buckingham Co. Common, June, July and August.

Conocephalus brevipennis (Scudder). Wingina, Aug., 1921, male and female.

Conocephalus strictus (Scudder). Wingina and Buckingham Co., Aug. 7 and 14, nymphs. The species can be easily recognized, even when immature, by the very long ovipositor.

Atlanticus davisii Rehn and Hebard. Wingina and Buckingham Co. Often in deep shaded woods among the dry leaves, June, July, August. Sometimes attracted to "sugared" trees. We have collected many by disturbing the dry leaves on the ground, especially in the woods to the north of Col. Robinson's museum. The collection contains forty-four individuals and others could have easily been secured. Wingina is less than sixty miles southwest of Orange, Orange Co., Va., from whence came the types and paratypes of the species.

Camptonotus carolinensis (Gerstæcker). About a dozen mature individuals and several times as many nymphs have been found at Wingina and in Buckingham Co., in June, July and August. They were often collected in the umbrella by beating dead leaves hanging on bushes and low branches. With its extremely long antennae and pale body this interesting home-constructing insect presents a remarkable appearance against the dark background of an umbrella.

Ceuthophilus nigricans Scudder. Wingina, Aug., 1916, male and female. A few mature individuals have been collected in August, but nymphs were not uncommon in our molasses traps in Buckingham Co. in early August, 1924.

Ceuthophilus gracilipes (Haldeman). Mature males and females and many nymphs were found August 4, 1916, in Old Joe's

Cave in the steep embankment of the James River in Buckingham Co., on the opposite side of the river and a little above Wingina. Some of these specimens were compared by Prof. Albert P. Morse with those in the Scudder collection and found to be *gracilipes*. On Aug. 11, 1921, three males, three females and five nymphs were collected in the cave, while on July 26, 1923, only six mature individuals and no nymphs were seen. The insects were near the top of the cave and close to some cracks in the rock into which they retreated if alarmed.

We also collected some *gracilipes* in our molasses jars.

Family Gryllidae

Gryllotalpa hexadactyla Perty. A number have been heard singing in August in low wet land and a nymph was collected Aug. 1, 1921. In Col. Robinson's collection there are two mature individuals dated July 18, 1913, and Aug. 18, 1919.

Tridactylus apicalis Say. A single specimen in Col. Robinson's collection dated July 14, 1917.

Ellipes minuta (Scudder). Sometimes a common species on the sand flats along the river, brooks, etc., in June, July and August. Many have been collected.

Nemobius fasciatus (De Geer). But few mature individuals have been found, as the majority reach that stage late in August and in September.

Nemobius fasciatus var. **socius** Scudder. Wingina; woods north of museum, Aug., 1924, two males and two females.

Nemobius confusus Blatchley. Buckingham Co., nymph among dry leaves in woods on bank of the James River, Aug., 1924, and easily determined by having "last two joints of maxillary palpi pure bone-white."

Miogryllus verticalis (Serville). Wingina and Buckingham Co., June, July and August, adults and nymphs. Not uncommon in dry woods under leaves, bits of wood, etc.

Gryllus assimilis Fabricius. Wingina and Buckingham Co., June, July and August. Most of the specimens belong to the var. *pennsylvanicus* Burm.

Oecanthus niveus (De Geer). No specimens have been collected but the distinctive song has been heard in August in the trees growing in the garden at Wingina.

Oecanthus angustipennis Fitch. Wingina and Buckingham Co. The earliest record for a mature male is Spear's Mt., July 30, 1923, at which time there were also many nymphs. On days preceding and immediately following July 28, 1923, many nymphs, but no adults, were beaten from the vegetation just north of the museum, where *exclamationis* was found. It evidently matures later than that species.

Oecanthus exclamationis Davis. Wingina and Buckingham Co., including Spear's Mt. Matures in July and August. Often found in post oaks, etc., but may occasionally be collected in bushes growing in moist situations. On July 28, 1923, one male and six females, all adults, were found on post oaks near the museum. At this same date only nymphs of *angustipennis* could be found, as already noted. The song of *exclamationis* resembles that of *angustipennis*, but is considerably louder, continues longer, and the stops between the periods of song are relatively shorter. In *angustipennis* the song and the intervals between are more nearly of the same length.

Oecanthus nigricornis var. **quadripunctatus** Beut. Wingina, July, 1917, male and female; Aug. 4, 1923, males and females mating in meadow and in the garden.

Oecanthus pini Beutenmuller. Wingina, July 28, 1923, female found on pine tree near the museum.

Oecanthus latipennis Riley. Numerous nymphs, but no adults, have been collected as they mature late in August.

Neoxabea bipunctata (De Geer). Wingina and Buckingham Co. Nymphs in June; two adult females July 21 and 23, 1921; not uncommon in August. On August 9, 1924, four males were found while they were singing in the apple trees in the garden. The song is continued for some time longer than in *exclamationis* and considerably longer than in *angustipennis*. The intervals or stops are very short, in fact on very warm evenings it is almost continuous, and when several singing individuals are near each other it may appear to be so. On August 12, 1924, a female was found in an apple tree near to two singing males.

Anaxipha exigua (Say). Wingina and Buckingham Co., July and August. Common and found in many different situations. Beaten from oaks in dry woods, but is most numerous in the rank vegetation on the banks of the James. On one occasion one was found between the slabs at a saw-mill.

Cyrtoxipha gundlachi columbiana Caudell. Wingina, Aug., 1921, two males and three females. Buckingham Co., Aug. 5, 1921, two males. Nymph beaten from an oak near the museum July 28, 1923, and numerous nymphs on bushes along a brook at Spear's Mt., July 30, 1923.

Phylloscyrtus pulchellus Uhler. Wingina and Buckingham Co. Very plentiful in the rank vegetation along the James; also along a brook at Spear's Mt. This beautiful little cricket, that keeps its antennae in almost constant motion, matures in early August. An adult female was found August 11, 1921, feeding on the seed-bearing stalk of a plantain (*Plantago*).

Hapithus agitator Uhler. Only nymphs have been found.

Orocharis saltator Uhler. Wingina and Buckingham Co.; common. Two males found near the river Aug. 13, 1921. It matures mainly in the latter part of August.

THE WING FOLDING PATTERNS OF THE COLEOPTERA

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In working out the venation of the Coleoptera it has gradually appeared that the arrangement of the folds also was significant and would give evidence as to relationships within the order. The folding pattern was therefore studied in a series of forms, including representatives of practically all the families of beetles, and has been far more productive even than had been hoped.

The folding patterns of practically all beetles prove to be derivable by relatively simple modifications from a single fundamental plan, close approximations to which are found in various families. These modifications have taken a relatively few definite directions, each of which characterizes a large series of Coleoptera, and which in several cases I believe is as significant as any of the characters now in use. They throw considerable doubt, however, on the present placing of a good many families and genera, especially of the smaller forms.

The study is based primarily on material in the collection of Cornell University, supplemented by purchased material. I am very much indebted to Dr. E. A. Schwarz, Mr. H. S. Barber and the U. S. National Museum for the loan of many significant forms, including *Cyathocerus*, *Hydroscapha* and *Discoloma*; to Dr. Wm. M. Mann for the loan of *Gnostus*, and to Mr. A. J. Mutchler for *Telegeusis* and several other interesting forms.

METHODS

In the case of forms of convenient size, especially if the species were somewhat rare and I did not wish to injure the appearance of a specimen, the beetle to be studied was relaxed somewhat, which made it possible to raise the left elytron and remove the wing without visible damage to the specimen. Then a drawing

was made of the venation, using a mounted specimen of the same genus when possible—in other cases a copy of any figure available, or building up a sketch from the wing being studied. Kempers' set of figures of most of the European types of Coleoptera (*Ent. Mitt.* 12: 71–115; 1923) was a very useful source. The position of all the folds visible in the wing was laid down on this drawing, in their proper relation to margins and visible veins. Then the outer part of the wing was partially and gradually unfolded, plotting the remaining folds as they became visible, always with reference to the veins so far as they could be seen; and noting in every case whether the folds were convex or concave as seen in the unfolded wing, and whether the areas were right side up or reversed in folding.

In some cases fresh specimens were used, and the folds studied without removing the wing, as in this way it was possible to see how many were of permanent character, and how many the result of accidents in the folding. But in general, specimens which had been dried were more useful, as the drying set the folds in, and they could be located more surely and accurately. The principal exceptions are the relatively small crumples, which proved unstable, and especially the dorsal margin of the wing, which in many forms has no definite folding pattern, but is merely packed away, apparently by use of the legs. In these cases the more obvious folds were noted in detail, and the presence of additional presumably inconstant ones is indicated in the diagrams by fine oblique hatching. Areas not completely folded over, and areas which it was not possible to work out fully, are also indicated in the same way.

With the smaller forms it was not possible to use the same method, as a relatively small amount of relaxing frequently caused the wings to unfold more or less completely, and sometimes caused the folds to vanish. In this case the left elytron was removed and the wing broken off. If the specimen was at all oily or gummy it was manipulated in alcohol (95 per cent.) which did not soften the wings enough to unfold them, but made the specimens' decidedly less brittle. The wing was then manipulated as in the case of larger wings, but it was frequently unnecessary to unfold it more than a little, as the folds could be

seen through several thicknesses of wing, and it was merely necessary to work out their relative position. This was usually done in alcohol, handling the wings with fine needles, but was tedious; and frequently it was not possible to work out a wing quite completely, though it was rarely difficult to determine the type of folding.

The wing was then usually transferred to weaker alcohol, allowed to unfold itself and mounted dry for the study of the venation. These small forms have lost the venation more or less completely, the outer veins being visible only in a cross light, and most of the anals often completely lost, but the foldings are by no means simplified, as will be readily seen by looking at the figures of such forms as the Nitidulidæ (the wing of *Colopterus*, fig. 51, is less than 3 mm. long). This gives the folding a very special value, as practically all the other structures, venation, tarsi, antennæ, etc., are more or less simplified in the minute species. Only at the limit of smallness (Hydroscaphidæ, Sphaeriidæ, Clambidæ, Ptiliidæ) is the folding somewhat simplified.

NOMENCLATURE

For convenience I have designated the areas delimited by the folds of the wings by capital letters, using the first part of the alphabet (A-J) for the areas reversed in folding, and the latter part (P-X) for the areas which remain upright, or which are finally upright as the result of two successive reversals. For the folds themselves I have used the letter belonging to the adjacent reversed area, combined with a number which is odd for concave and even for convex folds. These numbers and letters have been laid out on my hypothetical wing (text figure 1) and are used uniformly in all the forms where homologous folds occur.

Frequently some of the areas are subdivided by additional folds. In these cases I have added a small letter to the capital to distinguish each subdivision; new areas not obviously the product of division of typical areas are designated by small letters standing alone. These are applied arbitrarily, but so far as possible uniformly in closely related forms.

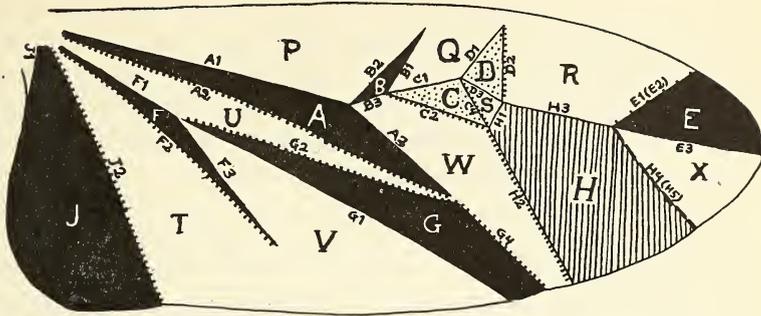


FIGURE 1. Hypothetical folding and nomenclature.

The following is a list of the principal areas (compare the figure).

- | | | |
|------------------------|----------------------|---|
| A—Median | P—First | } Costal |
| B—Proximal Pivot | Q—Second | |
| C—Antemedian | R—Stigmatal | |
| D—Pivot (Distal Pivot) | S—Central | |
| E—First Costo-apical | T—Wedge | } When combined forming the Anal Area |
| F—Second Anal | U—Cubital | |
| G—First Anal | V—Outer Anal | |
| H—Principal | W—Oblong | |
| J—Jugal or Axillary | X—First Dorso-apical | |

A few of the folds also are so fundamental in character as to deserve names.

The median is the concave fold through the wing from base to apex (A1—B1—C1—D3—H3—E3).

D1 is the concave pivot-fold.

D2 the convex pivot-fold.

H2 the principal fold.

A2 the cubital fold.

J2 the jugal or axillary fold.

Costo-apical and dorso-apical folds are named in order of appearance, the most basal being "first."

THE FUNDAMENTAL PLAN

In making up a hypothetical plan (text fig. 1) certain points must be taken into consideration. *First*, it must be derivable

with only minor changes from both the Adephagous and Polyphagous types; *second*, the necessities of a practical folding must be considered. The hypothetical pattern here suggested is a slight modification of the Adephagous type, and has no element not present in some Polyphaga; and it has been tested for functional possibility by actually folding a model.

It is to be noted that folds always meet in groups of four (rarely six), save in the case of narrow crumples that fade out imperceptibly at the ends. In such a group of four, one pair always makes a continuous fold, passing through without change of character; the other pair are always one convex and one concave, and may either be placed in mirror symmetry to the first pair or may both be located on the same side of it; in the latter case the first fold always is bent at an angle corresponding to that included between the other two. The narrowest of four areas that meet at a point is always bounded by one concave and one convex fold.

Bearing this in mind we may take our hypothetical type and analyze it further, on the supposition that a fold that changes character at an intersection is later than one that passes through unchanged. On this hypothesis the folds appear to have originated in the following order:

1, the axillary fold (J2); this is present in many orders and notably in the fore wing of the Lepidoptera and Trichoptera, where it separates the jugum from the rest of the wing. No doubt the fold that separated the alula of the fore wing from the elytron proper in the Adephaga and Hydrophilidæ is also homologous.

2, the median furrow (A1-B1-C1-D3-H3-E3). This is homologous with the median furrow of Neuroptera and various other orders, and no doubt originally lay along the median vein, which was primitively a concave vein—Adolph notwithstanding.

In the Coleoptera (as in the Lepidoptera and Hymenoptera) it no longer lies exactly on the vein, but alternately above and below it. If Tillyard's theory is correct, that media was originally trifold, with a convex middle branch between two concave branches, the outer part of the Coleopterous median fold (C1-E3) would have to represent the fold accompanying M_1 , while C2 and H2 may perhaps represent M_2 .

3, a convex fold along Cu (A2-G4).

4, a concave fold along 1st A (F1-G1).

5, a convex fold along 2d A (F2). These three folds are also more or less developed in several orders, at least as convexities and concavities along the veins. Like the median furrow they have left the veins, and in the beetles lie immediately above or below them.

The remaining folds are peculiar to the Coleoptera, except that the two hinge folds are developed toward the costa in many Hymenoptera (*e.g.* *Ophion*). They differ from the first set in being more or less transverse, and changing from concave to convex or vice versa, whenever they cross one of the earlier folds.

6, a zig-zag antemedial series, crossing 2, 3 and 4, and changing direction and character at each crossing (B2-A3-G2-F3).

7, the fold B3-C2-H2, crossing fold no. 1 only, and changing from concave to convex where it crosses. It is not unlikely that the convex part of this fold represents M2, and that the concave part, which is frequently absent, is a mere adjustment.

8, 9, the pivot folds, each starting from the costa before the stigma, at a point where the costal group of veins (C, Sc, R₁) are fused to form an elastic hinge; each crossing fold 1, changing direction and character, and then ending at a single point on fold 7, which changes direction somewhat as a result. These folds are absent in the *Liodes* group, and a few others, but probably not as a primitive character. Their costal portion is present in the Hymenoptera.

10, a subapical fold, not constantly present; and not constant in character, normally being concave at the costa in the Adephaga, and convex at the costa in most of the Polyphaga which have it.

THE INDIVIDUAL AREAS

The hypothetical type, as just constructed, is not found exactly in any form known to me, as none of the *Serricornia*, *Clavicornia*, etc., which have a typical preanal region, show the two adjustment folds in the anal region. Following are the principal modifications of the various areas.

A. The median area lies between media and cubitus in the basal part of the wing, terminating when well developed in a point which rests on cubitus at the angle of the first anal area.

Among the Adephaga A is typical in the Hygrobiidæ, Halipidæ, Bidessus and the Rhysodidæ. More frequently it is broken up at the middle to make an adjustment with C + D. In the Cicindelidæ and Carabidæ the adjustment usually takes the form of a small triangle which is folded back, interrupting the area opposite the apex of C, as shown in the figures of *Cicindela* and *Calosoma* (figs. 6 and 7). In the Cupedidæ and Paussidæ there is quite a different arrangement, an additional reversed area (a) being interpolated along the course of the median fold, and separated from the surrounding areas (Aa, Ab, C + D) by two adjustment triangles. In the Geadephaga the oblong cell does not reach Cu, and the tip of area A reaches nearly or quite to H; in the Hydradephaga there is a well-developed first anal area which intervenes. Paussus and *Nebria* are intermediate, having a well-developed first anal area, and a small oblong cell resting solidly on Cu (fig. 10). Paussus is in every other way close to *Brachinus*, and *Nebria* has always been reckoned with the Geadephaga.

In the remaining Coleoptera area A is of subordinate importance, and is never divided. Frequently it is reduced to a mere crumple (as in most *Serricornia*), or even absent (*Cucujus*). In quite a list of forms it is reversed, the convex fold coming above the concave. Examples are: *Dermestes*, *Trogosita*, *Helota*, the *Phytophaga* so far as examined, and those *Bostrychoids* which have the area well developed. In the *Sternoxia* and *Erotylidæ*, including *Phalacrus*, it appears to be normal or reduced to an amorphous crumple, and also in most forms with the *Staphylinoid* folding. In the *Dermestid* genus *Megatoma* it is divided into two as in the Adepfaga, but has its convex over its concave fold as in other *Bostrychoids*. Among the *Dryopoids* it is reversed in the *Mycetophagidæ*.

B is rarely well developed and may perhaps be of secondary character. It is absent in the Adepfaga, and in a very large proportion of forms (including all the *Heteromera* examined) is a minute crumple which can hardly be represented in a dia-

gram. In many forms with a short median recurrent vein it becomes an important part of the folding mechanism, especially in the more typical Bostrychoids, where it functionally takes the place of area A, and works with the anal fold in a similar way (figs. 69-76). In the immediate Dascyllis group, as also in Sphindus and Corticaria, there is an imperfect area at this point, but with the concave fold before the convex one. Presumably this is really not B, but a semi-independent part of C. B is best developed in Artematopus and Macropogon, where it works with area A, and ends at a notch in the median vein, and in Anthrenus, Cyphon, and the Ptinids and Bostrychids, where it works with the first anal area. In the aberrant Dermestid genus Megatoma, Nosodendron, Sphindus, and Corticaria it crosses the end of a short median recurrent, but terminates at area A. In those Dryopoids and forms related to the Coccinellidæ where it is present it is of the Dascillus character, and in some can be changed from a considerable area to a mere crumple, by a slight change of the position of the wing. The Melyridæ and some Byrrhidæ are the only decided exceptions I have seen, and perhaps belong to a different stock from the rest.

C is an important fold. In practically all Polyphaga it is well defined, but varies enormously in size, even in closely related genera. Thus in Hydrous it practically reaches the base of the wing, while in Hydrocharis and Helophorus it is short. In the Elateridæ and Lampyridæ it is very long, while in the closely related Lichadidæ and Buprestidæ it is short. It is long in Cucujus and Passandra, but short in most other Cucujidæ; long in Litargus, but shorter in Mycetophagus. Where it works with a well-developed area B it is always short. Frequently it fuses more or less completely with the neighboring areas—with B in the Dascillus group and Dryopoids, with D in the Adephaga and with both D and H in the higher Melyridæ. In many Staphyliniformia where the base of the wing is reduced, area C is very narrow, though fully functional, but it vanishes completely in such forms as the Lioididæ and Octhebius.

In a few forms, all Bostrychoids, C is divided in two by a triangular area which works with B. Examples are Corticaria, the South American Bostrychid figured, and apparently Dascillus.

This gives a close resemblance to forms in which D is reduced, with its apex resting on the inner side of E, but may be distinguished by the fact that the transverse fold at the end of the cell is concave instead of convex.

E. The first costoapical area begins to show the relative instability characteristic of the whole apical region. The costoapical region presumably was undivided in the original Coleopter, as its dividing fold is concave in the Adephaga, including Cupes, but convex in practically all the other Coleoptera. Where it is absent, however, I suspect a secondary loss. Examples are the typical Bostrychidæ, and *Dascillus*, though in the presumably more primitive Cyphonid and Sphindid types it is present. It is also absent in *Dermestes*, and is of the Adephagous type in some Buprestidæ and Phytophaga, *Megatoma* and *Attagenus*, where it presumably is secondary. In the Adephaga it is invariably present and typical in character, making one leaf of the double apical roll in the Archostemata.

Other apical folds are so complex and variable when present that they had better be discussed under the individual families. They are evidently secondary in character, and due to an enlargement of the apical part of the wing, except in the few Adephaga where they are symmetrically placed to the median furrow and may be the result of flattening out of the apical roll (*Bidesus*, *Hygrobia*, *Haliplidæ*, *Rhysodidæ*, *Cyathoceridæ*, *Sphærius*). The most complex apical foldings I have yet seen are in the *Nitidulidæ* (figs. 51-53) and *Cryptophagidæ* (fig. 137).

Anal folds. When fold A is well developed and terminates before the end of the cell, or when B is well developed and A is absent, a fold below Cu is needed to allow Cu to bend. This is the first anal fold (G). It in turn needs a smaller adjustment fold at its proximal end in many cases (F). In the diagrams these two folds are only shown when well characterized. In many other forms one or both are indicated by slight crumplings of the wing-membrane, which may even appear only when the wing is partly unfolded. Their disappearance is so gradual that F is of no use in classification, and G only in a certain proportion of cases.

In the Hydradephaga, in connection with the large size of the oblong cell and the shortness of A, G is always well developed,

in the Geadephaga and Rhysodidæ it is usually represented by a slight crumple only; but this narrow crumple frequently functions in exactly the same way as the large area of the Hydrade-phaga, so that the difference is one of degree, and not of kind. The Paussidæ show an intermediate state, that is undoubtedly ancestral.

In the Polyphaga A is rarely sufficiently strong to require adjustment at its tip, and when it is, it usually reaches the tip of the cell, working with area H. Usually it is area B which makes a strong adjustment system necessary. Examples are principally from the Bostrychoidea (Megatoma, Nosodendron, the Helodes group, Anthrenus and the true Bostrychidæ). In Nosodendron A is well developed and short as in the Adephegæ, it also appears among the Dryopoids in the curious Ptilodaetyla group, where it is an adjustment not so much to A or B as to H, which crosses the tip of Cu, and necessitates some complicated folding in the anal region. In most Haplogastra it has developed differently, as a slender longitudinal fold crossing the basal side of H at right angles, and evidently serves not as an adjustment to other folds, but as a means of further narrowing the wing. In the Scarabaeoids this area is always striking; in many others it tends to disappear, but is shown, for instance, in Ceryon, Georyssus, Sphaerites and Syntelia, Sericoderus, Monotoma and the Cryptophagidæ. In several, perhaps most, others it is indicated by a slight crumpling of the wing. In the Serricornes and Clavicornes it is also a slight crumple which is frequently absent, and does not cross into area A.

H is an area comparable in importance to C and D. Typically it lies between the median fold and C, and extends about half way to the apex of the wing, being cut off by the same transverse fold that cuts off the first costo-apical at the base. In the whole large group of Haplogastra it is increased by the addition of a reversed area below Cu, formed apparently in the first case by a convex fold from the tip of the cell to near the tip of $2d A_1$, and a concave one along the lower side of Cu. This concave fold and the convex one just above Cu tend to neutralize each other, and functionally at least the whole of H is a single area; in several forms in fact the two folds along Cu have completely disappeared, and the area is undivided (fig. 53).

In those forms where E has disappeared, area X is also absent and H reaches the apex of the wing. In a similar way, when the anterior side of E creeps forward on the costa to the end of the cell, the posterior side of H tends also to creep forward, though not always symmetrically. The first stage of the process shows in such forms as *Hydrocharis* (fig. 25), while it reaches the extreme in the *Derodontidæ* and *Coccinellidæ* on the one hand, and the *Micropeplidæ* on the other.

In a group of forms of the *Dryopid* type of folding this migration is carried to an extreme, and area H is reduced to a small quadrangle near the middle of the wing, either barely touching the inner margin or completely separated from it. This is strikingly shown in the *Derodontidæ*, already mentioned, and in the series of families grouped around the *Cisidæ*. In most of these forms Cu is disturbed, turning directly to the inner margin to avoid the transverse fold in the *Coccinellidæ* and *Collops*; but cut off by it in *Derodontus* and *Malachus*. In the *Byrrhidæ* and genera related to *Ptilodactyla* this fold can be seen gradually working up from the apex of Cu more than half way to the point of anastomosis of Cu and M_4 . In the *Cryptophagidæ*, on the other hand, it is not at all clear what has happened, though they appear on the whole to belong to this series. At first glance the *Nitidulidæ* seem similar, but the folding is much closer to that of the *Brathinidæ* and *Staphylinidæ*. Their venation is also approximately as in the *Synteliidæ*.

Another modification is the subdivision of area H. This in a definite way is practically confined to the suborder *Adephaga*, where a series of alternately convex and concave longitudinal folds may divide the area into as many as five separate portions, each corresponding to a slip in the apex of the wing.

In those few primitive *Adephaga* where C and D are still separated by a trace of the median fold (*e.g.*, *Paussus*, figs. 11, 12) the median furrow seems to attach to the second, rather than the first of these slips, the first being perhaps a development special to the *Adephaga*.

The area below G, which is added to H in the *Haplogastra*, is also apt to be complexly folded according to a plan which varies from family to family. Finally it is the habit of many beetles

to tuck in the hind edge of the wing by main force, resulting in a system of minute and irregular folds along the inner margin. These have usually been omitted from the diagrams.

Subapical area. The dorsal portion of the subapical area is even more unstable than the costal portion, though it shows resemblances in closely related forms; and the few points of interest will be discussed under the individual families.

The axillary region (J), corresponding to the jugum of the Lepidoptera, varies mainly in size. Primitively it is a broad sessile area, as in the more primitive members of all the groups. In a considerable variety of families and lesser groups it is a free lobe, and in stray types it is completely lost, the most striking cases being the Liodidæ with their kin, and the groups centering around the Cisdæ and Hydroscaphidæ. The identity of Cisdæ and Corylophidæ is specially striking. In the family Colydiidæ, as now delimited, every degree of development of the anal lobe is found. In the little Hydroscaphid group the entire anal region is obsolete.

The unreversed areas as a whole have little individuality or interest, appearing to be merely the portions of the wing left over. S alone, which is really twice reversed, rather than unreversed, alone shows some positive characters. Its usual form is a triangle with concave upper and outer, and convex lower side, adjoining areas D, H and C. In a few forms it is complex, made up of three or more areas. This may possibly be a primitive condition, as it occurs in such early families as the Elateridæ and Hydrophilidæ, as well as some Lamellicornia (Lachnosterna). In the Buprestidæ only a single one of these areas seems to have survived, but not the same one as that of most other families. It is distinguished from the usual area S by being reversed, with convex upper and outer sides, and concave inner, and its apex lies much farther out, on the fused part of M and Cu, and not as usual on the free part of M. I am distinguishing it by a small s. In more specialized Buprestidæ, and in a scattering of other forms, S vanishes, usually where areas C and D have become of subordinate importance. In the Staphylinidæ, Histeridæ and Nitidulidæ, however, though reduced, it takes its normal part in the folding of the wing. A few of the

primitive Adephaga show faint traces of it, crossing the area C + D, but as a rule it has disappeared.

CLASSIFICATION

In the following discussion of the characters of the various groups a classification has been adopted based primarily on the wings. I by no means believe that it is the last word, but do think that in some particulars new light has been thrown on the relationships of the families. It is noticeable that most of the types moved to new localities are forms already of disputed position, and that a specially large proportion belong to the old group Clavicornia. In several cases results obtained from the study of the venation without considering its relation to the folding have had to be abandoned; the Staphyliniformia, in particular, which Continental entomologists have consistently defined on venational characters, is reduced to a subordinate position, and several forms with much reduced venation have had to be added to or subtracted from it. The other most striking change is the discovery that in various families two entirely different types of folding occur, which are not really even derivable from each other. The most striking case is the series of families in which Dascilloid foldings and Dryopoid foldings occur and the intermediate Serricorn-Clavicorn type is absent. These are: Byrrhidæ-Nosodendridæ, Helodidæ-Eubria, Dascillidæ-Ptilodactyla, Lathridiidæ-Corticaria. In other cases there is the possibility of derivation, but it seems unlikely. For instance the group associated with the Liodidæ seems entirely homogeneous, but on superficial characters associates itself with the Hydrophilidæ, Silphidæ, Staphylinidæ and Brathinidæ, and there is nothing to prove from which of the four it has been derived; in fact even some Dryopoidea show a closely similar type of folding. This convergence is the most difficult point in the entire scheme, as the final product of specialization of the Hydrophilid and Dryopoid types would come to the same point.

The Adephaga are adequately defined on the type of folding. The Archostemata resemble them, and seem to be separated by the spiral rolling of the apex. The remainder will separate into four groups according to the direction of specialization.

1. In the group of which the Hydrophilidæ are typical, the tip of M_4 is folded across. In primitive members at least, Cu is not fused with M_4 , and may avoid the fold, in the higher ones it is not clear whether Cu has fused with M_4 or atrophied. This folding is accomplished in the first place by the crumpling of the dorsal region between Cu and 2d A, as well shown in the Histeridæ, as well as some Hydrophilidæ; only later is this area joined to the normal area H, and M_4 actually reversed, M_4 more typically pivoting back on its base; but the unreversed area which contains it is very narrow, and the folds are so close to the vein that it is frequently impossible to tell if the vein itself is reversed or not. The first costo-apical fold in this series is much slower to migrate toward the base, and the stigma remains for a long time as a well-marked chitinized area beyond the hinge, which is stiffened by a chitinized vein, and in the larger Staphyliniformia even shows two veins in close contact. Several forms of this series have retained the anal arculus (*Necrophilus* most conspicuously), and other signs of primitive position are the frequent presence of the pleurite of the second segment of the abdomen (Hydrophilidæ as well as the families included by Kolbe in his *Haplogastra*), and the frequent membranous alula of the elytron (never present in the remaining groups). This group would better deserve the name of Clavicornia than the group which carries it, as clavate antennae are far more nearly universal than in either of the other groups. The main group of anals is invariably reduced.

2. The group of which the Elateridæ are typical represent most closely the primitive type of folding, as the pivot fold is well marked, and not associated with any other fold, and M_4 and Cu (which are invariably fused) are not crossed by a fold. This group on other characters shows less primitiveness. The stigma is never distinct, though in a few primitive types the chitinized costa passes a very short distance beyond the hinge; the anal arculus is never present; the second pleurite is visible only in very loosely built degenerate forms, and the alula of the elytron is never present.

The two following groups are undoubtedly derived from this one. In the case of the Bostrychiformia survivals of an inter-

mediate condition are found in the Dermestidæ and Buprestidæ, while the Lichadidæ, which otherwise are very close to the Rhipiceridæ, belong clearly to this group on folding, and must more closely than any other living form represent the common ancestor. *Zenoa* is our native representative. It is not possible to pick out definitely the immediate ancestor of the fourth series, if indeed it is homogeneous, but many forms of this series show a tendency for the first costo-apical fold to migrate toward the hinge. The ancestor must have been an early form in which the hinge was still chitinized, and traces of the stigma present, as these are clearly recognizable in some of the Dryopoid group. The most plausible link is perhaps from the Lichadidæ to *Dæmon*.

3. The Bostrychoids are adequately defined by the fact that the hinge is broken up by the migration of the convex hinge-fold toward the apex. This could not have taken place in a type where the hinge was still chitinized; but in other characters this group shows signs of extreme primitiveness. All the forms which have preserved a distinct frontal ocellus (except the Cupedidæ and a few Lymexylidæ) belong to this group; and this group, especially the forms transitional to the preceding, show more free anal veins than any others except a few Lampyridæ. The preservation of 4th A_2 in a few forms is unique in the Polyphaga. The type seems made up of a mess of relicts, and the families are hard to delimit, such a family as the Dermestidæ, for instance, being the real equivalent of five or more ordinary families. There is never any tendency for $M_4 + Cu$ to be disturbed, and anal arculus, alula and visible second pleurite are never present.

4. The Dryopoid complex is defined by the fact that the first costo-apical fold has moved basally and joined with the hinge, so that three folds converge at a single point on the costa, and the outer part of the wing is folded directly back on the base. In the true Cryptophagidæ even a fourth fold has converged on this point. There is a strong tendency for the principal fold and first dorso-apical also to migrate toward the base of the wing, and in the more specialized families there is a close likeness to the more specialized Haplogastra; in fact I am uncer-

tain to which series such families as the Georyssidæ and Mycetæidæ belong. The type is easily derived from the second by the migration of a single fold, and may not be homogeneous, though there seems to be a distinct linking of the various families, especially through the Colydiidæ, which in genitalia also, according to Sharp and Muir, form a link between several principal types. Superficially the closest resemblances are to the preceding type, from which this hardly can be derived. I know of no special primitive character in any member of this group except the apparent trace of the anal areculus in some Coccinellidæ.

The diagrams hereto attached may make plainer the appearance of the principal types of folding as they look in the undisturbed wing.

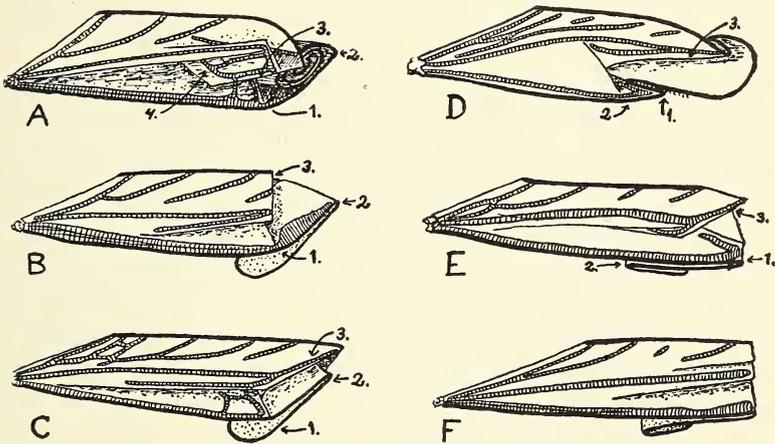


FIGURE 2. Folding patterns as shown with wings folded. A, Adephaga; B, Haplogastra; C, Diversicornia; D, Bostrychiformia; E, Dryopiformia; F, Ambiguus.

These diagrams represent a left wing seen from in front and above. The margins are represented by thick lines, so far as visible, the folds by fine lines, and the veins by double lines with cross-bars. The apex is represented as if drawn forward somewhat, to show the subapical fold, which would be covered by the basal part of the wing in the completely folded position.

Adephaga (Diagram A). 1, costal edge turned back at pivot; 2, apex of costa folded up and over; 3, principal fold cutting off Cu (not in Archostemata); 4, oblong area tucked under Cu (not in minute forms).

Polyphaga, Series 1 (Diagram B). 1, costal edge turned back at pivot; 2, apex of costa folded down and under; 3, principal fold cutting across M_4 (and Cu) at base.

Series 2 (Diagram C). 1, costal edge turned back at pivot; 2, apex of costa folded down and under; 3, principal fold running beyond Cu + M_4 .

Series 3 (Diagram D). 1, costal edge folded *up and over* at pivot; 2, then folded out again beyond; 3, principal fold running beyond Cu.

Series 4 (Diagram E). 1, costal edge folded *down and under* at pivot (the true pivot-fold obscure); 2, and then out again near apex; 3, principal fold avoiding Cu + M_4 , or crossing it beyond its base.

Ambiguous type (series 1 or 4) (Diagram F). Pivot obscured, a transverse convex fold right across the wing, which is also once longitudinally plaited. Apex folded at least once more.

ADEPHAGA

C fused with D more or less completely, never separated by a definite re-reversed area, apex of C + D resting on M or crossing it and working with a large area A, which invariably has its upper fold concave, B always absent; first costo-apical fold concave; following ones when present usually also concave; principal fold crossing base of M_4 , and cutting off Cu at its base; median fold always interrupted at the hinge, but wing with a complete transverse convex fold. Costa chitinized at hinge, frequently showing two veins; stigma conspicuous; Rs connected to stem of R, two radiomedial cross-veins; oblong cell almost always present (also in Sphaerius); at most four anals in principal group; 4th A normally forked, the forks gradually divergent; anal arcus well developed. The characters italicized apply also to the minute forms of the Hydroscaphid group.

GEADEPHAGA

Oblong cell small, usually connected to Cu by a short piece of simple transverse vein (except *Nebria* and *Paussidæ*); only one

concave costo-apical fold, the folding of the apical part of the wing dominantly longitudinal; first anal fold a mere crumple.

Cicindelidæ: Median fold continuous from lower angle of hinge area to apex; oblong cell absent (figs. 5, 6). Tetracha agrees with Cicindela, but Pogonostoma, which has preserved the oblong cell, was not studied. Apterous forms are well-known.

Carabidæ (figs. 7-9): Median fold from lower angle of hinge area ending at the costo-apical fold, the median fold of the apical part of the wing abutting against the outer side of the oblong area. Oblong cell present with rare exceptions, and (I believe) always indicated by an irregularity of $m-cu$. Hinge area usually simple, broken up in *Brachinus*, which approaches the *Paussidæ*; first anal area negligible. Adjustment between areas A and C + D made by a single re-reversed fold. There are many apterous forms.

Omophron: Entirely typical of the *Carabidæ*.

Nebria: Folding entirely typical, but oblong cell resting on Cu, and first anal area perhaps a little better developed than usual. *Elaphrus* and the other related genera are normal.

Brachinus (figs. 8, 9): Adjustment of C + D and A nearly normal, but a little irregular; C + D crossed by a well-marked median furrow, and region immediately beyond with a set of four extra folds, as in the *Paussidæ*. First anal area normal.

Paussidæ (figs. 10-12): Oblong cell very small, but resting solidly on Cu, and anal area much larger than normal in the *Carabidæ*, though smaller than in the *Hydradephaga*. Folding at hinge region highly complex, with area C + D divided, and several small folds beyond it. C adjusted to A as in the *Cupeidæ*. Median fold in apical portion divided in two parts as in *Carabidæ*. M_4 arising from lower corner of oblong cell, instead of from its upper portion.

HYDRADEPHAGA

Oblong cell very large (figs. 13-17), with a large first anal area below it and a well-marked second anal area working with the apex of the first. There are two thoroughly distinct subtypes in this group, which will divide in the midst of the family *Dytiscidæ*; in the *Hygrobiidæ* (figs. 14, 15), *Haliplidæ* (fig. 16)

and *Bidessus* (fig. 17) group there is a succession of concave costo-apical folds, no doubt produced by the flattening out of a spiral roll such as that in *Cupes*; area C+D touches area A at a point, without any adjustment fold, and the first anal vein is strongly curved, without any accompanying chitinization.

In the remaining *Dystiscidæ* (both *Fragmentati* and *Complicati*) as well as the *Amphizoidæ* and *Gyrinidæ* (fig. 13) there is only one costo-apical fold, corresponding to that of the *Carabidæ*, C+D joins area A broadly, producing a re-reversed adjustment area, and 1st A is straight and normally accompanied by a strong chitinization of the membrane. (See Forbes, '22, fig. 18.)

The following four families have universally been scattered among the Polyphaga, but the first of them shows unmistakable characters of the *Hydradephaga*, both in wing and other body characters, and the remainder show at least some traces of *Adephagous* characters and are linked to them. With *Clambus* these *Adephagous* traces become negligibly small, and the genus was viewed by me as of hopelessly uncertain affinity until I examined the linking types.

As a group they are characterized by the relations of area C+D, which is large and nearly equilaterally triangular, and extends the whole distance from R to Cu, vein M being absent or reduced to a short stub, and area A obsolete. The anal region is reduced, and is of substantial size only in *Cyathocerus*, where area G is also normal.

CYATHOCERIDÆ

Cyathocerus horni (figs. 19, 20). Veins well marked, oblong cell longitudinal in the wing (an exaggeration of the *Haliplid* character), without any trace of the tip of Cu; three successive concave costo-apical folds (leaving out of account a small crumple), and three convex dorsoapicals. Anal region but little reduced, with large area G and well-marked F, anal lobe functional, and a second notch in margin at apex of 3d A₁, as in the *Haliplidæ*. Elytron deeply toothed at the costal edge, an exaggeration of the tooth present in the *Haliplidæ*, but apparently adjusting to the legs, rather than forming a lock with the body.

First visible ventral segment divided into a small central and lateral portions as in Adephegata; but mouth-parts reduced, not Adephegata-like, and first tergopleural suture not visible.

SPHAERIIDAE

Sphaerius acaroides (fig. 21). Wing with anal region lost, carrying with it areas F, G and J, the large area C + D practically reaching the inner margin. Veins weak, but costal group and Cu functional, and with a spring-like structure which closes the wing when relaxed as in other Adephegata. Oblong cell fully traceable, but very weakly chitinized. Apex of wing with two convex dorsoapical and two concave costoapical folds, besides some confused ones. Fringe long and heavy, rather Ptiliid-like in the folded wing, but relatively shorter. Body structures reduced, with nothing definitely Adephegata; but habits apparently Haliplid-like.

HYDROSCAPHIDAE

Hydroscapha sp. (fig. 22). Wing as in the Sphaeriidae, but with venation more reduced and oblong cell lost. Body superficially Staphylinid-like, with fully chitinized second abdominal segment; tergopleural suture apparently preserved (the specimen before me is broken evenly and symmetrically on that line).

CLAMBIDAE

Calyptomeris alpestris (fig. 23). Wing much more slender than in the preceding forms. Area H working directly with the apex of C + D, without the intervention of a portion of E or secondary crumples, and bounded on the outer side by a concave, instead of the usual convex fold. Fringe subordinate in character.

Clambus armadillus (fig. 24). Wing even longer, the outer part crossed by a pair of transverse folds, Cu lost as a functional vein, and area C + D crossing its site and resting broadly on the inner margin (a unique character).

In the Clambidae the only truly Adephegata characters surviving are the presence of one or two concave costo-apical folds,

and in *Calyptomeris* the presence of a convex fold clear across the wing from the pivot to the inner margin, while the concave median fold is much interrupted. In other parts the only possible Adaphagous character is in the ædæagus, which has a partly free tongue on the ventral face as in many Hydradephaga.

RHYSODIDAE

Oblong area absent (fig. 18), as in *Cicindelidæ*, m-cu being straight; hinge area touching A at a point, without any adjustment area; apex with a series of concave costo-apical and convex dorso-apical folds as in the *Hygrobiidæ* and *Peltodytes*; first anal area obsolete. Anal venation characteristic and stigma nearly filled with a chitinization.

Clinidium is apterous; and the group of *Colydiidæ* formerly associated most closely with the *Rhysodidæ* are also apterous.

ARCHOSTEMATA

General type of folding as in the *Adephaga*; apical part of wing coiled in a double conical roll, the costal part concave and dorsal part convex; principal fold not crossing Cu, which practically reaches the margin, and has a well developed anal fold entirely below it. C + D adjusted to A through a group of four folds, one of them reversed, with its concave side facing M and continuous with the concave upper sides of the hinge and median areas. Oblong cell large, and first anal area correspondingly large, working with the tip of the median area. Stigmatal cell large, conspicuous, upright; two complete radiomedial cross-veins, with a broken one between them; five anal veins sometimes present in principal group, and 4th A forked, with its posterior branch running directly across to the inner margin.

This characterization will fully apply only to *Cupes* (figs. 2, 3) and *Priaema*, the other forms differing by more or less drastic reduction; though I think the spirally rolled apex and adepagous type of hinge are common to all. The isolated position of the group has generally been recognized. The peculiar type of forking of 4th A reappears in the few *Polyphaga* that have preserved it (*Dascillus*, *Sandalus*, *Cyphon*), and somewhat surprisingly in a few early *Hymenoptera*.

Cupes (figs. 2, 3): Venation fairly complete, about a third of the wing formed by the spiral roll.

Micromalthus (fig. 4): Venation much reduced, and basal part of the wing also reduced in area, half of the whole wing being taken up by the spiral roll. *Micromalthus* has nothing to do with the *Lymexylidæ* in venation or folding, the *Lymexylidæ* being normal *Serricornia* in those particulars.

POLYPHAGA

Pivot fold almost invariably divided in two by the interposition of a triangular unreversed area, rarely reaching the median vein, and in that case rarely working with a large and normal area A (*Dryops* is the most striking case). Median fold almost invariably continuous from near middle of wing to apex, the principal transverse fold not continuous to the costa. Costo-apical fold when present almost always convex; principal fold crossing M_4 in a minority of forms only (*Haplogastra* and weevils). Costa frequently not chitinized beyond hinge; stigma always more or less indefinite, and more often than not completely lost; first radiomedial cross-vein rudimentary in a few early forms (*e.g.*, *Daseillus*), usually absent; second, complete (the one that is broken in *Cupes* and absent in the *Adephaga*); third reduced to a vague thickening or absent. *Rs* only exceptionally connected to radial stem directly, though often by a cross-vein which may swing into the position of the lost connection in forms which have a small radial cell; oblong cell never present as such, in one or two forms with a faint trace of the first medio-cubital cross-vein far toward the base of the wing; five or even six *anals* frequently preserved in the principal group (1st A, 2d A, 3d A); 4th A simple save in a very few *Bostrychiformia* (*Daseillus*, *Sandalus* and *Cyphon*, and traces in a few others), where it forks as in the *Archostemata*. Anal arcus preserved only in a few primitive forms (*Staphyliniformia*, *Coccinellidæ*).

As already announced, this suborder, which is the largest and most varied of the *Coleoptera*, divides naturally into four folding types. The first, which I shall call *Haplogastra*, as it closely approximates Kolbe's group of that name, has the largest number of characters of the *Adephaga*, and should be undoubtedly

considered the most primitive; and the Dryopoid is certainly the most specialized. In its folding the "Normal" group is more primitive than the Bostrychiformia, as well as in the occasional preservation of traces of the chitinized hinge and stigma, but in other characters certain Bostrychiformia have a surprising number of archaic characters, and the two groups undoubtedly separated at an early date; their intergrading is due to the survival of such known highly archaic types as the Buprestidæ, and such synthetic forms as some Dermestidæ and the Lichadidæ.

HAPLOGASTRA

Principal fold crossing M_4 , and frequently Cu also; M_4 and Cu sometimes being separate; commonly ending near the tip of 2d A_1 ; costal chitinization at hinge usually distinct, stigma more or less obvious, though never as sharply defined as in the Adephaga and Archostemata (absent in the highly aberrant Nitidulidæ, Rhizophagidæ and Monotomidæ); the first costo-apical fold as a result never quite meeting the hinge. Apical venation frequently preserved more or less completely, most completely in the larger Hydrophilidæ, but traceable also in many Staphyliniformia, Lamellicornia and Histeridæ. Never more than four anals in principal group. Elytron frequently with membranous alula; second pleurite present as a small triangular sclerite covered by the elytron (frequently lost, but I believe by atrophy, not by fusion as in other groups). Recurrents more or less reduced in most forms, the radial recurrent reaching basad of the cross-vein only in the Hydrophilidæ, and even the median recurrent being lost in the Staphyliniformia, though preserved at least as far back as the cross-vein in the Histeroidea.

I make four superfamilies of this series, though they are not quite sharply separated. The Palpicornia include only the Hydrophilidæ, with the Georyssidæ as a doubtful appendage, and even of the commonly accepted Hydrophilidæ, Oethebius and Hydraena are to be excluded, as closely related to forms universally accepted as Staphyliniformia. The Staphyliniformia include those that have lost the whole mechanism of the recurrent veins, including the radio-medial cross-vein, and tend strongly to reduce the hinge mechanism. They, however, have preserved

the anal areculus in the larger species, and are highly primitive in body-structure. They subdivide into two groups;—in the forms centering about the genus *Silpha* the hinge, though small, is fully functional, and the outer part of the wing is bent back at that point about 60° as if by a hinge; in those centering about *Necrophilus* this mechanism is lost, and the outer part of the wing is doubled directly back by a transverse fold, homologous with that in the *Dryopoidea*. They differ from the *Dryopoidea*, however, in the dorsal transverse fold (principal fold) cutting across $M4 + Cu$ practically at its base. The third group centers about the *Histeridæ*, which are characterized by the very heavy loop formed by the recurrents and $r-m$, though the radial recurrent at least does not pass basad of $r-m$. Three of the families (*Histeridæ*, *Sphaeritidæ*, *Synteliidæ*) are closely bound together, and have preserved a well-marked hinge-thickening and stigma. In the *Nitidulidæ*, *Rhizophagidæ*, and *Monotomidæ* the costal thickening stops at the hinge, but the presence of the recurrents excludes the families from the *Staphyliniformia*, which their folding most closely resembles, and they may be attached tentatively to *Sphaerites*. Lameere has already noticed the likeness between *Sphaerites* and the *Nitidulidæ*. The *Synteliidæ* make a definite link in folding and venation as in other characters between the *Histeridæ* and the *Lamellicornia*, which form the fourth group. In the latter the first costo-apical fold never runs obliquely in toward the base as in the *Hydrophilidæ* and most *Nitidulidæ*, but is normally transverse when present; the radial recurrent and radial cell are reduced to a hook, which rarely shows any membrane in the center; the cross-vein is completely lost, but the median recurrent is long and well-developed. The apical venation does not form a regular pattern as in the *Hydrophilidæ*, but is represented by a great number of fine striations—a character also present in *Histeridæ*. There is nothing in the wing to give this group its isolated position, in fact so far as wing is concerned the *Histeridæ* and their kin might well be transferred to the *Lamellicornia*.

PALPICORNIA

Hydrophilidæ (figs. 25–28). Both recurrents and cross-vein $r-m$ present, the medial recurrent sometimes running nearly to

the base. Cu free from M_4 , but sometimes reduced to a spur (Sphaeridium). Area C well developed, in Hydrous (but no other genera examined, not even Tropisternus) extending far to the base of the wing, as in the Serricornia. First costo-apical fold strongly oblique down and out from the costa, the first posterior typically symmetrical with it, but not intersecting with the principal fold as a rule, and never dividing area H into two well-marked separate areas as in the Staphyliniformia. Othebius and Hydraena (doubtless all the genera with more than six abdominal segments) do not belong here, but with the aberrant "Silphidæ."

Hydrous: Median recurrent and area C extending almost to base of wing. Anal lobe sessile (also in *Hydrocharis*).

Cercyonini (figs. 26, 27): Cu reduced to a spur; anal lobe free, or of odd shape.

Helophorini (fig. 28): Apical area enlarged and complexly folded; anal lobe free. H divided in two.

Georyssidæ (fig. 49). A family of uncertain position. Sharp and Muir report the genitalia similar to those of the Hydrophilidæ, and the wing is as easily placed here as anywhere. Pivot chitinized, connecting to a short but heavily chitinized stigma which rests on the costa, unlike those few of the Liodid-like and Dryopoid groups in which the stigma is perceptible. Rr lost and Mr not really extending back of the position of the cross-vein, which is well-marked. H divided in two parts, as in many Staphyliniformia and Dryopoids; the lower one crossing the position of the apex of $M_4 + Cu$, which, however, is obsolete. Hinge fold a mere crumple, sometimes lost. Anal lobe slender but sessile, much as in *Cercyon*. Apex unfolded, as in the Coccinellidæ.

The folding has gone so far in specialization as to be ambiguous between the Hydrophiloids and Dryopiformia. In the former the well-marked Mr throws it out of the Staphyliniformia which it otherwise approaches; and the strongly chitinized hinge and peculiar anal lobe suggest the Hydrophilidæ, where the genitalia would place it. The inwardly oblique position of the first costo-apical fold is also Hydrophilid. There is no resemblance in the wing either to the Dryopidæ or to the Cyathoceridæ.

STAPHYLINIFORMIA

Recurrents both lost, and r-m also lost. Hinge fold and area C relatively small or absent. Area H consistently divided in two, the upper part reduced to a small triangle or quadrangle in the center of the wing; area D when present with some tendency to be drawn out in a long triangle pointing toward the apex of the wing, as in the Nitidulid type; first costo-apical fold not oblique.

A

Hinge functional, the apex of the wing being turned back at an angle of about 60° ; first costo-apical fold well beyond it, leaving a large oblique stigmatal area.

Silphidæ (Forbes, '22; fig. 25). *Silpha*, *Necrodes*, and *Necrophorus*, with a couple of exotic genera, alone seem to make up this group.

Staphylinidæ (figs. 31-33). A heterogeneous mass, with a highly varied folding pattern. In *Anthobium* the median fold follows close above the median "Strahlader," as in the Nitidulidæ, and the pattern is otherwise similar, but the loss of the recurrents makes it an impossible ancestor of the Nitidulidæ. *Micropeplus* does not belong here.

Scaphidiidæ (fig. 30). The relatively simple folding indicates an early type. *Scaphisoma* is similar to *Scaphidium*, but has lost the anal lobe more completely.

Brathinus (fig. 29), like the *Scaphidiidæ*, has an early type of folding, and shows no resemblance to the more normal *Seydmaenidæ*.

B

Area D absent, its position indicated in large forms by a faint oblique line, with a trace of the stigmatal chitinization below it; C completely fused with H, together making a small triangle in the center of the wing, which is cut off by a transverse fold clear across the wing.

Dr. Böving informs me that in larval characters this group is diphylectic; the *Lioididæ* having a larval type quite distinct from that of the *Seydmaenidæ* and *Pselaphidæ*, though both appear

as nearly Staphyliniform as anything. It would appear that the Liodidæ are descended from something like the ancestor of the Hydrophilidæ and Staphyliniformia, while the others are nearer to some of the more aberrant Staphylinidæ. The larva of *Micropeplus* is unknown, so it remains ambiguous, but presumably goes with the Pselaphidæ. The Georyssidæ have a close approximation to the folding of this group, but the entirely different stigma and well preserved Mr and r-m make direct connection impossible.

Liodidæ (including *Necrophilus* and *Prionochaeta*), *Octhebius*, *Hydraena* (figs. 34, 35). Outer part of wing divided twice longitudinally and once transversely. Anal lobe free (*Necrophilus*, Forbes, '22; fig. 27), or obsolete.

(To be continued)

CONCERNING TOWNSEND'S "INSIDE HISTORY OF NORTH AMERICAN MYIOLOGY"

Following the publication, in our March, 1925, issue, of Townsend's "Inside History of North American Myiology," the Publication Committee received a letter of protest from Doctor Aldrich. Replying to this communication, the committee wrote Doctor Aldrich as follows:

New York City, N. Y.,
April 7, 1925.

Dear Doctor Aldrich:

The Publication Committee of the New York Entomological Society has considered your letter addressed to it, as well as those addressed to Messers Sherman and Lutz. It regrets that any hard feeling has been aroused and all of us feel that Townsend went too far. In fact, it seems to us that he spoiled his own case, if he has one, by indulging in personalities. We would be very glad to publish a reply giving the other side of the question, such reply to be written by you or anyone selected by you and this reply to be printed under the following editorial note:

Editorial Note.—The policy of the Journal of the New York Entomological Society is to take no sides in any discussion of scientific or other matters. However, in view of Dr. Townsend's extended reference to Dr. Aldrich in his article entitled "The Inside History of North American Myiology," the Journal has asked that a reply be prepared and is glad to publish it as follows.

Hoping that this will meet with your approval and assuring you of our regard,

Yours truly,
Publication Committee
New York Entomological Society.

Under date of December 1, 1925, Doctor Aldrich advised the Committee that he had asked Mr. C. W. Johnson to write a reply to the Townsend article published in our March, 1925, number; also that we would hear from Mr. Johnson in due time and requesting us to publish his article as promised. Two weeks later the following document was received from Mr. Johnson and we are publishing it in accord with our promise of April 7, 1925.

TO THE PUBLICATION COMMITTEE,
NEW YORK ENTOMOLOGICAL SOCIETY.

The undersigned wish to express their great surprise and regret that you should have published in your Journal the article by C. H. T. Townsend, which appeared in the March number under the title "The Inside History of North American Myiology."

This article is in substance a bitter and uncalled for attack upon Dr. J. M. Aldrich, a man of high standing, who is greatly respected both as a man and an entomologist.

Dr. Aldrich's criticisms of Dr. Townsend's work in his studies of the Muscoidea have always been justifiable and were an honest endeavor to reach the truth. No one could do as much on this group as Dr. Aldrich has done and criticize Townsend less.

Therefore we earnestly desire that you make it known in the next issue of the Journal that you greatly regret the publication of this article and extend to Dr. Aldrich your sincere apology.

SIGNED:

| | |
|--------------------|---------------------|
| Chas. W. Johnson | Glenn W. Herrick |
| W. M. Wheeler | Raymond C. Osburn |
| C. T. Brues | Herbert Osborn |
| Nathan Banks | Clarence H. Kennedy |
| Albert P. Morse | H. W. Allen |
| Jos. Bequaert | Reginald H. Painter |
| Ray T. Webber | Dwight M. DeLong |
| Henry Skinner | Jas. S. Hine |
| E. T. Cresson, Jr. | W. R. Walton |
| James A. G. Rehn | T. E. Snyder |
| O. A. Johannsen | William Middleton |
| | Joe S. Wade |

SAMUEL PURCHAS AND HIS "THEATRE OF POLITICALL FLYING INSECTS"

BY HARRY B. WEISS

NEW BRUNSWICK, N. J.

When Nell Gwynn, if rather uncertain accounts are accepted, was about five or six years old, or, to be more specific, in 1657 there appeared in London a book entitled, "A Theatre of Political Flying Insects," written by one Samuel Purchas. In order to fix the publication date more clearly, it is not out of place to mention that Cromwell was Lord Protector of the Commonwealth of England, Scotland and Ireland at this time, that John Bunyan was being formally recognized as a preacher, that four years previous, or in 1653, Isaak Walton's "Compleat Angler" had been published, and that one year later, in 1658, John Milton commenced work on "Paradise Lost" and Dryden published "Heroic Stanzas to the Memory of Oliver Cromwell," his first poem of importance.

In this country, witchcraft was gaining headway; the orthodox colonies were denying admittance to Quakers, and misbelievers, burning their books and subjecting them to indignities, imprisonment and even death. Such were the times upon which Purchas launched his book.

The complete title is "A Theatre of Political Flying-Insects, wherein Especially the Nature, the Worth, the Work, the Wonder, and the Manner of Right-ordering of the Bee, Is Discovered and Described. Together with Discourses, Historical, and Observations Physical concerning them. And in a Second Part are annexed Meditations, and Observations Theological and Moral, in Three Centuries upon that Subject."

According to the title page, the first part was printed in London by "R. I. for Thomas Parkhurst, to be sold at his shop, at the Three Crowns in Cheapside, over against the Great Conduit, 1657." The title page of the second part bears the statement "Printed by M. S. for Thomas Parkhurst and are to be sould at

his Shop, at the signe of the three Crownes over against the Great Conduit at the lower end of Cheap-side. 1657.”

Apparently “R. I.” and “M. S.” did not agree beforehand as to the spelling of certain words. On the title page of the first part, Samuel is spelled with one “l” and in the second part with two. The word “Crowns” appears on the first title page, and “Crownes” on the second; “Moral” on the first and “Morall” on the second; “Pastor” on the first and “Pastour” on the second, and other differences meet one’s eye in the texts of both parts.

The book is dedicated “To the Right Honorable, Truly Noble, and Religious Lord, Robert Earle of Warwick, Baron of Leez, &c.,” and six pages of solemn devotion follow.

The table of contents, which is herewith presented, gives one a very good idea of the scope of the book.

- Chap. 1, Of the Excellency of Bees
- Chap. 2, Of the Name
- Chap. 3, The Definition and Description
- Chap. 4, Of the Kindes and Colours
- Chap. 5, Bees nature and properties
- Chap. 6, Bees Politicks, Ethicks, &c.
- Chap. 7, Of the Bees senses
- Chap. 8, Of the Queen-bee
- Chap. 9, Of the Drone
- Chap. 10, Of the Generation of Bees
- Chap. 11, Of the Hives, and ordering them
- Chap. 12, Of Seats for the Hives, and Bee-Garden
- Chap. 13, Of the Bees-work
- Chap. 14, Of swarming, and hiving of Bees
- Chap. 15, What Flowers the Bees gather of
- Chap. 16, Of the ordering of Bees
- Chap. 17, Of Bees breathing
- Chap. 18, Of Bees temperature, sleep, and age
- Chap. 19, Of Bees Fighting and Robbing
- Chap. 20, Of Bees Enemies and Sickneses
- Chap. 21, Of the Honey-dew
- Chap. 22, Of Hony
- Chap. 23, Of Tree-hony

- Chap. 24, Of Waxe
- Chap. 25, Observations and discourses, Historical and Fabulous
- Chap. 26, Observations, Physical, &c.
- Chap. 27, Of divers kindes of Wild-Bees
- Chap. 28, Of the Wasp
- Chap. 29, Of the Hornet
- Chap. 30, Of Humble-Bees
- Chap. 31, Of Grashoppers
- Chap. 32, Of American Bees

After the table of contents are six pages headed "A Catalogue of such Authors as are cited, and made use of in this Tractate" containing some 366 names. More definite references to the writings of these authors are given on the margins of the pages devoted to the text. Following the table of authorities are 16 pages given up to eight "elegies," each a flattering epopoeia, praising Purchas for his learning, extensive reading, experience and sermon on the text of the bee. Both the book and the author are included in these golden opinions, written presumably by friends and colleagues.

Succeeding the poems are the thirty-two chapters, totaling over 200 pages, mainly on the honey bee. These chapters constitute a quaint treatise on bees and beekeeping. Frequent references are made to the writings of Virgil, Aldrovandus, Galen, Pliny, Cardanus, Aristotle, Scaliger and others, the two latter authors being quoted extensively. In spite of the numerous citations it appears that Purchas kept bees and was intensely interested in the subject. In the chapters dealing with practical beekeeping, he injects the results of his experiences. In Chapter Eleven he says "I have many Hives containing five pecks which swarm yearly, and last longer than those that are hived in small Hives," and recommends straw hives as the best. Other records of his familiarity with bees are found in Chapters XI, XII, XIV, XV and later ones relative to apiculture. The last six chapters treat of wild bees, hornets, grasshoppers, etc.

Subsequent to the last chapter, the publisher, Thomas Parkhurst, devotes three pages to notices of other books, mainly reli-

gious ones. One is entitled "Groans of the Spirit, or the Trial of the Truth of Prayer. A Handkercher for Parents Wet-eyes, upon the death of their children or friends"; another, "A Treatise against the Toleration of all Religions. By Mr. Thomas Edwards." A page of errata for both first and second parts of the book precedes the title page of the second part.

The second part is divided into what Purchas calls three centuries, each century consisting of 100 meditations of varying lengths. The quotations are fewer in the second part, and it is probable that this is the more original of the two. Parallels are shown between the actions of men and bees and religious and other conclusions drawn.

A few of the shorter meditations are quoted as follows. These are similar to the longer ones, but less periphrastic.

"Bees will endure Waspes abroad, or in other hives, but never willingly in their owne, for antipathie is a perpetuall enmitie. If the force of antipathie prevaile so farre to make an irreconcilable hatred, as great should be our hatred against sinners and Gods dishonour. It is fearefull when we can easily comport with the wicked and digest their company and societie."

"Many hate not sin, neither flie it because it is sinne, but as children doe Bees, not because they are Bees, but because they have a sting; so doe they sinne, because it is hurtfull."

"All is one to God to make an Angel or a Bee, to create the brightest Cherub, or the most contemptible flie; for in every creation, no lesse then an omnipotency must be the efficient, and no more then nothing is ever the object."

"The Bee gives honey, but sometimes she stings: prosperitie hath it's sweetnesse, and also it's sting. Sunshine is pleasant, but sometime it scorseth."

"Some use flowers only for the beauty or the smell, the Physicians for health but the Bees for honey. So doe wise and prudent persons apply their studies for the enriching and feeding of their mindes."

"As a Spiders web is not therefore better because it is woven out of her bowels; so neither is the labour of the learned more contemptible, because as Bees, they gather much from others."

This last meditation makes it appear as if Purchas were justifying his actions in gathering much from others.

In 1834 Samuel Bagster republished most of the meditations under the title "Spiritual Honey from Natural Hives or Meditations and Observations on the Natural History and Habits of Bees, first introduced to public notice in 1657 by Samuel Purchas, A. M." In the preface, Bagster states that during his reading about bees, he bought a copy of Purchas's book and was so impressed by the "simplicity of their similes and their quaint style," that he printed them as Purchas wrote them, adding a text of scripture to each as a motto and rejecting only those that alluded to politics. It was Bagster's opinion that, as the selection of the meditations involved a long course of reading, they had been collected by Purchas's father, who, being in somewhat straightened circumstances, at his death left them to his son, and the son followed his father's footsteps by devoting himself to literature and parochial duties. However, there appears to be no conclusive evidence in support of such an opinion.

Samuel Purchas, author of "A Theatre of Politicall Flying Insects," was the son of Samuel Purchas, the "British Ptolemy" author of "Purchas his Pilgrimage, or Relations of the World, and the Religions observed in all Ages and Places discovered from the Creation to this present time." The father was born, according to some accounts, about 1577 at Thaxted in Essex, and was educated at St. John's College, Cambridge, where he took his Master's degree in 1600 and afterward that of Bachelor of Divinity. In 1614 he was collated to the rectory of St. Martin's, Ludgate, London, and in 1615 was incorporated at Oxford, bachelor of divinity as he stood at Cambridge. The first volume of his great work, the "Pilgrimage," appeared in 1613 and the last in 1625, a large part of his material being the unpublished papers of his predecessor, Hackylut. He published other books also, and it is recorded that his pecuniary circumstances were greatly embarrassed thereby, although part of his money difficulty was due to his assistance to relations. In 1618 his brother-in-law, William Predimore, died and left a widow and family in Purchas's care, and in the same year his brother Daniel Purchas died and left four destitute orphans which had to be looked after. About the same time he lost his mother.

On December 2, 1601, he obtained from the Bishop of London's office a license to marry Jane Lease, age 26, daughter of Vincent

Lease, and his own age at that time was given as 27. He died in 1626 at the age of 51, and his will, written May 31, 1625, was proved October 21, 1626. According to the above dates he must have been born close to 1575. Some accounts give 1577 at the year of his birth and 1628 as the year of his death. According to his will, his son Samuel inherited a dwelling house and lands in the parish of Thaxted. His wife, Jane, however, was to have the use of the lands so long as she remained a widow. Samuel also received his father's seal ring, and his library, globes, maps, charts and books except those which his father had written, as he (the son) already had copies of such.

According to "Alumni Cantabrigienses" the son was formally admitted into Cambridge University as a pensioner, the second of the three ranks in which students were matriculated, from St. John's College during the Michaelmas term 1622. He received the degree of bachelor of arts in 1625-1626, and that of master of arts in 1629. It is stated that he was perhaps ordained deacon (London) December 24, 1626, at the age of 24, which would make the year of his birth about 1602. He was Rector of Sutton, Essex, from 1629 until the year of his death, about 1658. His will was proved January 28, 1658-9.

Apparently his only printed work was his treatise on bees, the material for which might or might not have been inherited in part from his father. Ample time had elapsed between his father's death and the publication of the book, some thirty years, for the collection and compilation of material and also for the mature theological reflections which the book contains. Even though he interspersed his accounts with religious intellections, as did his father in his narratives, this is not proof that he did not write the accounts.

It is of interest to note in closing that during the lifetime of the author England's rulers were successively James VI of Scotland I of England, son of Mary Queen of Scots; his son Charles I, who was beheaded in 1649 at the end of the civil war between the king's party and that of the parliament, and Cromwell, whose protectorate ended in 1658.

On account of the fact that both father and son had identical names, the father is sometimes credited with the son's writings, as for instance in *Bibliotheca Entomologica* by Hagen.

ACKNOWLEDGMENTS

I am very grateful for the library facilities extended by the American Museum of Natural History, the New Jersey State Library and Princeton University. To Mr. George Osborn, Librarian of Rutgers College, I am especially indebted for many helpful suggestions and material assistance.

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A
THEATRE
 OF 54.57.44
Political Flying-Insects.

WHEREIN
 Especially the Nature, the VVorth, the
 VVork, the Wonder, and the manner of
 Right-ordering of the

B E E,
 Is Discovered and Delcribed.
 Together with Discourses, Historical, and Obser-
 vations Physical concerning them.

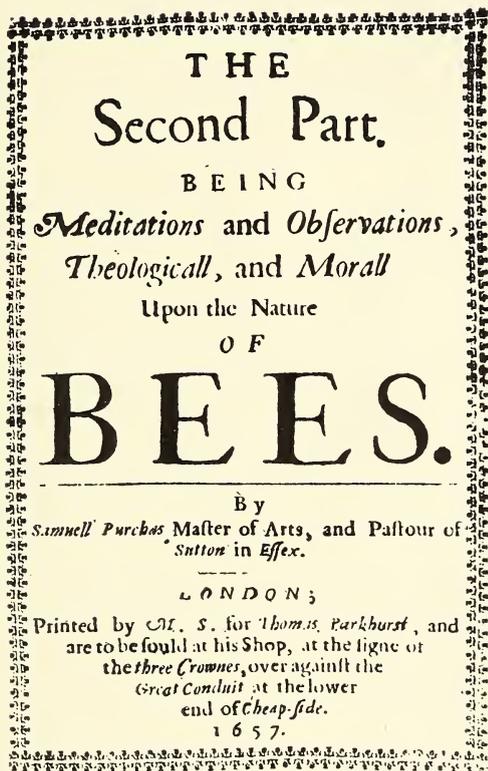
And in a Second Part are annexed Meditations, and
 Observations *Theological* and *Moral*, in Three
 Centuries upon that Subject.

By *Samuel Purchas*, Master of Arts, and Pastor at
Sutton in Essex.

Entered according to Order.

LONDON, Printed by *R. I.* for *Thomas Parkhurst*, to be sold
 at his shop, at the Three Crowns in Cheap-side, over
 against the Great Conduitt, 1657.

TITLE PAGE OF THE FIRST PART OF PURCHAS' BOOK



TITLE PAGE OF SECOND PART OF PURCHAS' BOOK

NEW SPECIES OF NEW YORK CADDISFLIES

BY CHARLES K. SIBLEY

The four new species named below were all taken in the Lloyd-Cornell Reservation near McLean, N. Y. Descriptions are here offered in order that the names may be included in the *List of New York Insects* that is now nearing publication.

Rhyacophila gordonii new species.

Length to tip of wings—10 mm.

Head ferruginous; front with mostly stiff black hairs and a few white ones; vertex mostly with white hairs. Antennæ with basal segment ferruginous, clothed with long black hairs; the succeeding five segments pale and the remaining segments fuscous, annulate with pale at both ends of segments; color becoming darker towards distal end of antennæ. Palpi ferruginous above, paler beneath; second segment swollen internally and clothed above with long stiff black hairs.

Thorax ferruginous above; ferruginous marked with yellow below. Legs with coxæ fuscous on outer surface, yellow within; other segments yellow clouded with dusky, sparsely covered with short black hairs. Short yellow spines present especially on last pair of legs. Femora of the mesothoracic legs with longitudinal fuscous stripe on the lower surface. Fore wings fuscous with ferruginous veins; costa and subcosta pale; stigma distinct; crossveins white; a small triangular white spot on mediocubital crossvein; a white spot in each of the apical cells near the wing margin. Hind wings tinged with fuscous; apex somewhat darker; stigma distinct.

Holotype—male in alcohol, taken at Inlet Brook, McLean, N. Y., Sept. 13, 1924.

Allotype—female in alcohol, taken at Inlet Brook, McLean, N. Y., Sept. 13, 1924.

Paratypes—male and female in alcohol, taken at Inlet Brook, McLean, N. Y., Sept. 10, 1924.

Agapetus minutus new species.

Length of body—3.8 mm.

Length to tip of wings—4.3 mm.

Head fuscous; vertex with two pairs of yellowish warts. Antennæ with first two segments yellowish brown; remaining segments brown, lighter

toward tip. Palpi brown, all segments short; segments of labial palpi of about equal length.

Thorax reddish brown. Legs brownish yellow. Fore wings dark brown, shining; a narrow white spot on media where it forks; tip of Sc and cross-vein r-m white. Hind wings smoky.

Abdomen reddish brown; a stout short backward projecting spine in center of seventh abdominal sternite.

Holotype—male in alcohol, taken at Inlet Brook, McLean, N. Y., Sept. 13, 1924.

Triaenodes marginata new species.

Length of body—male, 6.66 mm.; female, 7.6 mm.

Length to tip of wings—male, 9 mm.; female, 9 mm.

Length of palpi—male, 4 mm.; female, 4.66 mm.

Length of antennæ—25 mm.

Head yellow with white hair; a light brown wart bearing brown hairs at the inner margin of each eye. Basal segment of antennæ yellow, other segments white; basal half of antennæ narrowly annulate with black at base of each segment. Fore wings long and rather narrow; color reddish brown with golden hairs except for three large yellow spots covered with yellow hairs and located as follows: one on the central third of the costal margin, extending on the wing nearly to media; a band along the hind margin extending from the base of the wing to near the middle; a shorter band on the hind margin at about the level of the anastomosis. Posterior half of anastomosis white. The two spots on the hind margin of each wing come together when the wings are folded, giving the appearance of a dorsal stripe of yellow interrupted by brown. A short fringe of yellow hairs on the outer and hind margins. Hind wings white with yellow hairs. Palpi long, densely clothed with rather short brown hair; last segment longer than any other, flexible.

Thorax yellow with white hair. Legs pale yellow, clothed with dense white pubescence.

Abdomen yellow to yellowish green in dried specimens. In alcoholic specimens white, sometimes with a black spot on the sides of abdominal segments 4 and 5. The female genitalia are of the type common to the genus.

Holotype—male in alcohol, Mud Pond, McLean, N. Y., July 24, 1924.

Allotype—female in alcohol, Mud Pond, McLean, N. Y., July 24, 1924.

Paratypes—a series of pinned and alcoholic specimens taken at McLean and at Ithaca, N. Y.

Halesus dan new species.

Length of body—10 mm.

Length to tip of wings—18 mm.

Head, antennæ and palpi yellow with ferruginous hairs. Legs yellow with black spines; spurs yellow. First two segments of fore tarsi with a longitudinal black stripe on ventral surface.

Thorax and abdomen yellow. Fore wings yellow to brownish yellow. Three rows of fuscous spots as follows: innermost row—beginning with a spot in center of discoidal cell and continuing to hind margin of the wing; a row just beyond the anastomosis consisting of five small spots, one each in cells R3 to M2; a distal row beginning with a stripe in cell R4 half the length of that cell, and continuing along outer margin to hind margin where it joins the innermost row of spots.

The general color of this species is lighter than that of *H. guttifer* and the genitalia are distinctive.

Holotype—pinned male, The Shack, McLean, N. Y., Sept. 21, 1924.

Allotype—pinned female, The Shack, McLean, N. Y., Sept. 22, 1924.

Paratypes—a series of pinned specimens.

THE BLUEBERRY TIP WORM (*CONTARINIA VACCINII* FELT.), A NEW SPECIES OF MIDGE
ATTACKING CULTIVATED
BLUEBERRIES¹

BY BYRLEY F. DRIGGERS

ASSISTANT CRANBERRY SPECIALIST, NEW JERSEY AGRICULTURAL
EXPERIMENT STATIONS

The Blueberry Tip Worm was first observed in the summer of 1921. A severe infestation was reported at that time in the nursery bed of a blueberry propagator near New Lisbon, New Jersey. Adult specimens were collected by Mr. C. S. Beckwith, of the New Jersey Cranberry Station, who sent them to Dr. E. P. Felt for identification. From the specimens, all of which proved to be females, Dr. Felt tentatively described the midge as a new species, *Contarinia vaccinii*. As the females of the genus *Contarinia* are rather similar, publication of the description was deferred until there was an opportunity of studying the males.

The second and most recent outbreak of this insect occurred in the summer of 1925 at Whitesbog, New Jersey. Injured tips were found on plants in the nursery beds and greenhouse on July 5. The dried and blackened tips were examined, but no form of the insect was found inside the dead tip. Adult midges were noted around the plants in the greenhouse.

The plants in the greenhouse had begun a new growth on July 13. An examination of the partly open leaf buds disclosed the presence of larvæ on the inside of the young, loosely folded leaves. A number of injured tips containing larvæ were collected and placed in jelly glasses with half an inch of soil. Adults of both sexes emerged from the soil in about ten days. All new growth started by the plant soon became infested. Larvæ were collected from plants in the greenhouse as late as

¹ Paper No. 267 of the Journal series, New Jersey Agricultural Experiment Stations, Department of Entomology.

September 24. Additional larval material was collected on August 15 from the late summer growth on plants in the field. Adults of both sexes were reared from the larvæ found in the field. Male and female specimens reared from larvæ were sent to Dr. Felt who definitely described the insect as a new species.

DESCRIPTION AND EXTENT OF INJURY

Injury to the plant is caused by the larvæ feeding on the immature leaves of the partly open buds. Feeding of the larvæ on the two outside leaves of the bud is confined to the inner side of those two leaves. Subsequent growth on the outer side of the leaf, while growth on the inner side is retarded or stopped by the feeding of the larvæ, causes a cupping together of the two outside leaves, thus affording protection to the feeding larvæ. The larvæ continue feeding on the inside of the bud and eventually kill the young bud. Injury is first revealed by a lack of turgidity in the leaves and the failure of the bud to develop. The injured leaves turn yellow and, later, red spots appear on the outside of the exposed leaves. After the larvæ descend to the ground, the dead tip dries out and becomes blackened and brittle.

Conditions in the greenhouse and the nursery are apparently favorable to the development of this insect. One propagator found it necessary to move his nursery bed to a new location. At Whitesbog, during the spring of 1925, the plants made their first growth before the insect appeared in sufficient numbers to cause any noticeable injury. Practically one hundred per cent. infestation was found on plants in the greenhouse at Whitesbog from the first of July to the latter part of September.

DESCRIPTION OF THE INSECT

The Egg. Eggs are deposited in clusters between the loosely folded leaves of the unfolding bud. Clusters having ten and twelve eggs have been found. Eggs collected from plants in the greenhouse were colorless, cylindrical, slightly curved and blunt at both ends. The eggs average .3 mm. in length and .08 mm. in width. The eggs are held in mass and to the surface of the leaf by a sticky substance secreted by the female.

The Larva. The larvæ are colorless when first hatched. As the larvæ reach maturity, they become light orange in color, this color being more pronounced in some larvæ than in others. A peculiar horny process, the "breast bone," is found on the underside of the body in all mature larvæ. It has also been observed on larvæ apparently not quite mature. It is believed that the larvæ use the "breast bone" to rasp the tissues of the leaf, thus causing the contents of the cells to flow. The cell contents are then taken in through the mouth. Mature larvæ average a little over 2 mm. in length and .5 mm. in width. The body is flattened dorsoventrad, with the posterior end rounded and the anterior end pointed.

Movements of the larva were effected in two ways. Usually the larva moved by extending the anterior end and then drawing up the posterior end. At other times, and especially when on a dry surface, the larva would draw the two ends of its body together to form a bow or loop. Then, by a sort of spring movement, the larva would let go and propel itself several inches. Upon landing, the larva would resume crawling or arch its body for another leap.

The Pupa. The larvæ enter the soil to pupate. A sticky, gelatinous substance is secreted by the larva which causes particles of peat and sand to adhere to its body. When dry, the gelatinous secretion, mixed with sand and peat, forms a tough capsule within which the larva transforms to a pupa. The pupæ are bright orange in color when first formed. Later, the antennæ, legs, head and thorax become dark and the abdomen yellowish. Pupæ vary somewhat in size, averaging a little less than 2 mm. in length.

The pupæ wriggle partly out of the cocoons before the adults emerge. The ability of the adults to free themselves from the pupal case is apparently affected by the amount of moisture present. In one breeding tumbler, where the soil had become air dry before time for the adults to emerge, a number of adults were observed unable to free their legs and antennæ of the pupal cases. Only a few adults emerged completely in this particular cage. In other cages, where the moisture content of the soil was higher, adults emerged without any apparent difficulty.

The Adult. The adult is a delicate, long-legged, two-winged fly. It is most active in the early morning and late afternoon. In the middle of the day it is usually to be found resting on the underside of leaves or under the framework of the nursery bed. When disturbed they fly awkwardly to another resting place. The following descriptions of the male and female were drafted by Dr. E. P. Felt:

***Contarinia vaccinii* new species.**

MALE. Length, .75 mm. Antennæ a little longer than the body, sparsely haired, fuscous yellowish, 14 segments, the fifth having the basal portion of the stem with a length equal to its diameter, the distal part with a length one half greater than its diameter. Terminal segment, basal enlargement subglobose, basal portion of the stem with a length one fourth greater than its diameter, the distal enlargement sub-cylindric, somewhat produced with a length one half greater than its diameter and with a somewhat long stout apical process. Palpi, first segment irregular with a length nearly twice its diameter, the second a little longer, the third one fourth longer than the second, slender, the fourth as long as the third, dilated apically. Mesonotum fuscous yellowish, scutellum and postscutellum pale yellowish, abdomen fuscous yellowish, the genitalia yellowish. Halteres yellowish basally, fuscous apically. Legs a nearly uniform pale straw, the pulvilli as long as the strongly curved slender claws. Genitalia, basal clasp segment moderately long, stout, terminal clasp segment rather short, stout. Other structures indistinct in the preparation.

FEMALE. Length, 1 mm. Antennæ nearly as long as the body, sparsely haired, fuscous yellowish, 14 segments, the fifth with a stem about one third the length of the cylindrical basal enlargement, the latter with a length about twice its diameter. Terminal segment somewhat produced, with a length two and one half times its diameter and apically a somewhat short finger-like process. Mesonotum fuscous yellowish, scutellum and postscutellum pale yellowish, abdomen fuscous yellowish. Halteres yellowish basally, fuscous apically, legs pale straw, ovipositor as long as the abdomen, the terminal lobes sparsely setose, with a length five times the width and tapering to a narrowly rounded apex. Other characters nearly as in the male.

Type Cecid. A 3361 (b).

The specimens were reared from injured blueberry tips collected in the field. The colors are from alcoholic specimens. The dimensions of the stems of the fifth antennal segment in the male serve to differentiate this species from others presenting similar color characteristics.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF JANUARY 6, 1925

The annual meeting of the New York Entomological Society was held at 8 P. M., January 6, 1925, in the American Museum of Natural History, President Harry B. Weiss in the chair, with seventeen members and six visitors present.

The Nominating Committee reported the following nominations for officers in 1925:

President—Frank E. Lutz.

Vice-President—Henry Bird.

Secretary—Charles W. Leng.

Treasurer—Wm. T. Davis.

Librarian—Frank E. Watson.

Curator—A. J. Mutchler.

Executive Committee—H. J. Barber, Lewis B. Woodruff, Harry B. Weiss, A. H. Sturtevant, Gaylord C. Hall.

Publication Committee—Harry B. Weiss, F. E. Lutz, J. D. Sherman, Jr., C. E. Olsen.

Auditing Committee—E. L. Bell, Wm. L. Lawler, Jr., Dr. E. R. P. Janvrin,

Field Committee—A. S. Nicolay, E. Shoemaker.

There being no other nominations the secretary, on motion duly seconded and carried, cast an affirmative ballot electing the nominees.

Dr. Lutz, with a few appropriate remarks, assumed the chair.

A letter of thanks from Mrs. Gustav Beyer was read by Mr. Davis.

Mr. Nicolay spoke on his summer collecting, with particular reference to a trip to Skyland, Va., in the Blue Ridge Mts. There is at Skyland a settlement of about forty log cabins of various sizes reached by train to Luray and automobile and buck-board up the mountain. In one of the cabins Mr. Nicolay, accompanied by Mr. Quirsfeld and Mr. Mason, of Philadelphia, abode for several days, collecting on the sides and summit of Stony Man Mt. Among the interesting results were *Centrodera picta* and *Encyclops coeruleus*, thirty-eight species of Elateridæ, a number of Carabini, including *Nomaretus imperfectus* and a remarkable form of *Cychnus*, and some interesting Rhyndophora, among which *Lepidophorus setiger* was conspicuous by its abundance. Mr. Nicolay's remarks were illustrated by photographs and by specimens of some of the interesting beetles. He spoke also of visits to Fairfax Co., Va., to Swartswood Lake, to the coast near Manasquan, and near Cape Henry, Va., the latter devoted to an unsuccessful search for *Trachykele* in Cypress killed by the sand dunes creeping into the borders of the swamp.

The president announced the appointment of Messrs. Weiss, Davis and Mutchler as a committee to arrange a program for each meeting.

Mr. Beamer, curator of the collection of the University of Kansas, spoke briefly of the pleasure of meeting eastern entomologists and seeing the great eastern museums. His visit was in a large measure due to his interest in Cicadas and his desire to meet Mr. Davis.

Mr. E. G. Smyth, also present as a visitor, spoke of his work in Mexico and Guatemala on the Bean Beetle, *Epilachna corrupta*, which has become a serious pest in Alabama and has spread already as far as Columbus, Ohio. Tachinid parasites were collected in the hope that they would check its advance.

Mr. Watson exhibited for Mrs. Heineman a tin can containing a living *Vanessa antiopa* as found by her.

Mr. Klots said he had found similar hibernations near Leonia, N. J., of two species of *Polygonia* as well as *Vanessa*.

Mr. Davis, commenting upon such hibernation, said he thought *Vanessa* responded first to increasing warmth and would be found flying before the other species.

MEETING OF JANUARY 20, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on January 20, 1925, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twelve members and four visitors present.

Mr. Mutchler reported for the Program Committee that Dr. L. O. Howard and Mr. Weiss would be the speakers at the next meeting.

The following new members were elected:

Mr. Edgar Irving Huntington, 115 East 90th St., N. Y.

Mr. B. Heineman, 229 West 97th St., N. Y.

Mrs. L. Heineman, 229 West 97th St., N. Y.

Letters were read from: Dr. Zerny and Mr. Richard Tompkins de Garnet.

Mr. Wm. T. Davis was elected delegate of the Society to the N. Y. Academy of Sciences.

Mr. Klots spoke of his "Collecting Experiences in Wyoming" with illustrations by lantern slides, principally from his own photographs.

The locality visited was Jackson's Hole; the illustrations showed the important mammals, elk, moose, bears, porcupine; some of the birds, chickadee, grouse, duck; and trees, particularly lodge pole pine and aspen. The collecting places in the canons and about the numerous lakes were illustrated as well as the snow-clad mountains and brush flats; and a box of representative Lepidoptera was shown. Unfortunately the bulk of Mr. Klots' collections was destroyed by the burning of his cabin following a stroke of lightning. In response to questions by members Mr. Klots spoke of the mosquitoes being troublesome in July, and of the great work accomplished by the Community Centre and Hospital directed by Dr. Hough.

MEETING OF FEBRUARY 3, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on February 3, 1925, in the American Museum of Natural History, Vice-President Henry Bird in the chair, with thirty-eight members and twenty-five visitors present.

The chairman announced with regret the absence of Dr. Frank E. Lutz, president, on account of illness, and his own gratification upon election as vice-president.

The Program Committee announced for the meeting of February 17 a paper by Mr. E. Graywood Smyth.

Mr. H. M. Tietz, 10326 118th St., Richmond Hill, L. I., was elected an active member of the Society.

Mr. Weiss read a paper on "The Illustrator of Jaeger's Book on North American Insects" which will be published in full. It dealt in careful detail, accumulated by three months' research, with Dr. Washington Hoppin, his work and family history, with a view to doing justice to a half-forgotten worthy.

In the discussion that followed the meritorious work of other illustrators was recalled, notably Peale and Joutel.

Dr. L. O. Howard, chief of the Bureau of Entomology, U. S. Department of Agriculture, in an informal talk congratulated the Society on its Journal and the work done by its non-professional members in studying the taxonomy and ecology of insects. He pointed out the study of taxonomy as the first requisite in entomology and the great advance made therein by non-professional students. He commended especially the method of meeting informally around the table and holding discussion seated, contrasting it with the unnecessary formality observed in some European societies. He propounded the theory that the research temperament is essentially an artistic one and pointed to Mr. Davis as an example. Among other matters he spoke of the recent discovery of a Staphylinid beetle on a gravestone, paralleled by wasp cells on a European monument, of mosquitoes that do not bite, of the apparent practice in Europe of storing insects either in the basement or the attic, and congratulated the audience that the popular idea of the triviality of Entomology had in this country somewhat disappeared. Later in the evening he gave as an example the increase in Congressional appropriations from \$5,000 to \$2,500,000 based upon the emergency work necessitated by the Japanese beetle, the European Cornborer, the Gypsy Moth, also the Boll Weevil.

Many members spoke of the important part Dr. Howard had played in bringing this condition about.

Mr. Engelhardt described recent meetings in Washington, and the earnestness manifested by the large attendance; he thought the development was largely due to the present chief of the Bureau.

Dr. Leale spoke at some length on this subject and proposed a resolution

of thanks to Dr. Howard for the work he had accomplished, which was adopted by a rising vote.

Mr. Ottolengui made a plea for a greater interest in the study of the Lepidoptera, pointing out the necessity for continued close study of their taxonomy.

Mr. Nicolay spoke briefly of his recent collections in the Southern Mts.

Mr. Doll was also called upon to speak.

Mr. Smyth spoke of another phase of Dr. Howard's activities in the fatherly encouragement of the younger men in the Bureau and gave some instances from his own experiences.

Dr. Howard responding in lighter vein told of some cases in which the young men had involved him in embarrassing affairs, as when Fred Knab mistook No. 2022 Hillyer Place for No. 2026. He told also of Mr. Schwarz' eightieth birthday and the embarrassment the young women had caused him by their enthusiastic greetings.

The meeting closed with the presentation of a short note by Mr. Davis on the capture by *Anax junius* of so large a creature as *Plantana flavescens*, which is printed elsewhere; and by Dr. Priscilla Hussey's account of the 450 eggs obligingly laid by some Phasmids imported from Europe.

THE WASP, *BEMBIDULA QUADRIFASCIATA*

On August 26, 1925, Mr. John M. Farley, Jr., and the writer were near the Town Bank in Cape May Co., N. J., where we had gone to get further acquainted with the cicada, *Tibicen latifasciata*, that is to be found in the tangle of cedars, hollies, oaks, etc., a little back from the shore.

There was a colony of *Emphor bombiformis* bees by the side of the road, and soon we noticed what we took to be a hovering Tabanid fly. This we captured and were surprised to discover that we had not a fly, but the handsome yellow-marked wasp, *Bembidula quadrifasciata* Say. The length of time that this insect hovered was what interested us. It is a female and its nest was probably in the vicinity.

Dr. Joseph Bequaert has examined my specimens of this species, and Prof. John B. Parker determined a number of them in the writer's collection. In his Revision of the Bembicine Wasps of America North of Mexico, 1917, Prof. Parker states that he had found two nests of this species, and that the wasp poises in

the air several feet from the ground and then descends directly to her nest.

While at Dennisville, Cape May Co., N. J., September 7, 1908, one of these wasps was collected that had secured a nymph of the bug *Chariesterus antennator* Fabricius; at Lakehurst, N. J., August 23, 1912, one had a large nymph of *Brochymena carolinensis* Westwood, and while at Riverhead, Long Island, August 16, 1919, one was captured while carrying a *Nezara* nymph. At the same place, on August 23, 1919, four immature bugs, *Tetyra bipunctata* H. S., that feed on pine trees, were either taken from wasps of this species, or found on the sand near their nests, where they had been abandoned. One of the wasps was seen in the act of completing her nest. She stood at the entrance and pulled the sand inward. She soon had it to suit her, and flew swiftly away.

—WM. T. DAVIS.

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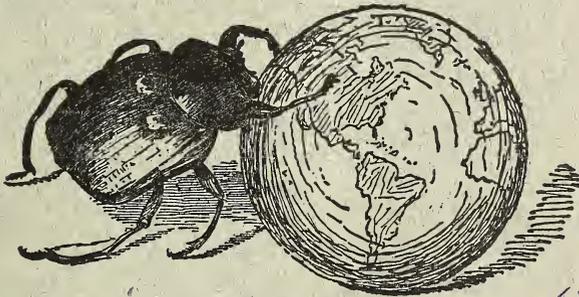
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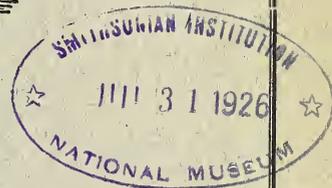
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VOL. XXXIV

JUNE, 1926

No. 2

THE WING FOLDING PATTERNS OF THE COLEOPTERA

BY WM. T. M. FORBES

CORNELL UNIVERSITY, ITHACA, N. Y.

(Continued from page 68)

Scydmaenidæ (fig. 37), *Pselaphidæ* (fig. 38). Outer part of wing divided twice longitudinally as in the preceding type, but then folded many times transversely, the folds being alternately convex and concave, without the two successive concave folds characteristic of the Nitidulidæ. Anal lobe absent. These two families are obviously closely related, as they were placed by Leconte and Horn. Some recent workers have put most of the other Staphyliniform families between them.

Micropeplidæ (fig. 39). Outer part of wing folded many times transversely, but not longitudinally at all; Area C + H very narrow, almost rudimentary. Anal lobe absent as in the preceding type. This little group seems plainly related to the Pselaphidæ rather than the Staphylinidæ with which it is usually grouped, and represents the extreme of specialization in the recognized Staphyliniformia.

Phaenocephalidæ: Not available. Possibly a link between the Ptiliidæ and Nitidulidæ.

Discolomidæ (*Aphanocephalidæ*). *Discoloma vestita* (fig. 36) has two transverse folds and a somewhat irregular longitudinal crease, fading out before the second transverse fold. This sug-

gests the Liodidæ, but there are some discordances, especially the strong M_1 in the outer part of the wing. The absence of a fringe is unique in so small a form.

Ptiliidæ (Trichopterygidæ): As noted by Matthews there are two stages of reduction in the Ptiliid wing. In *Nossidium* (fig. 47) the wing is narrow-oval, with a considerable number of transverse folds. The first is convex, and there is enough left of the venation to show it is homologous with the fold formed by the first costo-apical and the principal fold in the Pselaphid series. Following this are two concave folds and then a regular alternation of convex and concave, definite on the costa, but somewhat broken up toward the inner margin; besides this there is the appearance of a longitudinal fold in the middle of the wing, but it is really made up of a mere series of crumples. The dorsal part of the wing has disappeared, and there is only a doubtful trace of area $C + H$.

In most of the family (*Ptilium* and *Trichopteryx* examined (fig. 48)), there are only four transverse folds, convex—concave—concave—convex; and the fringe is relatively much more developed.

This family seems definitely to belong to the Haplogastra, but shares characters of the Liodid-Pselaphid series (the simple convex transverse fold and obsolete pivot-system) and of the Nitidulidæ (the two successive concave folds following a convex one, which occur in no other families than these two). The genitalia throw no further light on their position.

HISTEROIDEA

I am applying this term to a series of forms without any very close union among themselves, but which can be excluded from the other three superfamilies of this series. Radial recurrent not extending before the cross-vein, which is well-developed; medial recurrent as a rule with a spur, long in *Rhizophagus*. Stigma more or less reduced, fairly well developed in *Hister*, but vanishing in the Nitidulid group of families. Anal lobe well set off or lost, irregular in outline or more or less definitely double in *Sphaerites*, *Syntelia* and most *Histeridæ*. Folding variable in detail but never with the regular two longitudinal folds of the second group of *Staphyliniformia*.

Histeridæ (figs. 40-42). A very characteristic family in the wing, as in other features. Hinge area reduced in size but wholly normal in function, the veins in the hinge region enormously thickened and the recurrents forming a heavy loop with the cross-vein r-m. Radial cell absent. Apical region with numerous traces of veins, R_2 and R_3 both being represented among others. M_4 and Cu perhaps also separate. Anals of principal group irregular, with broadened chitinizations and irregular grooves, the anal lobe normally more or less divided, and only the last part fully folded over. Area D not lengthened. Apical part of wing sometimes folded across twice, and normally with numerous longitudinal crumples. This family seems to link to the Hydrophilidæ on one side and more closely to the Lamellicornia on the other. I cannot see any direct connection with the Staphyliniformia.

Synteliidæ (figs. 43-46). Hinge part of wing less reduced than in the Histeridæ, the cross-vein and Mr being well distinguished from each other, and Mr with a basal spur. Stigma typically well developed, reduced in Sphærites; radial cell distinct in Sphærites, filled up with a rounded chitinous mass in Syntelia. Hinge region with a group of broad chitinizations, the more costal ones being also represented in the Nitidulidæ, and the more dorsal in the Histeridæ. Anals three, arranged the same way in Syntelia and Rhizophagus. Anal lobe highly characteristic, formed of two lobes which are separated by a slight crumple, but both fold over.

This is a curious family, with suggestions of each of the other groups of Haplogastra. The curious anal lobe would not be out of place in the Histeridæ, which the hinge also resembles, but the venation of Syntelia would connect the Hydrophilidæ and Lamellicornia, while Sphærites shows distinct leanings toward the Nitidulidæ and Syntelia to Rhizophagus. Superficially the family is equally transitional, with Syntelia leaning more to the Lamellicorns, and Sphaerites more to the Histeridæ and Nitidulidæ.

Nitidulidæ (figs. 50-54). This and the next two families are not very close to the preceding, though nearest perhaps to Sphærites, as Laneere has already noted. The costal thickening at the

hinge and the stigma have completely disappeared, though the secondary chitinizations at the hinge, which are so well developed in *Syntelia* and *Sphaerites*, survive. The recurrents and cross-vein make a *Syntelia*-like loop. Most distinctive of the three families is the hinge arrangement; S and D are drawn out into long similar triangles pointing toward the center of the wing, and are folded together and then folded back on area C, which is also similar in shape, though longer as a rule. This peculiar form makes it possible to swing the apex of the wing almost directly back on the base without the use of the first costo-apical fold, and at first glance makes the folded wing look like a *Liodid* or *Cryptophagid*. The *Nitidulidæ* have an abundantly folded apical part of the wing, in which two things are characteristic;—the second and third costo-apical folds are both concave, instead of being alternately concave and convex, as in all other forms with large apical areas except the *Ptiliidæ*; and the concave median fold is much lower in the wing than usual, lying immediately above the median vein. The anal lobe is free. Variation in detail is enormous. I suspect that the primitive members of the family had short transverse folds, and short elytra, like *Colopterus*, and that long elytra are secondary, since the wings do not completely fill the space under them. In this case the transverse folding and well defined median fold of *Colopterus* is more primitive than the oblique costal folds and irregularly broken median fold more usual in the family (*Phenolia*). *Nitidula* is essentially like *Phenolia*, figured, but *Camptodes* and *Amartus* show somewhat more primitive conditions. Several of the early genera show *Histerid*-like traces of apical venation.

Rhizophagidæ (fig. 55). Hinge as in the *Nitidulidæ*, but apical part of the wing with the median fold central, and only a single transverse fold. Anal lobe free. Anals as in *Syntelia*.

Monotomidæ (figs. 56, 57). Similar, but anal fold sometimes sessile or lost. I have had no material of this family in really good condition, and cannot be sure how much of the apparent difference from the *Rhizophagidæ* is merely due to imperfect folding.

LAMELLICORNIA

This is an entirely homogeneous group in both folding and venation, the principal difference being a little in the relative

size of the apical region. The distinction formerly used by Kolbe ('01) for the Passalidæ fails in our species, which has as large an apical region as many Lucanidæ. Anal lobe sessile (figs. 58-60), hinge erect, like the Synteliidæ rather than the Nitidulidæ, the area S sometimes broken up almost as in the Hydrophilus group; first anal area always well developed, and crossing the principal fold; with its convex above its concave fold. Apical region normally without a transverse fold (? if always). The venation is marked by numerous remnants of apical venation, R_2 and R_3 being especially conspicuous in Aphodius; and by the loop-like course of $3d A_1$, which is faintly suggested in Sphærites but otherwise is limited to the Lamellicornia. The radial recurrent is not really present, the hook-like structure resembling it being really the filled-up radial cell; the medial recurrent is long and not connected with the radial.

BOSTRYCHIFORMIA

Costal chitinization stopping abruptly at the first hinge-fold, there being no trace of a stigma. Hinge folds reaching the costa separately, and with a few exceptions widely separated. The most striking exception is Endecatomus, which may possibly be a relict-form. Its venation is normal. Area B almost always markedly developed and forming the functional hinge, which is usually convex proximally and concave distally, and may either work with A, or cross the stump of M and work with the first anal area, or with smaller secondary folds. Wing usually without an apical fold. Median strahlader usually strongly developed, arising from an exceptionally long cross-vein; 1st r-m also developed in Artematopus and the Dascillid complex; and 4th A_2 in Dascillus with its close kin, and Cyphon. Anals in the principal group sometimes as many as six, the wedge-cell being open to the inner margin in Attagenus and few other Dermestidæ.

This is a very distinct type, though intergrading with the following through the Dermestidæ, and Rhipiceridæ-Lichadidæ. There are several dominant sub-types, the Dascillid, Cyphonid and Bostrychid; but only a plurality of the genera belong to either of these types, an unusually large proportion being oddities. I am not at all sure if the Buprestidæ should be placed here

or in the following series; they have always been associated with the Elateridæ, but are not over close (as Gahan and others have noted), and the hinge certainly approaches the Dascillid type in the few genera that have normally developed folding. Dermestes is also a joker. The venation associates it definitely enough with Dascillus, and the body characters with the other genera commonly called Dermestidæ, but the folding is entirely of the Serricorn-Clavicorn type, the hinge being not only at a definite point, but with a perceptibly chitinized costal margin, and with traces of a stigma. On the folding the genus would stand far better between the Lichadidæ and Ostomidæ. I have divided this series in three superfamilies according to the length of M, and the relation of area B to it and to the anal area, but the separation is superficial, and the groups are perhaps not pure. Sphindus and Corticaria, which have a modified Bostrychoid folding, might make a fourth sub-group, apparently related to the ancestor of the Ptinidæ; their distinctive feature is the small erect hinge-area.

A

Media extending well toward base of wing, with a more or less distinct bulla or deflection where area C mets it. Area B subordinate, and not extending below media, or occasionally large and working with A instead of with G, frequently with B not really developed, but with an indefinite extension of C to near the base of the wing.

Artematopus (figs. 62, 63). B very large, and C correspondingly short, the apex of B touching M at a slender place, and distorting it; A reversed, with the convex fold above the concave. First anal area indefinite, but of good size, reaching the margin; apex of wing with indefinite crumpling which tends to fall in two groups, possibly representing the two halves of the spiral roll of Cupes. First r-m fully developed, but with the part of Rs which attaches to it cut off from the rest by fold B.

A curious form, with a development of 1st r-m stronger than any other known Polyphagan, but in the folding of areas C and D distinctly associated with the more specialized Bostrychi-formia.

Macropogon, *Eurypogon*: similar to *Artematopus* so far as studied; but with vein 1st r-m lost.

Dascillus (fig. 61). B represented by a slender fold, concave on the upper side and extending nearly to the base of the wing, partially separated from area C by some crumpling, but functioning as a unit with it; median fold slender; first anal fold practically lost; area S imperfectly developed, but with area D as large on the costa as in any form of the series. 1st r-m fine but traceable, extending from the small subtriangular radial cell across to M, which is long but weak and broken. The wing of *Anorus* is similar. A curious type, connecting the *Bostrychoidea* and *Elateridae*. The *Schizopini*, *Sandalus* and *Rhipicera* agree with merely generic differences. The remaining *Rhipiceridae* and *Buprestidae* are of very distinct types.

Dermestes (fig. 77). Similar to the preceding group except that the hinge is formed, and the costa slightly chitinized at that point. Vein 1st r-m not preserved, but venation otherwise practically as in *Dascillus*. Area B is not recognizable, but vein M tends to be interrupted in the same way as in *Dascillus*. A genus of uncertain relationship, perhaps derived from the ancestor of the *Bostrychiformia*.

B

Media extending less than half way to the base of the wing, crossed (except in *Nosodendron*) by a well-developed area B. Superficially this group would divide into a *Helodid*, a *Dermestoid* and a *Bostrychid* type, but the foldings intergrade completely. Some subapical folding is commonly present, but it never seems to take the form of a costo-apical convex and dorso-apical concave fold.

Nosodendron (fig. 64). This is possibly not related to the following genera, but separately reduced from something like *Artematopus*. Folding as in *Artematopus*, with a large area B working with area A, but media stopping short and not running between them; first anal fold narrower at the margin.

Anthrenus (fig. 65). Folding practically always incomplete, but of the general *Nosodendron* type. Area A not really developed, replaced by a small adjustment fold between B and G only, anal lobe freer than in *Nosodendron*.

Attagenus (fig. 68). Media longer than in the others of this sub-group, and area C correspondingly lengthened; area D distinctly narrowed to costa as in some Buprestidæ, but much further out and more oblique than in the Sphindidæ. Apical fold definite, concave to both costa and inner margin, and convex to apex. Anal lobe separated by a slight notch. Venation peculiar in having six free anals in the main group, as in the following genus and various Buprestidæ.

Megatoma (Dermestidæ) (fig. 67). Similar to *Attagenus* in venation, but with area C broken in two parts, and D broad at the costa; first anal area about as in *Nosodendron*; anal lobe sessile. A curious form. The folding is more Bostrychid than anything else but the venation connects it with *Attagenus*.

For winged specimens of *Thylotrias* (Hospitopterus) I am indebted to Mr. Barber. The folding is imperfect and peculiar (fig. 66) but the large reversed pivot is a Bostrychoid character, and the genus will fit near *Anthrenus* as well as anywhere.

Mastogenius (Good '25, fig. 49), to judge by the venation, is also a member of this group. In any case the reversed pivot (area B) is present, and the unsymmetrical recurrents will definitely throw it out of the Buprestidæ.

Eucinetus (fig. 69). Resembles the Cyphonidæ, but is a little more primitive in the small area G not reaching the margin, and peculiar in the two areas representing B, of which the smaller corresponds most closely to the usual one.

Cyphon (fig. 70), *Helodes*, *Scirtes*. Area B very large, and first anal area enormous, reaching the margin broadly, and divided by subordinate folds. Area C short, D broad on costa; apical fold as in *Attagenus* and *Megatoma*, but even more definite. A unique development.

Bostrychidæ (fig. 73). Area B large and normally transverse, but only indirectly working with the first anal area, being separated by a mass of small and variable folds; area C variable and sometimes divided, but always short; apex without a definite transverse fold; anal lobe sessile.

Several species have been looked at, but the differences are insignificant and the type very distinct. The closest thing, aside from the following forms, appears to be the Cyphonidæ, with

Eucinetus, which differ in the larger first anal area and the sub-apical fold, as well as in wing form, and especially in the transverse position of the short stub of M, and the short radial cell.

Lyctus (fig. 74) differs mainly in the free anal lobe.

In *Endecatomois* (fig. 75) the pivot is of the type found in the "normal" series, but is very oblique, and far out toward the apex. I suspect that as in some Buprestidæ this is a secondary effect of the migration out of the tip of the radial cell. The venation is normal Bostrychoid; on the other hand the genus is abnormal in other ways, and may be a relict comparable to *Dermostes* in the Anthrenid complex. The wing shows no connection with the Cisidæ.

Petalon combines the wing of the Bostrychidæ with body characters of the Dasyllidæ.

Ptinidæ. Folding was imperfect in the specimens of *Ptinus* examined, and it was not possible to make out if the sub-apical fold was as in *Cyphon* or as in *Sphindus*, but the apical area is large, with several folds. Area B is large, and functions as in the related forms, but barely crosses Mr and works with little crumples, rather than with G, which is well-developed. Areas C and H are apparently not separated (as occasionally also in the Bostrychidæ), and H narrows to a point at the inner margin; anal lobe free.

Sitodrepa (fig. 76). Similar; the apex with eight approximately radial folds, the last of them reaching the margin very close to the principal fold, almost cutting off area H from the margin. First costo-apical fold concave.

Ectrephidæ. Not examined, presumably intermediate between the *Ptinidæ*, which they resemble superficially, and the *Gnostidæ*, which have similar habits.

Gnostidæ. I have the opportunity to examine a specimen of *Gnostus*, through the courtesy of Dr. Wm. M. Mann. The venation and folding is substantially that of the *Lyctidæ*; the apical region large, but not as much folded as in the true *Ptinidæ*. Area A absent, B a large right triangle, extending from the costa to the tip of Mr which is far down toward the lower side of the cell and moderately long; radial cell a triangular chitinization, as in the *Ptinidæ* and *Lyctidæ*; apical folding confined to the

apex, forming a narrow chevron. Jugal fold narrow, with free tip, more like *Ptinus* than *Lyctus*. Area G well-marked, but not reaching the margin. The location of the genus here is beyond all question, and the family will take its place beside the *Ectrephidæ*, as a derivative of the *Ptinidæ*. There is nothing in other structures to contradict the reference, and its previous locations no doubt were due to its superficial likeness to the *Paussidæ* or to the *Pselaphidæ*.

C

Area D upright, distinctly narrowed to costa and at just about half the length of the wing; *Mr* longer than in the preceding forms, with *B* running along it to its tip, and with the concave fold above the convex, or broken up. First apical fold normal, being convex on costal half and concave on dorsal, and with further folds in the apex. Anal lobe free.

A distinct little group, but with obvious affinities to this series, and most closely to the *Ptinidæ*, apparently. The preservation of the costo-apical fold in this case is perhaps primitive.

Sphindus (fig. 71). Area B simple, concave before convex; C well marked.

Cordicaria (fig. 72). Area B broken up, its costal part with the convex fold before the concave as in other *Bostrychiformia*; C reduced.

NORMAL GROUP (DIVERSICORNIA)

In the following four superfamilies the pivot fold is normal in character; that is, the concave and convex folds meet at a point on the costa and the first costo-apical fold is at a distinct interval. In practically all forms $M_4 + Cu$ is undisturbed, the principal fold running along its upper side, but in the weevils, and to a slight extent in some *Chrysomelidæ* there has developed a crumpled region below *Cu* as in the *Haplogastra*, and *Cu* bends back in practically the same way. Such forms show no folding character to separate them from some of the *Haplogastra*. Stigma absent, or represented by a slight chitinization which is usually distant from the margin; costal edge rarely chitinized at hinge; anals in the principal group as many as six in early

forms, or even with traces of a larger number in some Lamproyridæ and Buprestidæ. Body in general without primitive characters, the ocellus being present only in two or three Lymexylidæ, and the second pleurite fused with the third save in a few soft-bodied types, most of which seem to be degenerate rather than primitive.

I have divided this series into four superfamilies, on a close approximation to conventional lines. The Heteromera and Phytophaga seem to have absolutely nothing distinctive in the wings; in the case of the Serricornia and Clavicornia, I have used the length of area C, either taken alone, or including a secondary fold which may represent B. In most of the forms commonly treated as Serricornia this area or pair of areas reaches nearly to the base of the wing, and media is extended nearly to the base also; in most Clavicorns the area and vein stop near the middle of the wing. The Buprestidæ form a third main group, which may be appended to the Serricornia, but in this particular agrees more nearly with the Clavicornia; it is separable from both by the equal length of radial and median recurrents, and for the most part by the reversed area between C and D, which has the concave side facing C and convex side facing D and H, the exact opposite of the condition in the ordinary run of beetles. The folding is less stable than in most families, and may be reduced to a couple of crumples, with areas C and D completely fused, and H slender. It is also the only family of the series in which there are six anals in the principal group and the wedge-cell is open. It may perhaps not belong to this series at all, but to the foot of the Bostrychoidea. One would also like to attach the Lymexylidæ to the Bostrychiformia, but there is nothing in the wing of any member of the family that would be out of place in the Serricornia or Heteromera. The frontal ocellus of a part of the genera appears to be the only Bostrychid character.

SERRICORNIA

Area C reaching nearly to base of wing, sometimes bisected by a weak crumple indicating B. Anal lobe sessile (except the Throscidæ). Adjustment of areas C and D highly variable, sometimes normal, sometimes by a group of folds, and sometimes

largely fused. Antennæ serrate or flabellate, etc., hardly ever clavate.

Lichadidæ (figs. 83, 84). B almost completely separated from C, but like it with the concave side up, and functionally continuous with it. C and D fused, save for minor crumples, S obliterated. Apical region without definite folds. Venation rather elater-like, but with the whole of 1st r-m traceable, much more oblique than in the Dascillus group. Base of 1st A distinct from cross-vein cu-a, as in the Elateridæ, and wedge-cell with the outer cross-vein somewhat oblique, but less so than the basal.

The family represents almost perfectly the point of origin of the Bostrychiformia, to which it should perhaps be transferred. It includes *Zenoa* and *Callirhipis* as well as *Lichas*.

Cebrioidæ (fig. 85). Six anals in the principal group, and wedge-cell closed by a cross-vein. Areas C and D fused, C extending to base without interposition of any area B. Cross-vein 1st r-m lost. Apical fold normal.

Elateridæ (fig. 86). B reduced to a slight crumple or lost, C extending to base of wing; C and D separated by a group of three small areas, the first corresponding to S, the second reversed and convex on all sides, the third with the concave side in front as in the Buprestidæ. As a result the area H seems to lie over C in the folded wing, instead of C over D and H as usual. Apical region with normal or somewhat irregular folds. Venation characterized by distinctness of 1st A and cross-vein cu-a at base, the long oblique radical cell with r-m attached near its middle, and the wedge cell closed by a transverse vein or open. There are a few genera associated with the Elateridæ in which all these characters fail, though the elaterid spring is present. The most striking case is *Tharops*, in which the base of 1st A and folding at apex of cell are exactly as in the Lampyridæ.

To judge by a very incomplete examination *Brachypsectra* may possibly be related to the Elateridæ or Lampyridæ. The pivot-fold is complete, and simple, unlike the genera which have been associated with it, and is followed by a deep chevron-like subapical fold, with a convex fold running to the costa, unlike any of the Dascillidæ or Helodidæ.

Lampyridæ (including *Telephoridæ* and *Lycidæ* (fig. 87). Exactly like the Elateridæ, except for the normal formation of

area S and the absence of an angle and spur at the base of 1st A, representing the separation of 1st A and cu-a. Subapical fold normal, convex at costa and concave at inner margin.

Languriidæ (fig. 88). Folding as in the Lampyridæ and Tharops, but with the apex crumpled rather than definitely folded. Venation as in Lampyridæ, etc., but with one branch of 2d A lost, as in the true Erotylidæ. This is no doubt on the Erotylid stem but in folding and venation is still a Serricorn.

Cucujus (fig. 89), *Passandra*: Fold A apparently completely lost, venation and folding otherwise normal for the Serricornia.

Lymexylidæ. Hylecoetus, similar to Languria, and like it with only four anals in the principal group. In Mellittomma area A is divided in two parts much as in Lichas; while in Euthysanius area S is practically eliminated, and C fused with D as in Cebrio. Telegeusis (fig. 78) has only two folds of a somewhat ambiguous character, but is easily derivable from the Lymexylid type; Atractoceras has gone a stage farther, and lost its folding entirely. In wing characters this family appears plainly to belong to the Serricornia, and to lie between an early Elater type and the Languriidæ, though without any important difference from the Heteromera. It has no resemblance to either the Bostrychiformia or Micromalthus. The frontal ocellus, however, reappears just in those two groups.

Buprestidæ (figs. 79-82). An anomalous family, apparently separately derived from something near the ancestor of the Bostrychiformia. Areas A and B normally reduced to slender crumples, C stopping at about half the length of the wing, and frequently fused more or less completely with D, which is either open to the costa or reduced to a slender crumple. H always well marked and reaching the margin with its full width, very slender and nearly longitudinal in the more typical forms. Commonly with one chevron-like apical fold, but in Brachys and its kin with two, in several genera without any. Anal lobe highly variable, but never free. There is a regular reduction series in the family. In Eupristocerus and the Brachys group all folds are present and of normal size, but S is replaced by an area of reversed folding; Brachys is more advanced in venation, having lost the radial cell. Agrilus folds like Brachys, but the wing and

all the folds are slender and tend to be longitudinal. *Acmaeodera* and *Buprestis* have practically lost area *s*, and have only a single apical fold; *Sternocera* has lost all except a slender area *H*, and crumples. The completely chitinized dorsum of the abdomen (which is shared by a few *Elateridæ*) indicates an extremely primitive position.

CLAVICORNIA

Area *C* extending less than half way to base of wing, usually working with a well marked area *B*, which cuts across the end of the relatively short median recurrent. Apical folding more various than in the *Serricornia*, sometimes absent; venation more frequently reduced, the anals very commonly reduced to four; and anal lobe frequently more or less free. Antenna usually clavate. *Dermestes* may perhaps belong in this group, but is a link with the *Bostrychiformia*. A large proportion of forms have developed a wing-like chitinization crossing *r-m*, and stiffening area *S*, and a good many show some trace of the stigma as a small chitinization far from the costal margin.

Helotidæ (figs. 91, 92). About five apical folds, the first ones normal. Area *B* absent, *A* working directly with *C*, and media correspondingly long. Anal lobe partly free. Only four anals in principal group.

Ostomidæ (fig. 97). Similar, *B* more distinctly developed, anal lobe typically sessile. Anals various.

Cleridæ (figs. 93, 94). Apical folding variable in amount, the other characters as in the *Ostomidæ*. Altogether this is probably the most primitive of the *Clavicorn* families, and also (through the *Necrobia* group) leads up to the *Dryopiformia*. The genera *Blatchleya* and *Onethes* actually appear transitional in wing-folding, the first costo-apical fold starting from the costa practically at the pivot, but not actually working with it. The same condition appears in a few *Melyridæ*, though in the *Melyridæ* normally the pivot has become definitely associated with the costo-apical fold. There is no suggestion of special likeness to the *Lampyrid-elater* type.

Cucujidæ (fig. 90). The smaller genera associated with the *Cucujidæ* have wing characters far more like the three preceding

families; *Laemophlaeus* for instance is nearer to *Necrobia* than *Clerus* is.

Erotylidæ (fig. 95), *Phalacridæ* (fig. 96). Substantially as in the *Ostomidæ*. These families will separate from many clavicornes, but not from *Laemophlaeus*, by the fact that the median area is normal and not reversed. Anal lobe sessile in *Erotylidæ*, free in *Phalacrus*.

The *Thorictidæ* are apterous. They may be associated with the *Phalacridæ*.

These families make an almost perfectly homogeneous group. *Dermestes* approaches it in folds, but has a long media, and is generally associated with *Bostrychiform* genera. The *Buprestidæ* also connect with the *Bostrychidæ*, and are distinguished by the reversed area S and equal length of the radial and median recurrents, as already noted.

HETEROMERA

Folding varying from that of the *Serricornia* to that of the *Clavicornia*, without any distinctive group character. All folds are quite normal, and the area C tends as a whole to be long, more on the *Serricorn* order. (It is short in *Monomma*.) The wing-like chitization and rudimentary stigma noted under the *Clavicornia* are often distinct. There is nothing about the venation or folding to divide the series where Sharp and Muir, and Leng have done, but the *Meloidæ* stand out a little in venation. All possible links between the *Meloidæ* and the more normal *Heteromera* are found in the *Rhipiphoridæ*, as well as unfolded forms approaching the *Stylopidæ*, notably *Rhipidius*, while *Myodites* seems to belong to a variant type. The *Trictenotomidæ* and *Rhysopausidæ* (*Tretothorax*) are normal.

PHYTOPHAGA

Folding in the *Cerambycidæ* (fig. 98) and most *Chrysomelidæ* exactly as in the normal *Clavicornia*, sometimes with and sometimes without an apical cross-fold, which is usually chevron-like. In some *Chrysomelidæ* (fig. 99) there begin to appear folds below Cu like those in the *Haplogastra*; and in the weevils, even the *Anthribidæ* (fig. 100), these have developed into a regular folded

area working with H as in that series. The only difference—which is not wholly constant—is in the relation to the vein Cu, as the convex fold along it tends to cross it obliquely, and not at the base, and the vein itself is more or less sinuous. Anal lobe sessile.

Protterrhinidæ apterous; Aglycyderidæ not seen.

DRYOPIFORMIA

I am using this name for the series of forms where the first costo-apical fold has migrated basad till it reaches the hinge, and then (almost always) the hinge has migrated down along the fold for a greater or less distance. The group may perhaps not be homogeneous. Off-hand there is a special temptation to separate the Melyridæ and Malachiidæ from the rest, and associate them with the Cleridæ, in some of which the costo-apical fold has almost reached the hinge. But none of the Cleridæ or their kin show the complex system of chitinizations in the hinge region and especially the chitinization of area D, which unites the Malachiidæ with the Coccinellidæ. The other groups all link together more or less closely. I make five subgroups, but the boundaries are more or less artificial.

In the Dryopiformia the costo-apical fold is less firmly set in than most of the folds of importance for classification, and I have had some trouble with specimens in which it had become partly unfolded or even had disappeared. In my single specimen of *Monoedus* the fold does not connect with the pivot, but the form is otherwise, both in body and wing, so close to the Colydiidæ that I think its position is in no doubt, especially as the hinge does not reach the costa but is connected to it by crumples. In all the other cases a second specimen has shown the fold in its proper position.

In most of this series cubitus remains undisturbed, and in short-winged types it turns almost directly across to the inner margin, to avoid crossing the principal fold. Frequently the tip of Cu is folded over, not so often by fold H₂ itself as by secondary folds working with areas G and H; occasionally this works back up the vein toward the point of junction with M, but only rarely reaches that point. In the final condition there is no real differ-

ence from the Haplogastra, and a few specialized forms must be placed in one series or the other on other characters. I have discussed most of these families here (in group C), but the Georyssidæ, on account of its chitinized pivot, with the Hydrophilidæ.

A

Anal lobe sessile; area H more or less narrowed to the inner margin, typically cut off from it by the meeting of the principal and first posterior folds, and working with a more or less extensive folded area below Cu, but without the second posterior fold being involved, as in the Coccinellidæ and their kin. The extremes of this type (Ptilodactyla and the Mycetophagidæ) seem widely separated, but they seem to be connected by insensible gradations through the Byrrhidæ and Heteroceridæ. On the other side the Mycetophagidæ are very close to such Colydiidæ as Ditoma, in the following group, and the separation is due to the apparent necessity of drawing a line somewhere.

Ptilodactylidæ (figs. 101-106, 114). This seems as good a name as any to indicate those genera formerly in the Dascillidæ which belong to this series. I have examined the following: Dæmon, Anchytarsus, Ptilodactyla, Odontonyx, Araeopus, Ectopria, Eubria, Placonycha, Chaetodactyla. In Eubria and Placonycha the principal area rests broadly on the inner margin, in most of the others the first posterior fold has met and crossed Cu, leading into a more or less developed folded area below Cu, which becomes very large in Placonycha. Dæmon and Anchytarsus have a fully developed anal venation, while the others are more or less reduced. On the other hand it is just the genera Eubria and Placonycha in which the pivot area is most reduced. The larva of Placonycha is said to be similar to Psephenus in the Dryopidæ. Mr. Böving also informs me that the larva of Ptilodactyla suggests that of the Dryopidæ and the Byrrhidæ. Araeopus seems to be a primitive form, perhaps transitional to the Cleridæ.

Chelonarium (figs. 107, 108) links the Ptilodactylidæ and Byrrhidæ.

Dryopidæ (figs. 112, 113). Areas C and D large and normal, B more or less foreshadowed but only appearing when the wing

is held in a certain position, so that a strain arises between the tip of M and the costal veins, in other positions with most of its area attached to C, as in the figure of *Dryops* (fig. 112). Fold A well marked; apex with a second fold, more or less unsymmetrically placed.

Heteroceridæ (fig. 115). Folding as in the *Dryopidæ*; anal venation reduced.

Mycetophagidæ (figs. 116, 117). Folding as in the *Dryopidæ*, but apparently with area B always insignificant or absent. Second apical fold absent.

Byrrhidæ (figs. 109–111). Similar to *Eubriidæ*, the areas C and D normally even more reduced. Area H typically cut off from inner margin; second apical fold close to apex of wing or absent. Areas B and G represented by small crumples, A obsolete. The difference between this family and the *Nosodendridæ* is parallel to that between the *Eubriidæ* and *Cyphonidæ*, and equally striking. There is at first glance a resemblance in venation between the *Nosodendridæ* and *Byrrhidæ*, but it does not extend to details, and may be the effect of similar body and wing-form. *Limnichus* is more generalized than the typical *Byrrhids*, with the pivot normal, and the principal area not cut off from the inner margin. It can be viewed as transitional to the *Dryopidæ*. *Chelonarium* is intermediate, with normal hinge, but with the first posterior fold crossing the cubital vein.

B

Anal lobe well set off, absent in the *Malachiidæ*. Area H primitively reaching the inner margin, but somewhat narrower, sometimes cut off from the margin by the first dorso-apical area (upright), but with the second (reversed) dorso-apical area never reaching in to Cu, and rarely even with the first dorso-apical area narrowed to the margin. Area B always developed and sometimes a principal fold of the wing, but unlike the *Bostrychoids* in which area B is similarly developed, without a functional first anal fold. This group intergrades imperceptibly with the next two through the *Colydiidæ*, and with the next one through the *Endomychidæ*. In these two families I have discussed individual genera where they would fall according to their folding, but it

would be premature to change their family reference without study of many more forms. It is interesting how the double chitinization at the anal angle, which appears on the two sides of an anal vein in the *Endomychidæ*, remains double in the *Colydiidæ*, and even the *Lathridiidæ* and *Cisidæ*, after all trace of the vein has gone. The *Cryptophagidæ* are a very different type from anything in this series, but as they are equally unlike anything else and have usually been grouped with *Atomaria* they are discussed in group C.

Melyridæ (figs. 122-124). Anal lobe free; area D well developed, and not chitinized. Area H reaching inner margin at a point if at all, B well marked, but not a principal fold. This family seems to be a link with the preceding group and to the *Cleridæ*, as the following attaches to the *Coccinellidæ*. *Astylis* appears aberrant in several points, but I have not seen any material of which I was sure the folds were undisturbed, and may not have interpreted it right.

Malachiidæ (figs. 125, 126). Area D very slender and heavily chitinized, and surrounded with other chitinized areas; B very large and dominating the folding of the wing, the costa curving back as it does in the *Bostrychidæ*. Folding in dorso-apical region more or less complex, with area H not completely cut off from the margin. No anal lobe. Plainly derived from the *Melyridæ* in folding, but correlated with the *Coccinellidæ* in venation. In *Collops* Cu runs transversely to avoid the principal fold, in *Malachus* it is more oblique and the principal fold crosses it not far from the base.

Endomychus (fig. 128). Essentially like the *Melyridæ*, but with a strong double chitinization at the apex of first A, and with the second dorso-apical fold, though somewhat vague, already strongly oblique in toward the apex of Cu.

Ditoma (*Colydiidæ*) (fig. 120). Similar to *Endomychus*, the anal lobe not so well set off; principal and first dorso-apical folds just meeting at the margin, as in the *Cisoid* group, but without the second apical fold of that group, and preserving the anal area. Many *Colydiidæ* are apterous or subapterous (fig. 119).

Monoedidæ (*Adimeridæ*) (fig. 118). *Monoedus guttatus* agrees substantially with *Ditoma* in wing-form and venation, and

has the characteristic double anal chitization of this group, but in the specimen examined the first posterior fold does not meet the hinge. Whether this is an artifact or not the position of the genus can hardly be in doubt next to the *Colydiidæ*. In both these genera the anal lobe is hardly better set off than in the *Mycetophagidæ*.

C

Anal lobe always well developed and free; area C always well developed in forms with clean-cut folding, but in most *Coccinellidæ* lost in a general vagueness of all folds in the central part of the wing; D tending strongly to reduction in size, but usually perfectly distinct; H very small, not nearly reaching the inner margin, which is occupied by a large second reversed area, while the center of the wing is not reversed. Apex frequently of a single upright area, in that case with the upright area in the center of the wing tapering to a point, and the costal and dorsal reversed areas meeting at its tip. I believe this group is homogeneous except for the *Georyssidæ* and *Cryptophagidæ*, which are of quite uncertain position, but not wholly out of place here.

Aphorista (*Endomychidæ*) (fig. 127). Areas C and D well developed, and separated by a well-developed area S. Folds for the most part clean-cut, unlike the similar *Coccinellidæ*.

Mycetaeidæ (*Endomychidæ* ?) (fig. 135). Anal lobe rudimentary or absent. Area C long and slender, without a distinct area B at its end. Areas D and S small. Convex longitudinal fold from lower angle of area H not converging with the concave fold bounding area E, but running out to inner margin; a cross-fold across the apex of the wing cutting both these folds. *Atomaria* (fig. 136) is similar. I do not think these two forms are close either to the *Endomychidæ* or the *Cryptophagidæ*, but they come from the same general stock.

Derodontidæ (figs. 131–133). Areas A, B, C, D, S and H all fairly normal but forming a small group in the center of the wing; outer part of wing more or less definitely divided into two ranks of three areas each by longitudinal concave and convex folds, and a transverse fold, but less symmetrically than in *Mycetaea* and *Atomaria*; with a tendency for the reversed area of the outer rank and the dorsal area of the inner rank to fuse and

obliterate the outer dorsal area; and also with various and unstable smaller folds. Anal lobe small but well marked.

A very distinct family related to the Endomychidæ on one side and the Mycetaeidæ on the other, and probably not far from the ancestor of both. Laricobius hardly differs from Derodontus in folding, but has preserved more anal veins.

Coccinellidæ (figs. 129, 130, 134). Anal lobe free; central part of wing with vague bends rather than definite folds; among them area B is well marked, and at least the basal part of area C is distinct, but S, D and H are usually lost in the general curvature and crumpling. Postmedial part of wing with a triangular upright area between two reversed ones, as in the Endomychidæ, and *simple upright apex*. A rather distinct family type, and difficult to interpret on account of the vagueness of practically all the folding, but the large unfolded apex will distinguish it from most others at a glance. Coccidula is a little less vague, and areas D and S are distinct, but H is still lost in the vague outer folding. There is no difficulty in associating this family with the Endomychidæ, and even less when the venation is also considered (Forbes, '22, fig. 56).

Cryptophagidæ (fig. 137). Four folds converging at hinge, there being a concave one above the usual convex, and the outer part of the costa being swung back 180° on the base without folding under. Area H crossing Cu broadly as in the Haplogastra, and as in that group with the vein itself in a narrow unreversed strip. Anal lobe large, free, areas A and B present, C and D of relatively good size, H well marked off, but very small. Outer part of wing with a transverse fold cutting across three or four longitudinals.

A most anomalous family, thrown out of the Haplogastra, mainly by the preservation of five anals in the main group in some forms (Antherophagus). As the migration of folds on the costa has gone farther than on the inner margin it seems to belong to the general Dryopoid neighborhood, and the small size of areas D, S and H is suggestive of the Derodontidæ. The really fundamental difference from such genera as Atomaria and Laricobius is the appearance of a new longitudinal fold below the costal edge. In the Histeridæ there is a parallel develop-

ment of a new fold along the costa, which explains the concave character of the first costo-apical fold in that group, but it does not there involve the hinge. *Telmatophilus* and *Henoticus* do not differ from *Antherophagus*.

Catopochrotidae (*C. cremastogastris*,—fig. 138). Identical in folding with the true *Cryptophagidae*. The unique folding puts the position of this family (which was originally compared with the *Cryptophagidae*) beyond all doubt.

D

Anal lobe lost; inner margin markedly notched at middle, both sides of area H converging to a point exactly at the notch; areas A and B insignificant or absent, D and S smallish, equal in size and directly superposed in the folded wing; outer part of wing relatively large, transversely folded at the middle, and with or without minor folds. Wing always markedly fringed, but the fringe varying somewhat in development, conspicuous on the costa in the *Corylophidae* only.

This is an obviously homogeneous group, though its members have been widely separated on superficial characters. It is unmistakably derived from the *Colydiidae* and *Endomychidae*, many of the forms showing the characteristic double anal chitinization of these families. The venation is much reduced, but *Cu* avoids the folded areas, and *Cerylon* shows a stub of the median "Strahlader."

Cisidae (figs. 139, 140). Double chitinization present, area C very small and working with more or less distinct crumples in the cell. Notch on inner margin strong.

Murmidiidae (fig. 143). Similar to *Cisidae*.

Lathridiidae (fig. 141). Practically identical with *Cisidae*, but with area C larger, and crumples in cell not obvious. Apex with a third transverse fold (? if always).

Cerylon (fig. 142). Area C exceptionally large; M_1 present as a well-developed stub; chitinization absent.

Corylophidae (figs. 144, 145). Fringes present on outer half of costa as well as near hinge of costa and on inner margin; notch on inner margin less conspicuous than in the preceding forms, but well marked, and with area H extending to it in a point as

usual. Outer part of wing with some indefinite folding, but plainly of the same type as the preceding. This family plainly belongs here and not to the Staphyliniformia.

For clearness the facts here presented may be integrated into the following classification:*

Suborder ARCHOSTEMATA

34. Cupedidæ (Ommatidæ), 38. Micromalthidæ.

Suborder ADEPHAGA

Superfamily *Geadephaga*: 1. Cicindelidæ, 2, 4. Carabidæ (with Omophron), Paussidæ.

Superfamily *Hydradephaga*: A: 6. Bidessus, Hygrobiidæ, 5. Haliplidæ.

B: 6. Dytiscidæ (except Bidessus), 3. Amphizoidæ, 7. Gyridinæ.

C: Cyathoceridæ, 8. Hydroscaphidæ, 27. Sphæriidæ, 13. Clambidæ.

Superfamily *Rhysodoidea*: 67. Rhysodidæ.

Suborder POLYPHAGA

Series *Haplogastra*

Superfamily *Palpicornia*: 8. Hydrophilidæ (except Octhebius group), 59. Georyssidæ (?).

Superfamily *Staphyliniformia*: A: 10. Brathinidæ, 20. Sca-phidiidæ, 12. Silphidæ (s. str.), 16. Staphylinidæ (except Micropeplus), 9. Platypsyllidæ (?) 11. Leptinidæ (?).

B: 8, 12. Lioidæ (with Necrophilus, Prionochæta, Octhebius, etc.), Discolomidæ, 14. Seydmaenidæ, 17, 18, Pselaphidæ, 16. Micropeplus, 19. Ptiliidæ (?).

Superfamily *Histeroidea*: 21. Synteliidæ (with Sphaerites), 23. Histeridæ, 70. Rhizophagidæ, 71. Monotomidæ, 69. Nitidulidæ, Phaenocephalidæ (?), 19. Ptiliidæ (?).

Superfamily *Scarabaeoidea*: 99. Lucanidæ, 100. Passalidæ, 98. Trox, 97. Scarabæidæ.

* The numbers refer to Leng's Catalogue.

Series Bostrychiformia

Superfamily *Dascilloidea*: Artematopus, 60. Macropogon, 60. Dascillus, 50. Rhipiceridæ (s. str.), 54. Schizopini, 64. Dermestes (?), 54. Buprestidæ (?).

Superfamily *Cyphonoidea*: 66, 64. Nosodendridæ (with Anthrenus, Thylodrias, etc.), 54. Mastogenius, 62. Cyphonidæ, 61. Eucinetidæ.

Superfamily *Bostrychoidea*: 92, 93. Bostrychidæ, 94. Lycidæ, 91. Ptinidæ, Ectrephidæ (?), Gnostidæ, 95. Sphindidæ, 81. Corticaria.

Series Diversicornia

Superfamily *Serricornia*: 50. Lichadidæ (with Zenoa and Callirhipis), 48. Cebrionidæ, 49, 51, 52. Elateridæ (with Plastoceridæ, Eucnemidæ, etc.), 53. Throscidæ, 24, 25, 26, 27. Lampyridæ (s. l.), 73. Languriidæ, 31, 32. Lymexylidæ, 72. Cueujidæ (s. str.).

Superfamily *Clavicornia*: Helotidæ, 68. Ostomidæ, 29, 30. Cleridæ, 72. aberrant "Cueujidæ," 73. Erotylidæ, 84. Phalacridæ, Thorictidæ, 54. Buprestidæ (?), 89. Monommidæ (?).

Superfamily *Heteromera*: 87. Tenebrionidæ, Rhysopaussidæ, 90. Melandryidæ, 86. Cistelidæ, 42. Pythidæ, 43. Pyrochroidæ, Trictenotomidæ, 37. Mordellidæ, 38. Rhipiphoridæ, 39. Meloidæ, (110). Stylopidæ, etc., 89. Monommidæ (?).

Superfamily *Phytophaga*: 101. Cerambycidæ (with Spondylidæ), 102. Chrysomelidæ, 103. Bruchidæ, 106. Anthribidæ, 107. Cureulionidæ, 105. Belidæ, 104. Brentidæ, etc.; Aglyeyderidæ (?), Proterrhinidæ (?).

Series Dryopiformia

Superfamily *Dryopoidea*: 60, 61. Ptilodaetylidæ (with Eubria, etc.), 55, 57. Dryopidæ (with Psephenus and Elmis), 63. Chelonariidæ, 58. Heteroceridæ, 65. Byrrhidæ (except Nosodendron), 77. Mycetophagidæ.

Superfamily *Melyroidea*: 28. Melyridæ, 28. Malachiidæ.

Superfamily *Coccinelloidea*: 83. Endomychidæ, 78. Colydiidæ, 80. Monoedidæ, 82, 75. Mycetæidæ (with Atomaria), 74. Dero-

dontidæ (with Laricobius), 85. Coccinellidæ, 75. Cryptophagidæ, Catopochrotidæ.

Superfamily *Cisoidea*: 96. Cisdæ, 81. Lathridiidæ, 79, 78. Murmidiidæ (with Cerylon), 15. Corylophidæ.

Families not available: Phaenocephalidæ, Ectrephidæ, Aglycyderidæ.

Families with no known winged species: Platypsyllidæ, Lep-
tinidæ, Thorictidæ, Proterrhinidæ.

EXPLANATION OF FIGURES

PLATE VII

- Figure 1. Hypothetical venation
Figure 2. *Cupes latreillei*, venation (Cupedidæ)
Figure 3. *Cupes latreillei*, folding (Cupedidæ)
Figure 4. *Micromalthus debilis*, venation and folding (Micromalthidæ)
Figure 5. *Cicindela sexguttata*, venation (Cicindelidæ)
Figure 6. *Cicindela sexguttata*, folding
Figure 7. *Calosoma peregrinatus* (Carabidæ)
Figure 8. *Brachinus fumans*, venation (Carabidæ)
Figure 9. *Brachinus fumans*, folding (Carabidæ)
Figure 10. *Paussus hova*, venation (Paussidæ)
Figure 11. *Paussus hova*, folding (Paussidæ)
Figure 12. *Paussus cervinus*, folding (Paussidæ)

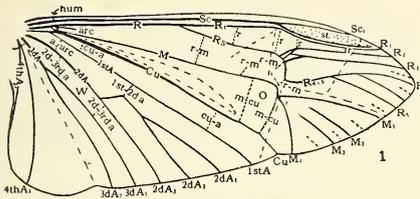
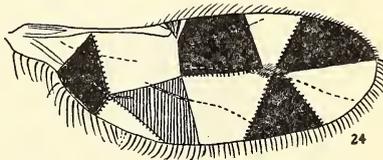
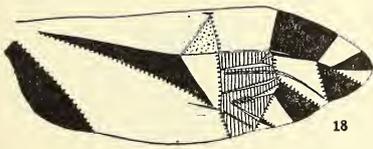
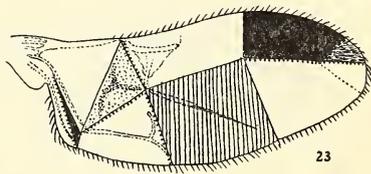
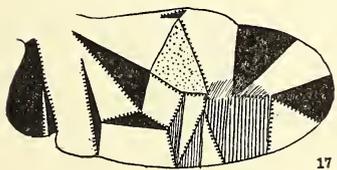
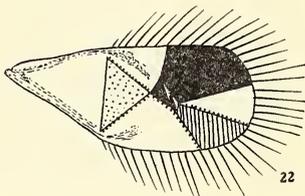
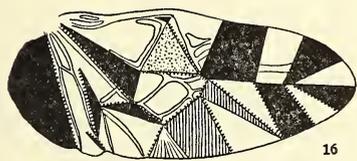
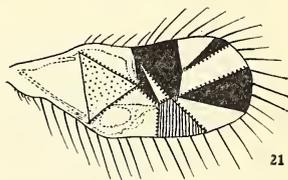
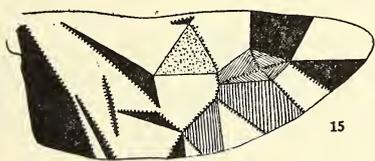
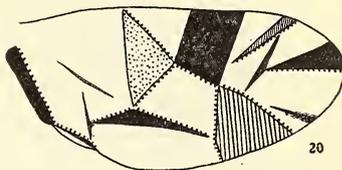
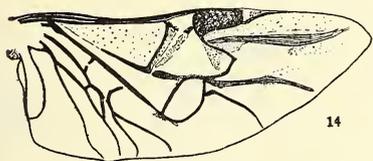
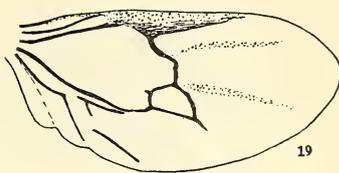
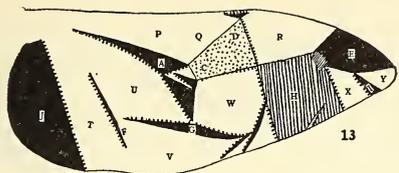


PLATE VIII

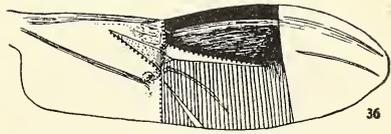
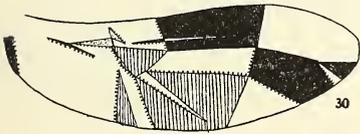
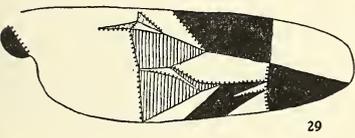
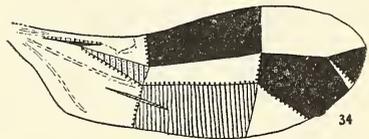
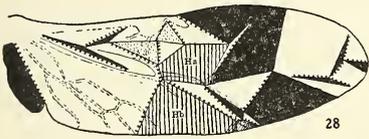
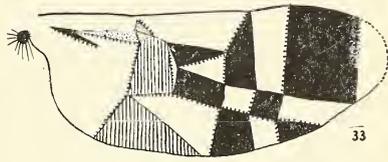
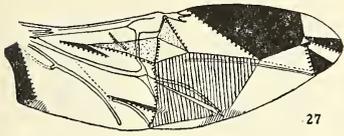
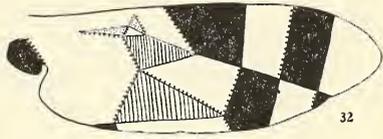
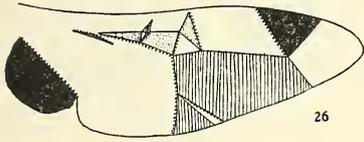
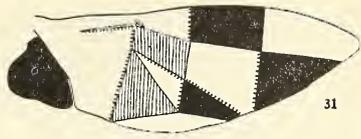
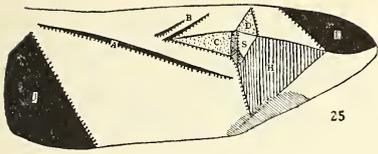
- Figure 13. *Dineutes* sp., folding (Gyrinidæ)
Figure 14. *Hygrobia tarda*, venation (Hygrobiiidæ)
Figure 15. *Hygrobia tarda*, folding (Hygrobiiidæ)
Figure 16. *Peltoodytes* sp. (Haliplidæ)
Figure 17. *Bidessus affinis* ("Dytiscidæ")
Figure 18. *Rhysodes exaratus* (Rhysodidæ)
Figure 19. *Cyathocerus horni* ?, venation (Cyathoceridæ)
Figure 20. *Cyathocerus horni* ?, folding
Figure 21. *Sphaerius acaroides* (Sphaeriidæ)
Figure 22. *Hydroscapha* sp. (Hydroscaphidæ)
Figure 23. *Calyptomeris alpestris* (Clambidæ)
Figure 24. *Clambus armadillus* (Clambidæ)



WING FOLDING

PLATE IX

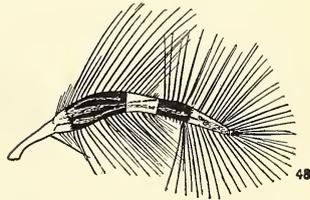
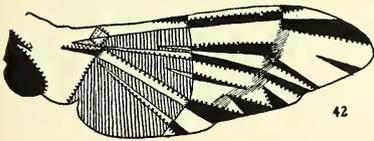
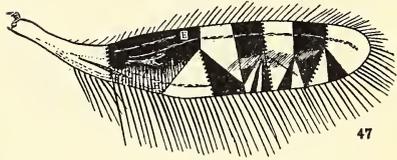
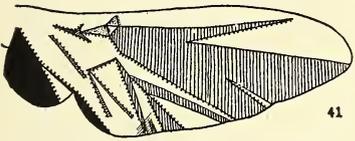
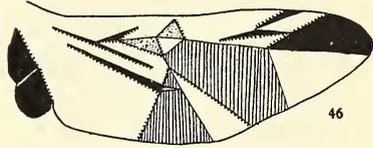
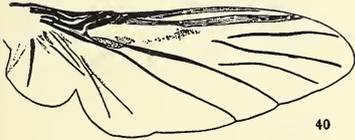
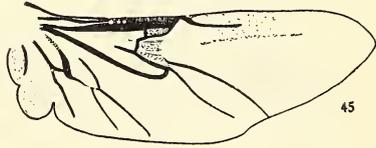
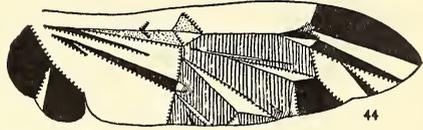
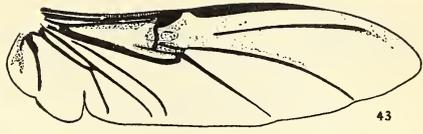
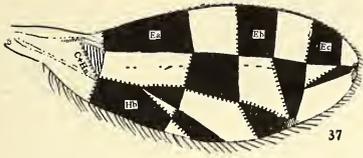
- Figure 25. *Hydrocharis obtusatus* (Hydrophilidæ)
Figure 26. *Sphæridium scarabæoides* (Hydrophilidæ)
Figure 27. *Cercyon hæmorrhoidalis* (Hydrophilidæ)
Figure 28. *Helophorus lineatus* ? (Hydrophilidæ)
Figure 29. *Brathinus nitidus* (Brathinidæ)
Figure 30. *Scaphidium quadriguttatum* (Scaphidiidæ)
Figure 31. *Staphylinus* or *Creophilus* sp. (Staphylinidæ)
Figure 32. *Geodromicus plagiatus* (Staphylinidæ)
Figure 33. *Anthobium sorbi* (Staphylinidæ)
Figure 34. *Octhebius* sp. (Lioididæ)
Figure 35. *Anisotoma rubiginosa* (Lioididæ)
Figure 36. *Discoloma vestita* (Discolomidæ)



WING FOLDING

PLATE X

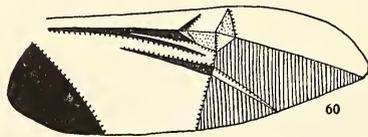
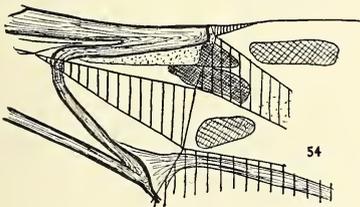
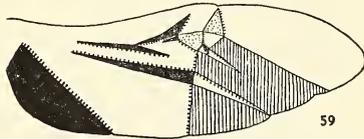
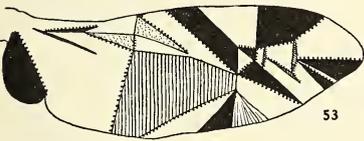
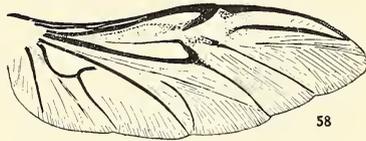
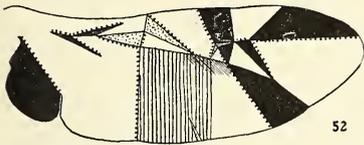
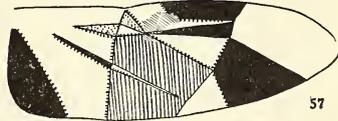
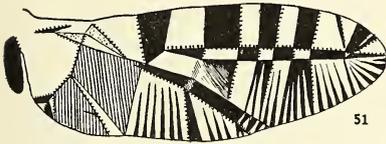
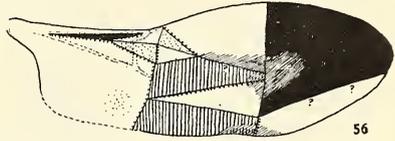
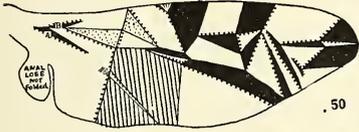
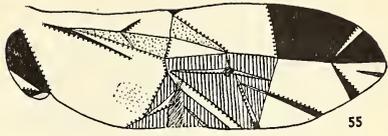
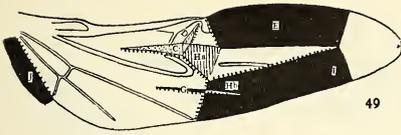
- Figure 37. *Scydmaenus claviger* (Scydmaenidæ)
Figure 38. *Pilopius* sp. (Pselaphidæ)
Figure 39. *Micropeplus brunneus* (Micropeplidæ)
Figure 40. *Saprinus assimilis*, venation (Histeridæ)
Figure 41. *Saprinus lugens*, folding (Histeridæ)
Figure 42. *Hister depurator* (Histeridæ)
Figure 43. *Syntelia histeroides*, venation (Synteliidæ)
Figure 44. *Syntelia histeroides*, folding (Synteliidæ)
Figure 45. *Sphærites glabratus*, venation (Synteliidæ)
Figure 46. *Sphærites glabratus*, folding (Synteliidæ)
Figure 47. *Nossidium* sp. (Ptiliidæ)
Figure 48. *Acratrichis* (Trichopteryx) sp. (Ptiliidæ)



WING FOLDING

PLATE XI

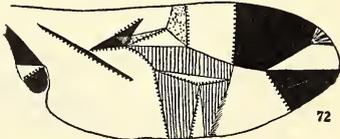
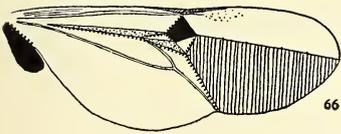
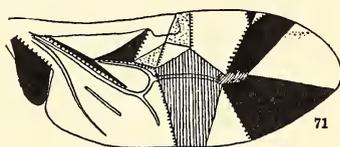
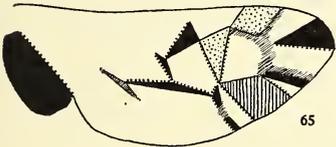
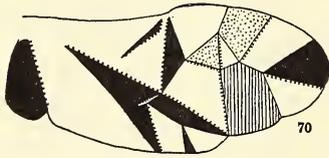
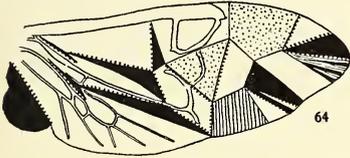
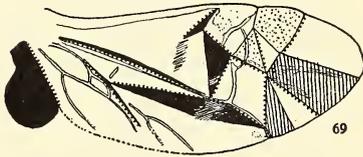
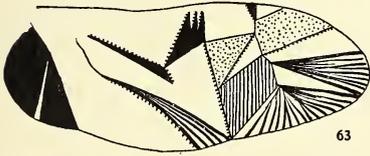
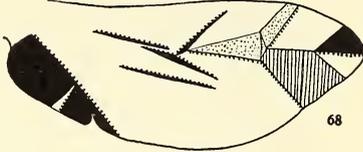
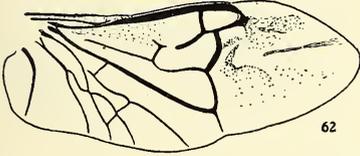
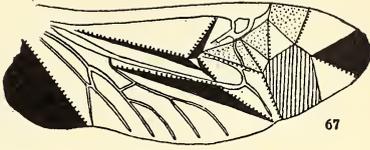
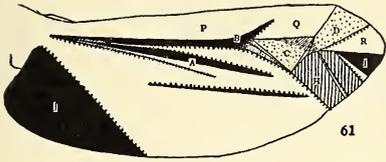
- Figure 49. *Georyssus californicus* (Georyssidæ)
Figure 50. *Amartus rufipes* (Nitidulidæ)
Figure 51. *Colopterus truncatus* (Nitidulidæ)
Figure 52. *Camptodes vittatus* (Nitidulidæ)
Figure 53. *Phenolia grossa* (Nitidulidæ)
Figure 54. *Phenolia grossa*, detail of hinge
Figure 55. *Rhizophagus politus*, folding (Rhizophagidæ)
Figure 56. *Hesperobaenus abbreviatus* (Monotomidæ)
Figure 57. *Monotoma picipes* (Monotomidæ), incompletely worked out
Figure 58. *Lachnosterna* sp., venation (Scarabæidæ)
Figure 59. *Lachnosterna fusca*, folding (Scarabæidæ)
Figure 60. *Osmoderma*, folding (Scarabæidæ)



WING FOLDING

PLATE XII

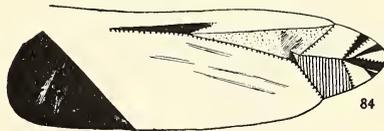
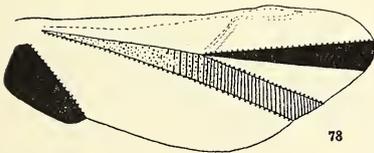
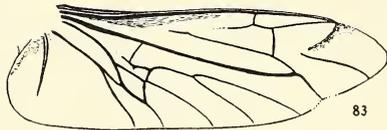
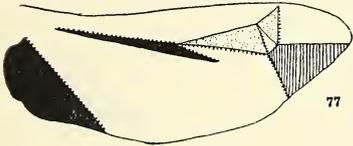
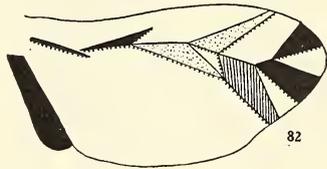
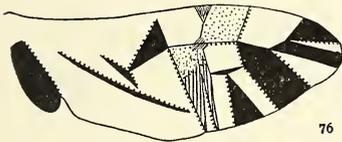
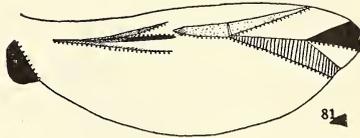
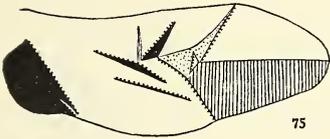
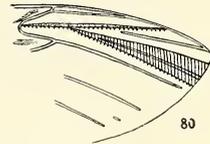
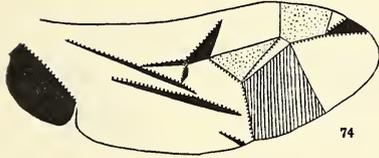
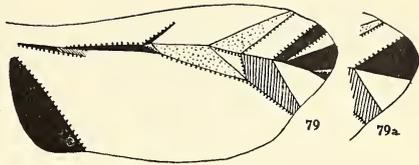
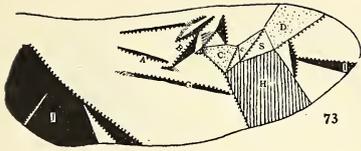
- Figure 61. *Dascillus davidsoni* (Dascillidæ)
Figure 62. *Artematopus* sp. from Peru, venation (Artematopidæ)
Figure 63. *Artematopus* sp. from Peru, folding (Artematopidæ)
Figure 64. *Nosodendron fasciculare* (Nosodendridæ)
Figure 65. *Anthrenus* sp. ("Dermestidæ")
Figure 66. *Thylotrias contractus* ("Dermestidæ")
Figure 67. *Megatoma undata* ("Dermestidæ")
Figure 68. *Attagenus* sp. ("Dermestidæ")
Figure 69. *Eucinetus meridionalis* (Eucinetidæ)
Figure 70. *Cyphon variabilis* (Cyphonidæ)
Figure 71. *Sphindus americanus* (Sphindidæ)
Figure 72. *Corticaria transversalis* (Sphindidæ ?)



WING FOLDING

PLATE XIII

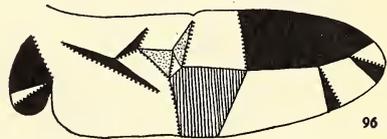
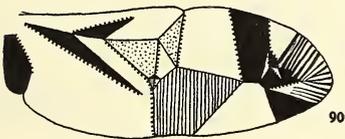
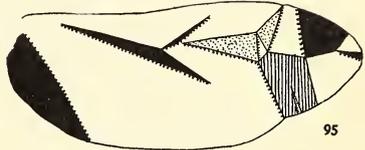
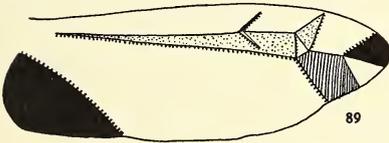
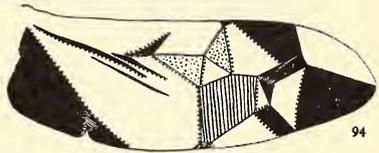
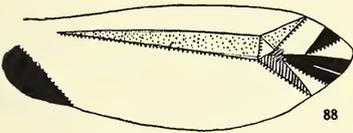
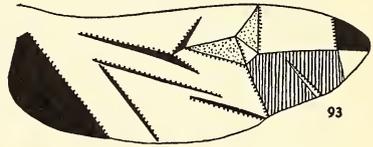
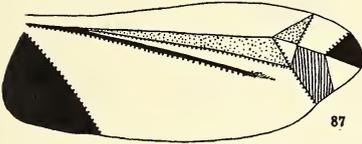
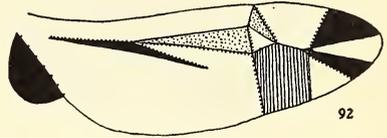
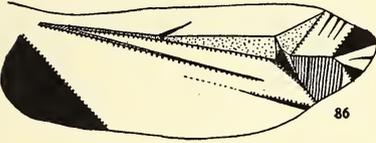
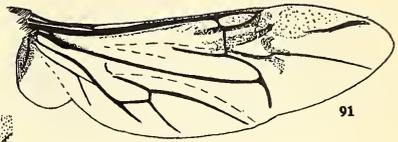
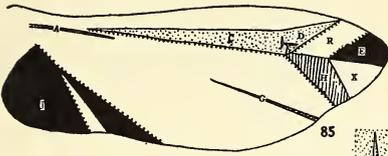
- Figure 73. *Bostrychidæ*, undetermined species from Diamantina, Brazil
Figure 74. *Lyctus striatus* (Lyctidæ)
Figure 75. *Endecatomois rugosus* (family ?)
Figure 76. *Sitodrepa panicea* (Ptinidæ)
Figure 77. *Dermestes* sp. (Dermestidæ)
Figure 78. *Telegeusis debilis* (Telegeusidæ)
Figure 79. *Eupristocerus cogitans* (Buprestidæ). Left wing and apex
of right wing.
Figure 80. *Sternocera* sp. (Buprestidæ). Apex of wing.
Figure 81. *Acmæodera* sp. (Buprestidæ)
Figure 82. *Brachys ovata* (Buprestidæ)
Figure 83. *Lichas subocellata*, venation (Lichadidæ)
Figure 84. *Lichas subocellata*, folding (Lichadidæ)



WING FOLDING

PLATE XIV

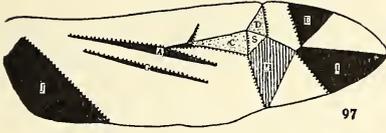
- Figure 85. *Cebrio* sp., folding and detail of hinge (Cebrionidæ)
Figure 86. *Ludius* sp. (Elateridæ)
Figure 87. *Telephorus* sp. (Lampyridæ, Telephorinæ)
Figure 88. *Languria* (*Acropteroxys*) *gracilis* (Languriidæ). In L.
(L.) *mozardi* the apical folds are more numerous and
radiate fan-like.
Figure 89. *Cucujus clavipes* (Cucujidæ)
Figure 90. *Laemophlaeus fasciatus* ("Cucujidæ")
Figure 91. *Helota vigorsi*, venation (Helotidæ)
Figure 92. *Helota vigorsi*, folding (Helotidæ)
Figure 93. *Clerus mutillarius* (Cleridæ)
Figure 94. *Necrobia rufipes* (Cleridæ)
Figure 95. *Megalodacne fasciata* (Erotylidæ)
Figure 96. *Phalacrus* sp. from Wyoming (Phalacridæ)



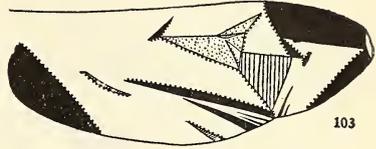
WING FOLDING

PLATE XV

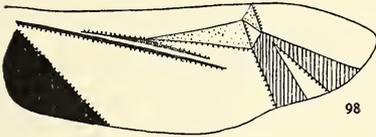
- Figure 97. *Trogosita virescens* (Ostomidæ)
Figure 98. *Cyllene* sp. (Cerambycidæ)
Figure 99. *Zeugophora kirbyi* (Chrysomelidæ)
Figure 100. *Platystoma labinus* (Anthribidæ)
Figure 101. *Dæmon fuscicollis*, venation (Ptilodaetylidæ)
Figure 102. *Dæmon fuscicollis*, folding (Ptilodaetylidæ)
Figure 103. *Anchytarsus bicolor* (Ptilodaetylidæ)
Figure 104. *Ptilodaetyla serricornis* (Ptilodaetylidæ)
Figure 105. *Placonycha edwardsii* (Ptilodaetylidæ ?)
Figure 106. *Eubria palustris* (Ptilodaetylidæ)
Figure 107. *Chelonarium ornatum*, venation (Chelonariidæ)
Figure 108. *Chelonarium ornatum*, folding (Chelonariidæ)



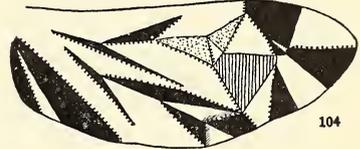
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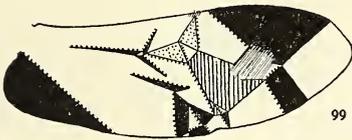
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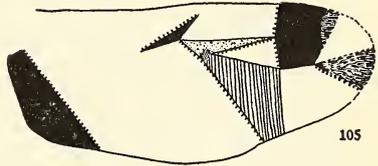
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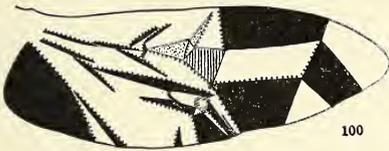
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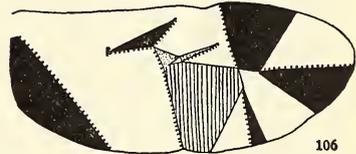
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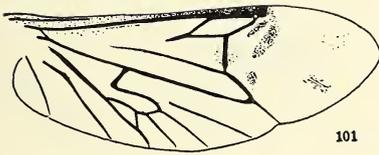
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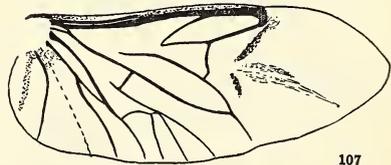
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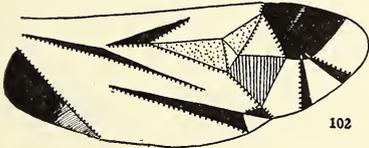
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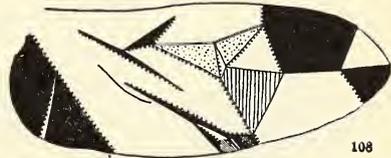
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107



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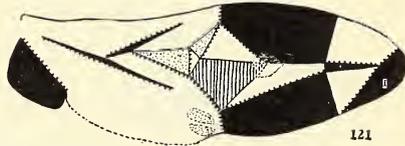
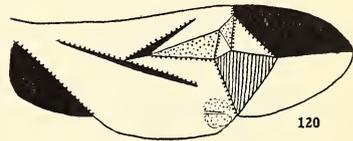
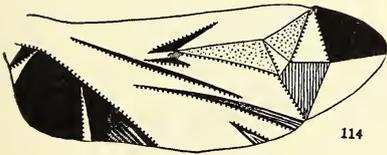
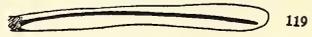
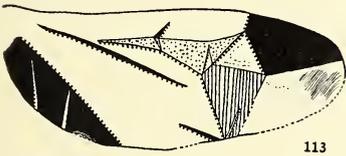
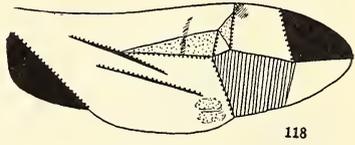
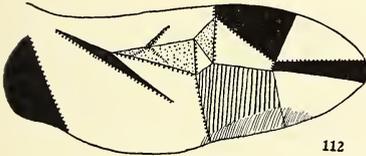
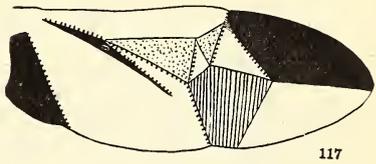
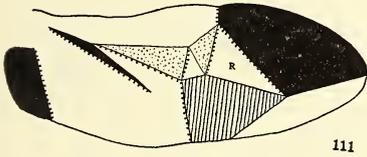
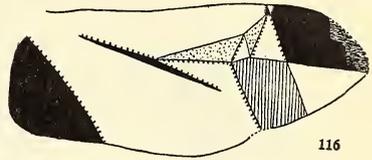
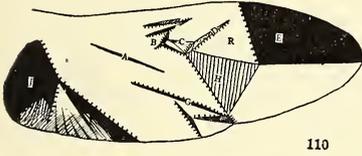
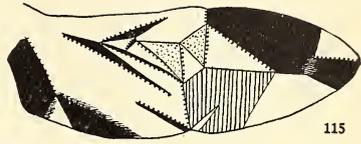
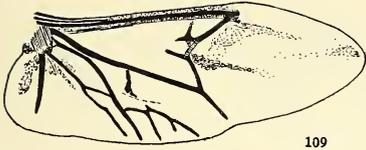


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WING FOLDING

PLATE XVI

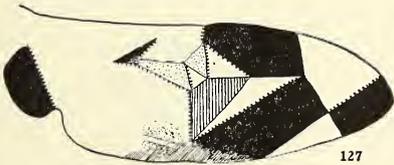
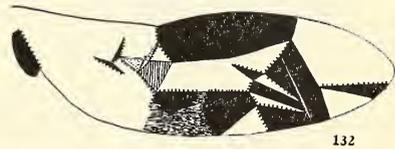
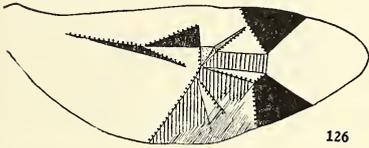
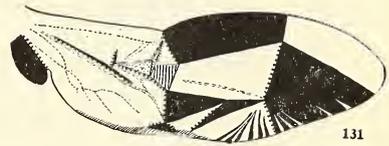
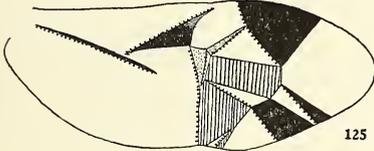
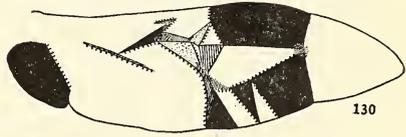
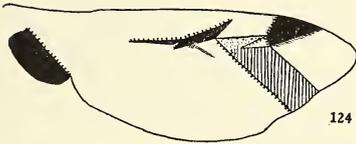
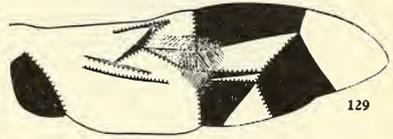
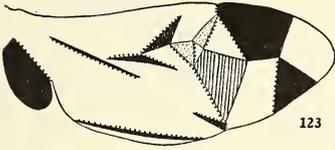
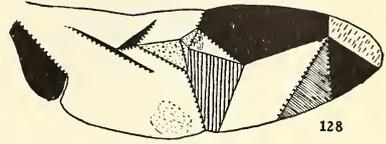
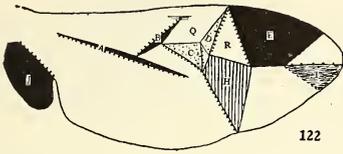
- Figure 109. *Cytilus* sp., venation (Byrrhidæ)
Figure 110. *Cytilus* sp., folding (Byrrhidæ)
Figure 111. *Limnichus* sp. (Byrrhidæ)
Figure 112. *Dryops lithophilus* (Dryopidæ)
Figure 113. *Psephenus lecontei* (Dryopidæ)
Figure 114. *Araeopus monachus* (family ?)
Figure 115. *Heterocerus guttatus* (Heteroceridæ)
Figure 116. *Mycetophagus punctatus* (Mycetophagidæ)
Figure 117. *Litargus bifasciatus* (Mycetophagidæ)
Figure 118. *Monoedus guttatus* (Monoedidæ)
Figure 119. *Cozelus pictus*, rudimentary wing (Colydiidæ)
Figure 120. *Ditoma quadriguttata* (Colydiidæ)
Figure 121. *Oxylaemus californicus* (Colydiidæ)



WING FOLDING

PLATE XVII

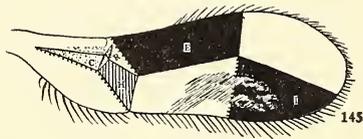
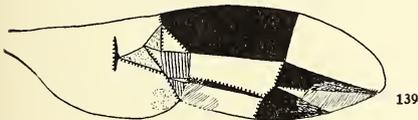
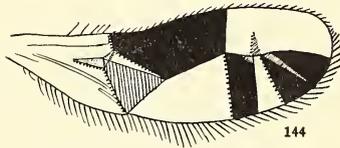
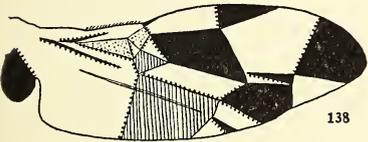
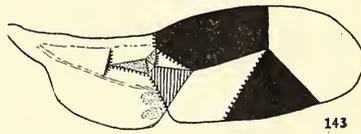
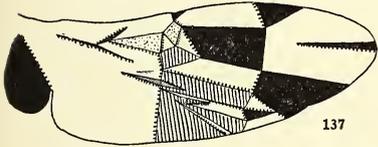
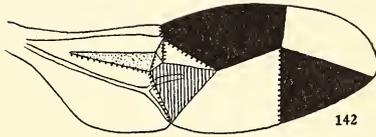
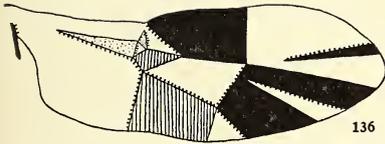
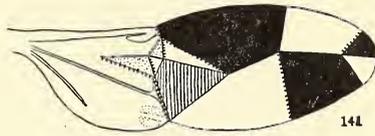
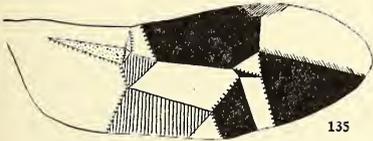
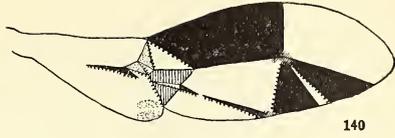
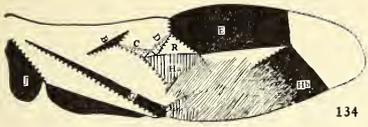
- Figure 122. *Pristocelis antennatus* (Melyridæ)
Figure 123. *Listrus* sp. (Melyridæ)
Figure 124. *Astylis trifasciatus* (Melyridæ)
Figure 125. *Collops quadrimaculatus* (Malachiidæ)
Figure 126. *Malachius* sp. (Malachiidæ)
Figure 127. *Aphorista vittata* (Endomychidæ)
Figure 128. *Endomychus biguttatus* (Endomychidæ)
Figure 129. *Epilachna borealis* (Coccinellidæ)
Figure 130. *Anatis 15-punctata* (Coccinellidæ)
Figure 131. *Laricobius erichsoni* (Derodontidæ)
Figure 132. *Derodontus maculatus*, left wing (Derodontidæ)
Figure 133. Right wing of same specimen, showing variation in detail



WING FOLDING

PLATE XVIII

- Figure 134. *Coccidula scutellata* (Endomychidæ)
Figure 135. *Rhaxis unicolor* (Mycetaeidæ)
Figure 136. *Atomaria ephippiata* (Mycetaeidæ)
Figure 137. *Antherophagus pallens* (Cryptophagidæ)
Figure 138. *Catopochrota crematogastri* (Catopochrotidæ)
Figure 139. *Cis boleti* (Cisidæ)
Figure 140. *Octotemnus laevis* (Cisidæ)
Figure 141. *Lathridius minutus* (Lathridiidæ)
Figure 142. *Cerylon histeroides* (family ?)
Figure 143. *Myhocerus depressus* (Murmidiidæ)
Figure 144. *Sericoderus lateralis* (Corylophidæ)
Figure 145. *Orthoperus scutellaris* (Corylophidæ)



WING FOLDING

NOTES ON NEOTROPICAL EUPTERYGINAE, WITH
A KEY TO THE VARIETIES OF ALEBRA ALBO-
STRIELLA (HOMOPTERA: JASSIDAE)

BY W. L. McATEE

The definition of a segregate of Eupterygine leafhoppers is made more difficult than hitherto supposed by vagaries in characters of some of the neotropical forms. The confluence of sectors or their juncture by crossveins anterior to the usual apical cells break down what has long been considered the best character for separation of a subfamily Eupteryginæ. Some of the collateral characters also have been robbed of part of their significance by the discovery of intermediate phases, so that we now seem reduced to the following relative and qualified statements for a definition of the group. Sectors of tegmen usually evanescent basally, no forks or crossveins discernible in that part of tegmen; crossveins or anastomosing of sectors usually lacking also on disk of tegmen; antepical cells rarely present; claval veins usually indistinguishable, the full complement never (?) visible; ocelli usually lacking, when present, close to eyes (less than their own diameters from front margins of eyes).

Other Jassidæ by contrast have the venation usually distinct at base of tegmen, including forks, or crossveins, or both; usually antepical cells are present, and the full complement of claval veins visible; ocelli are usually present also. The Jassidæ are otherwise distinguished from the remaining Jassoidea by the vertex not being distinctly marked off from the front by a sutural line or carina; by the ocelli, when present, being situated on the transition from crown to face, and by the lateral sutural lines (or their rudiments) bounding the frons being directed toward the ocelli or the ocellar positions.

The material reported upon in the present paper is chiefly from the collection of the United States National Museum; but numerous specimens from the University of Kansas collection and from that of the writer also have been available. Mr. J. G.

Myers was kind enough to make a special effort to collect Eupteryginæ on his trip to Cuba in the early months of 1925. Types of new species from his material will be deposited in the Museum of Comparative Zoology, Cambridge, Mass. The location of types is shown by name of the collection, or abbreviation, in parentheses after the locality records.

TRIBE ALEBRINI

Alebrini are Eupteryginæ, having an appendix to the tegmen

KEY TO THE GENERA

1. Appendix distinctly prolonged around apex of tegmen; submarginal vein distinctly within the margin of hind wing; tegmen with four apical, and no antepical cells (Fig. 1).....*Alebra* Fieber
- Appendix not prolonged around apex of tegmen; submarginal vein on the margin of hind wing, tegmen with 4, or 3 apical cells, and sometimes with antepical cells (Figs. 2-6).....*Protalebra* Baker

GENUS ALEBRA FIEBER

1. Vertex distinctly longer in middle than at inner border of eye..... 2
Vertex of about the same length at all points between eyes
albostriella Fallén
2. "Tegment yellowish hyaline on outer half, the inner half and entire apex deep smoky"*dorsalis* Gillette
Tegmen pale yellowish with two oblique vittæ and crossveins red; apical cells smoky with a single transparent spot in each
sanguinolinea Baker

Alebra albostriella Fallén.

C[icada] albostriella Fallén, C. F., Hemiptera Sueciae, I Cicadaria, 1826, p. 54 [Ostrogothia]. Oshanin and Van Duzee agree in dating this publication 1826. The copy or edition I have seen is dated 1829.

Examinations of the genitalia I have made indicate that there is only one species of *Alebra* with short vertex, and that common to the Old and New Worlds. I am treating the described forms, therefore, as color varieties. Venation as in Fig. 1.

Occurs throughout Europe, in Asia Minor, northern Africa, southern Canada, and the eastern United States.

KEY TO THE COLOR VARIETIES

1. Without dark markings above, other than duskieness of apical cells..... 2
With dark markings above..... 8

2. Lacking distinct yellow or red markings, the extreme margins of tegmen sometimes tinged with yellow..... 3
 With more or less pronounced yellow or red markings above..... 4
3. Apical cells hyaline or only slightly fumose.....*pallidula* Walsh
 Tegmen from just anterior to crossveins to apex, solid deep smoky
tincta new variety
4. Color markings in the form of vittæ..... 5
 Color markings covering tegmina..... 6
5. (Three alternatives.) Pronotum with one, tegmen with two, yellow vittæ, one along each margin.....*agresta* new variety
 Pronotum with two, tegmen with two, red vittæ, the costa yellow
insigita new variety
 Pronotum with two, tegmen with three, yellow vittæ
albostriella Fallén
6. Tegmen anterior to apical cells yellow to orange..... 7
 Tegmen deep smoky.....*fumida* Gillette
7. Head yellow to orange.....*fulveola* Herrich-Schaeffer
 Head bright red.....*rubrafrons* DeLong
8. Lacking saddle spot or crossband near middle of tegmen..... 9
 With a saddle spot or crossband near middle of tegmen.....10
9. Thorax with two transverse dark dots on its anterior submargin
binotata Walsh
 Disk of scutellum dusky.....*scopa* new variety
10. A distinct dusky band across middle of tegmen, and another covering apical cells.....*bicincta* DeLong
 Vertex, pronotum, and scutellum with a common dusky spot, and tegmina with a saddle spot or crossband at middle
discicollis Herrich-Schaeffer

***Alebra albostriella* var. *pallidula* Walsh.**

Typhlocyba pallidula Walsh, Benj. D., Prairie Farmer, 10, No. 10, Sept. 6, 1862, p. 149 [Southern Illinois].

Alebra eburnea DeLong, D. M., Ohio Journ. Sci., 18, No. 7, May, 1918, pp. 241-242, figs. 4, c, d [Covington, Tenn.].

Common in the vicinity of Washington, D. C.; have seen specimens also from Massachusetts, New York, Illinois, Missouri, and Kansas.

***Alebra albostriella* var. *tincta* new variety.**

Pale golden yellowish, the tegmina shining, and a little deeper yellow along margins, the apex to slightly anterior to crossveins uniform smoky. Length 3 mm.

Holotype male, Douglas County, Kansas, 7. 9. 1924, P. B. Lawson (Kans. Univ.).

Alebra albostriella var. **agresta** new variety.

Vertex and pronotum washed medianly with golden yellow, tegmen with a broad band of same color along each margin anterior to crossveins, the apical cells more or less fumose. Length 4 mm.

Holotype and paratype female, Odenton, Md., July 20, 1917, on *Castanea dentata* W. L. McAtee (McAtee). Other paratypes: Odenton, Md., July 4, 1913, July 12, 1914, July 14, 1918, on hickory; Beltsville, Md., Aug. 14, 1914, July 4, 1915, June 23, 1918, on *Quercus alba*; Maywood, Va., June 9, 1921; Glencarlynn to mouth of Four-mile Run, Va., Sept. 27, 1914, W. L. McAtee (McAtee).

Douglas Co., Kans., Aug., 1923, W. Robinson; 7. 9. 1924, P. B. Lawson; Leavenworth Co., Kans., 7. 1. 24, R. H. Beamer (Kans. Univ.).

Specimens not typical enough to be made paratypes further represent the preceding localities, and also Washington, D. C., and Wyandotte County, Kans.

Alebra albostriella var. **albostriella** Fallén.

Bibliographic reference same as for species.

C[icada] elegantula Zetterstedt, J. W., Fauna Insectorum Lapponica, I, 1828, p. 536 [Lapponica].

T[yphlocyba] eximia Hardy, James, Trans. Tyneside Naturalists' Field Club, I, 1850, p. 417 [Derwent River, England].

Does not seem to be so common in this country as either vars. *agresta* or *fulveola*; specimens at hand were collected at Washington, D. C.; Odenton, Md., and Four-mile Run, Va. (McAtee).

Alebra albostriella var. **insignita** new variety.

Vertex, pronotum, and scutellum with two broad vittæ, showing some tendency to fuse, clavus except narrow outer margin, and broad vitta from near base of tegmen to crossveins exterior to claval suture, bright red; costa broadly yellow; apical cells and spots anterior to crossveins smoky. Length, 4.5 mm.

Holotype, Palmord Green, England, Oct. 29, 1915. E. A. Butler (McAtee).

Alebra albostriella var. **fulveola** Herrich-Schaeffer.

Typhlocyba fulveola Herrich-Schaeffer, G. A. W., Faunae Insectorum Germaniae, No. 165, 16, 1839. This reference not personally verified.

Typhlocyba aurea Walsh, Benj. D., Prairie Farmer, 10, No. 10, Sept. 6, 1862, p. 149 [Rock Island, Ill.].

Alebra flavocephala Kupka, Ent. Nachr., 25, Nos. 3-4, Feb., 1899, pp. 33-34 [Halle, Germany].

Specimens are at hand from New York, Maryland, District of Columbia, Virginia, Illinois, Minnesota, and Kansas.

***Alebra albostriella* var. *rubrafrons* DeLong.**

Alebra albostriella var. *rubrafrons* DeLong, D. M., Ohio Journ. Sci., 18, No. 7, May, 1918, p. 240 [Clarksville, Tenn.].

Apparently not otherwise recorded.

***Alebra albostriella* var. *fumida* Gillette.**

Alebra fumida Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, pp. 714-715, figs. 10-12 [Ithaca, N. Y.].

Specimens are at hand from Minnesota and Kansas; it has been recorded also from Tennessee.

***Alebra albostriella* var. *binotata* Walsh.**

Typhlocyba binotata Walsh, Benj. D., Prairie Farmer, 10, No. 10, Sept. 6, 1862, p. 149 [Rock Island, Ill.].

This form like others of Walsh's species with the "elytra bordered by a vein on the inner terminal margin" is ranged under *Alebra albostriella*. However, it has not been rediscovered and its exact identity is in doubt.

***Alebra albostriella* var. *scopa* new variety.**

Shining stramineous with pale golden reflections, a quadrate blackish spot on base of disk of scutellum. Length, 4 mm.

Holotype female, Leavenworth County, Kans., June 30, 1924, R. H. Beamer (Kans. Univ.).

***Alebra albostriella* var. *bicincta* DeLong.**

Alebra bicincta DeLong, D. M., Ohio Journ. Sci., 18, No. 7, pp. 240-241, figs. 4a, b [Clarksville, Tenn.].

Coloration as in var. *agresta*, overlaid by two broad dusky crossbands, one just back of apex of scutellum, the other covering apical cells and a narrow area anterior to crossveins. May be a distinct species but no male is available for examination of the genitalia. A specimen from DuBois, Ill., Aug. 9, 1917, is one of

several collected by J. R. Malloch. One examined also from Raravis, Miss., July 5, 1921, Carl J. Drake.

***Alebra albostriella* var. *discicollis* Herrich-Schaeffer.**

Typhlocyba discicollis Herrich-Schaeffer, G. A. W., Faunae Insectorum Germaniae, No. 124, 8, date?. This work not available; but the date is prior to that of the following.

Typhlocyba (Cicadula Zett.) *wahlbergi* Boheman, Carl H., Öfv. Kgl. Vet.-Akad. Forh. 2, No. 6, 1845, p. 160 [Sweden].

Specimens at hand are from Falls Church, Va. (June 9, N. Banks), and Washington, D. C. In June of both 1924 and 1925, some Japanese maples in Washington parks, heavily infested with the species, yielded a considerable proportion of this variety, which rarely was seen on other trees attacked.

If *Eupteryx fasciata* Curtis (British Entomology, 14, 1837, Fasc. 640 [p. 2]) is assignable as a variety of *Alebra albostriella* its position would be near *discicollis* to which it would bear the same relation as var. *insignita* does to var. *albostriella*. However, the reference is doubtful as *E. fasciata* is placed by Curtis in a group with the "face elongated," not a good description of *albostriella*.

***Alebra dorsalis* Gillette.**

Alebra dorsalis Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 713 [Chapada, Brazil].

The type seen (U. S. N. M.).

Species not seen.

Alebra sanguinolinea Baker, C. F., Invertebrata Pacifica, 1, pp. 5-6, Sept. 15, 1903 [San Marcos, Nicaragua].

Alebra terminalis Osborn, H., Ann. Carnegie Museum, 15, No. 4, Aug., 1924, p. 451 [Province del Sara, Bolivia].

GENUS PROTALEBRA BAKER

KEY TO THE SUBGENERA

1. Sectors of tegmen straight, traversing the color pattern, apical cells four, anteapical cells none (Fig. 2); venation of wing much as in *Alebra* (Fig. 1) *Protalebra* Baker
- Sectors of tegmen more or less curved conforming to the color pattern2

- 2. Four apical* and one or two anteapical cells present.....3
 Less than four apical, and no anteapical cells present.....4
- 3. With two anteapical cells, one formed by confluence of first and second sectors, the other by a distinct crossvein between second and third sectors; marginal vein of hind wing lacking a fork near middle of radial margin (Fig. 3).....*Plagalebra* new subgenus
 With a single nearly or entirely closed anteapical cell formed by convergence or confluence of first and second sectors (Fig. 4); marginal vein of hind wing with a fork near middle or radial margin, as in *Alebra* (Fig. 1) and in fact all the other subgenera here keyed
Paralebra new subgenus
- 4. Reduction to three anteapical cells due to incompleteness of first (costal) cell; first sector indistinguishable, second and third united in a stalk anterior to crossveins (Fig. 6).....*Aphanalebra* new subgenus
 Reduction to three anteapical cells apparently due to suppression of second; all sectors traceable, no stalk anterior to crossveins (Fig. 5)
Kallebra new subgenus

SUBGENUS PROTALEBRA BAKER

- 1. Fourth apical cell broader at base than elsewhere, its costad margin introrsely angulate, the cell stubbily L-shaped, inclosing at the angle a conspicuous black dot; a larger black spot in first apical cell; corium with 4 dark lines which converge posteriorly
octolineata Baker
 Fourth apical cell narrow at base, its costad margin extrorsely angulate2
- 2. Principal color marking of tegmen a pale vitta which runs from middle of clavus to costa and thence posteriorly and inwardly to base of fourth apical cell.....3
 Lacking such a vitta.....4
- 3. Pronotum yellowish anteriorly, whitish posteriorly, curved pale vitta of tegmen reaching radial margin at apex of clavus, and sending a branch to second apical cell.....*curvilinea* Gillette
 Pronotum chiefly whitish, yellowish spotting on disk and reddish edging laterally; curved pale vitta terminating at inner part of base of fourth apical cell.....*vexillifera* Baker
- 4. Tegmen with its chief markings essentially transverse.....5
 Tegmen with its chief markings otherwise.....6
- 5. Tegmen with a broad dusky band at base, and another over crossveins
bifasciata Gillette
 Tegmen with four deeply wavy transverse yellow lines.....*terminata* Baker
- 6. Color pattern of tegmen consisting chiefly of spots along radial margin, the costal side mostly clear.....7

* Crossvein forming base of first or costal apical cell occasionally is obsolete, apparently in any of the Eupteryginae.

- Color pattern otherwise.....8
7. A dark dot on middle of radial margin and one at apex of clavus; another just exterior to latter on corium, and a faint dusky band across apical cells.....*trimaculata* Gillette
Clavus with a large reddish, and corium with two yellowish, blotches near radial margin; apical cells chiefly dusky; scutellum dark subapically, white apically; a dark dot near base of tegmen
amoena Baker
8. Pronotum, scutellum, and apical cells chiefly dusky with whitish or hyaline spots, clavus with a curved longitudinal vitta bordering radial margin, and corium with a broad oblique band from costal plaque tapering near base of fourth apical cell, dusky, similarly interrupted by clear spots.....*brasiliensis* Baker
Coloration otherwise.....9
9. Tegmen dusky with orange-red costal region, a similarly colored oblique mark on clavus, and one on corium just exterior to it; narrow whitish crossband on fourth crossvein, and another across apical cell
robusta Gillette
Tegmen whitish with oblique golden-yellow vittæ on basal half and a lemon-yellow one bordered with dusky across apical cells
nexa new species

Protalebra (Protalebra) octolineata Baker.

Protalebra octolineata Baker, C. F., Invertebrata Pacifica, 1, p. 7, Sept. 15, 1903 [Nicaragua; Guatemala].

Outer claspers of male with numerous long pale bristles, especially basally. Specimens are at hand from: Grenada, H. H. Smith; La Ceiba, Honduras, F. J. Dyer, and Ancon, Canal Zone, May 12, 1911, A. H. Jennings (U. S. N. M.). The latter specimen (somewhat damaged) may represent another species, but for the present it may be placed as a variety of *Protalebra octolineata*, namely, var. *signata* n. var. The costal dark stripe is lacking in this form, the costal section of tegmen is pale brownish yellow; the part between the pair of discal stripes is white, as is also the costa apically and the top of head and pronotum; the lateral color vittæ on pronotum are orange red, the median one dusky. Van Duzee records this species from Jamaica.

Protalebra (Protalebra) curvilinea Gillette.

Alebra curvilinea Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, pp. 710-711, fig. 1 [Chapada, Brazil].

The original specimens have been examined; the outer claspers of male and ovipositor sheaths of female each have a row of sev-

eral bristles, two of which in the middle are dark, the others pale.

Protalebra (Protalebra) vexillifera Baker.

Protalebra vexillifera Baker, C. F., Psyche, 8, p. 404, Sept., 1899 [Chapada, Brazil].

One female and two males from the type material. The outer claspers and ovipositor sheaths each have a row of pale bristles.

Protalebra (Protalebra) bifasciata Gillette.

Alabra bifasciata Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 711, fig. 2 [Chapada, Brazil].

One female and three males from the type material. The cross-bands in all cases complete medianly, may or may not reach the costal margin of tegmen. Bristles of genitalia as in *P. vexillifera*. Van Duzee records this species from Jamaica, and I have seen a specimen collected at Juana Diaz, Porto Rico, Feb. 11, 1925, by H. L. Dozier.

Protalebra (Protalebra) terminata Baker.

Protalebra terminata Baker, C. F., Psyche, 8, p. 404, Sept., 1899 [Chapada, Brazil].

All of the original material is extant; genitalia with pale bristles.

Protalebra (Protalebra) trimaculata Gillette.

Alabra trimaculata Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 711, figs. 3-4 [Chapada, Brazil].

The holotype female examined; ovipositor sheaths each with a row of pale bristles.

Protalebra (Protalebra) amoena Baker.

Protalebra amoena Baker, C. F., Psyche, 8, pp. 404-405, Sept., 1899 [Chapada, Brazil].

The holotype male examined; genitalie bristles pale.

Protalebra (Protalebra) brasiliensis Baker.

Protalebra brasiliensis Baker, C. F. Psyche, 8, p. 405 [Chapada and Corumba, Brazil].

Genitalie bristles pale in both sexes; venation of tegmen as in Fig. 2; numerous specimens available from the type material.

Existing information indicates that this is the most common and widespread species of the genus. Specimens at hand, other than the Brazilian types are from Rurrenabaque, Bolivia, W. M. Mann; Honduras, F. J. Dyer; Sinaloa, Mex., J. A. Kusche; Trinidad, Aug. Busck; Grenada and St. Vincent, H. H. Smith; St. Thomas, Harold Morrison; Porto Rico, Aug. Busck, R. T. Cotton, G. N. Wolcott; Brownsville, Tex., Nov. 30, 1910, C. A. Hart; Little River, Fla., Dec. 1, 1912, F. Knab; Jacksonville, Fla., W. H. Ashmead; Gainesville, Fla., Aug. 25, 1918, J. R. Watson. The species is recorded from Jamaica also by Van Duzee.

Protalebra (Protalebra) robusta Gillette.

Alebra robusta Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, pp. 712-713, figs. 5-6 [Chapada, Brazil].

Besides the male holotype, two females from the type locality are available. The genitalic bristles are in more than one row, and a group of several of them in middle of series are black; the posterior margin of the side of ninth segment in the male also bears several strong posteriorly directed pale bristles.

Protalebra (Protalebra) nexa new species.

General color stramineous, vertex with a yellowish discal blotch; pronotum with a marking following anterior margin, and emitting three broad posterior projections, golden-yellow; clavus with base and c-shaped median mark, golden-yellow, and the apex orange-red; corium with two oblique, irregular golden-yellow vittæ originating anterior to costal plaque and joining about middle of claval suture; an oblique pale lemon-yellow vitta begins at hind margin of costal plaque and runs to crossveins, where it joins another of irregular shape that extends from apex of clavus to exterior apical angle of tegmen; these vittæ are bordered almost throughout by dusky to black lines. Underparts stramineous; genitalic bristles pale; eighth sternite of female almost evenly convex posteriorly. Length: 2.75-3 mm.

Described from three females, Signal Hill, St. Thomas, Virgin Islands, June 1, 1917, Harold Morrison; a teneral female from St. Thomas, June 5, also seen (U. S. N. M.).

Subgenus **Plagalebra** new subgenus.

Essential characters expressed in key and in Fig. 3. Subgenotype *Protalebra singularis* Baker.

Protalebra (Plagalebra) singularis Baker.

Protalebra singularis Baker, C. F., Psyche, 8, pp. 402-403, Sept., 1899 [Chapada, Brazil].

The original material available; the male genitalia are peculiar in that the outer claspers do not extend to apex of ninth segment, the latter being greatly enlarged; claspers with a row of strong pale bristles. The ovipositor sheaths are similarly armed; eighth sternite of female moderately emarginate laterally, and slightly angulate medianly.

Subgenus **Paralebra** new subgenus.

Based on the characters mentioned in key and illustrated in Figure 4. Subgenotype *Protalebra similis* Baker.

KEY TO THE SPECIES

Color pattern consisting chiefly of longitudinal vittæ, the dorsum crossed by two pale lunes.....*similis* Baker
 Color pattern composed of rather large yellowish or hyaline spots
pardalis new species

Protalebra (Paralebra) similis Baker.

Protalebra similis Baker, C. F., Psyche, 8, p. 403, Sept., 1899 [Corumba, Brazil].

The original material is extant, but one specimen is now represented by only a single tegmen. Male claspers extending about to apex of ninth segment which is moderately large. In a female from Chapada, Brazil, the eighth sternite is almost straight across the hind margin; ovipositor sheaths each with a row of long pale bristles. Venation of tegmen as in Fig. 4. Specimens of this species are at hand also from Panama, Honduras, Porto Rico, Grenada, and St. Vincent.

Protalebra (Paralebra) pardalis new species.

General color, shining black, marked with the following white to yellow spots; three in a row across anterior part of vertex, the median one largest, more or less diamond-shaped, and sometimes connected with the others; two on posterior margin of vertex next the eyes; a median wedged-shaped one, anterior margin of pronotum, and three across disk, of which the lateral ones are larger, and approximately circular, and the median one small and lunate (lateral and posterior margins of pronotum narrowly whitish); scutellum beyond transverse impression, two small spots basad

of that marking, and sometimes two near basal angles; clavus with two large roundish spots basally and a pair of more or less oblong ones at middle, and a triangular one covering apex; corium with two larger spots basally along clavus, two smaller ones near costa, a small speck about middle along clavus, and four larger spots anterior to the crossveins; the outer one of these, the first apical cell, and the partially closed cell of corium are more or less hyaline, and the veins bordering them are yellow. Clypeus and lower margins of face whitish, also a band across upper part of front, with extensions at the sides to antennal insertions. Legs chiefly whitish, male claspers and female ovipositor sheaths, each with a row of pale bristles; eighth sternite of female very moderately emarginate laterally and slightly angulate medianly. Length: 2.5-3 mm.

Holotype male, allotype and several paratypes from La Ceiba, Honduras, August to December, F. J. Dyer; also a female from Hot Springs, Ariz., June 25, E. A. Schwarz and H. S. Barber (U. S. N. M.).

This may be the same as *Protalebra maculata* Baker, but I cannot be certain of it from the description alone.

Subgenus **Kallebra** new species.

Characters as outlined in key and illustrated in Fig. 5. Subgenotype *Protalebra ninettae* Baker.

Protalebra ninettae Baker, C. F., Psyche, 8, p. 403, Sept., 1899 [Chapada, Brazil].

The holotype male is the only specimen seen; the outer claspers lack the bristles so characteristic of most species of Alebrini. (Possibly rubbed off.) Venation of tegmen as in Fig. 5.

Subgenus **Aphanalebra** new subgenus.

Characters as shown in the key and in Fig. 6. Subgenotype *Protalebra unipuncta* Baker.

Protalebra (Aphanalebra) unipuncta Baker.

Protalebra unipuncta Baker, C. F., Psyche, 8, p. 404, Sept., 1899 [Chapada, Brazil].

The four specimens mentioned in the original description, and one other from Chapada are available. The outer claspers of male and ovipositor sheaths of female each have a row of long pale bristles. Venation of tegmen as in Fig. 6.

Species not seen.

Protalebra nicaraguensis Baker, C. F., Invert. Pacif., 1, p. 6, Sept., 1903 [San Marcos, Nicaragua].

Protalebra transversalis Baker, C. F., Invert. Pacif., 1, p. 6, Sept., 1903 [Acapulco, Mexico].

Protalebra maculata Baker, C. F., Invert. Pacif., 1, pp. 6-7, Sept., 1903 [San Marcos, and Managua, Nicaragua]. See note under *Protalebra pardalis*, p. 151.

Protalebra apicalis Van Duzee, E. P., Bul. Buffalo Soc. Nat. Sci., 8, 1907, p. 74 [Mandeville, Jamaica]. Is this a *Protalebra?*; the distinct ocelli indicate need of close scrutiny.

Protalebra omega, Van Duzee, E. P., Bull. Buffalo Soc. Nat. Sci., 8, 1907, p. 75 [Rock Fort, Jamaica].

Alebra aureovittatus DeLong, D. M., Journ. Dept. Agr. Porto Rico, 7, No. 1 (Jan., 1923), Jan., 1924, pp. 267-269, Pl. 2, figs. 3a, 3b [Porto Rico]. Seems to be a *Protalebra*.

Protalebra scriptozona Van Duzee, E. P., Proc. Calif. Acad. Sci., 12, No. 11, June, 1923, pp. 186-187 [Ceralbo Island, Gulf of California].

TRIBE DIKRANEURINI

Dikraneurini are Eupteryginæ which lack an appendix to the tegmen but possess a submarginal vein closing all the apical cells in the wing.

KEY TO THE GENERA

1. Submarginal vein joining costal margin of wing, not bounding outermost closed apical cell (Figs. 7, 12, 13, 15, 16).....2
Submarginal vein of wing bounding the outermost closed apical cell (Fig. 10).....4
2. With 2 closed apical cells in wing.....3
With one closed cell in wing (Fig. 16).....*Typhlocybella* Baker
3. Third apical vein of tegmen curving to radial margin, sectors convergent at one or more points, or with stump veins, or united by crossveins (Figs. 7-9).....*Parallaxis* new genus
Third apical vein of tegmen more or less paralleling radial margin, ending in apical margin; sectors neither convergent nor united (Figs. 11-15).....*Dikraneura* Hardy
4. With 3 apical cells in wing (Fig. 10).....*Eualebra* Baker
With one apical cell in wing.....*Empoasca* Walsh*

* *Empoasca*, a cosmopolitan genus with numerous neotropical species, is not reported upon here as time does not suffice for revising it even by the somewhat incomplete method here applied to the other genera.

Genus *Parallaxis* new genus

Venation of wing as in *Dikraneura* s. s. (Fig. 12). Venation of tegmen characterized by tortuosity of both sectors and apical veins. I have used the curvature of third apical vein to the radial margin as a leading generic character because the same feature has proved reliable in the genus *Typhlocyba*. The first apical vein curves to the costal margin but not so much stress is laid upon this feature because of its known variability not only in *Typhlocyba* but also in the more closely related genus *Dikraneura*. Sectors convergent, or nearly or quite united as described in key and figure (Figs. 7-9).

Genotype *Parallaxis vacillans* new species.

KEY TO THE SPECIES

1. Vertex little if any longer at middle than at inner margin of eye.....2
Vertex distinctly longer at middle than at inner margin of eye.....3
2. Sectors 1 and 2 convergent, but without stump veins (Fig. 7)
vacillans new species
Sectors 1 and 2, and 2 and 3 convergent, with more or less developed stump veins (Fig. 9).....*tessellata* new species
3. Sectors 1 and 2, and 2 and 3 convergent, sometimes nearly connected by stump veins.....*respersa* new species
Sectors 1 and 2, and 2 and 3 connected by crossveins forming two distinct anteapical cells (Fig. 8).....*clathrata* new species

Parallaxis vacillans new species.

Head, anterior border of pronotum, and scutellum, yellowish; face with short dark bars on the sides below, a double parentheses-like pale marking above, the upper part of which is outlined by darker, a line on middle of vertex, forking on upper border of face, also dark. Pronotum except anterior border and most of tegmina old gold with a flocculated appearance; three small triangles along inner margin of clavus whitish; areas anterior and posterior to crossveins hyaline, apical cells otherwise fumose. Venter yellow, legs testaceous. Outer claspers of male and ovipositor sheaths of female each with a row of pale bristles; eighth sternite of female evenly convex posteriorly. Venation of tegmen and wing as in Fig. 7. Length, 3-3.5 mm.

Holotype male, allotype female, and numerous paratypes from Chapada, Brazil, January, March, April, May; Corumba, Brazil, April, May; La Ceiba, Honduras, F. J. Dyer; Millan, Vera Cruz, Mexico, Jan. 2, 1908, F. Knab (U. S. N. M.).

Parallaxis tessellata new species.

KEY TO THE COLOR VARIETIES

1. Clavus with few pale spots.....var. *beata* new variety
Clavus with numerous pale spots.....2

2. Costal plaque and posterior parts of costal region chiefly whitish; general coloration stramineous.....var. *mendica* new variety
 Costal plaque yellow, first apical cell dusky; general coloration olivaceous var. *tessellata* new variety

***Parallaxis tessellata* var. *tessellata* new variety.**

Ground color of head and thorax pale yellow, marked with olivaceous as follows: two dense triangles on disk of vertex, a small more diffuse elongate mark between each triangle and one eye, a faint lune on posterior margin of vertex each side of the short blackish median line; a broad band across pronotum, bordered and medianly interrupted by whitish, two dots near median line anteriorly, and a large transverse comma-like marking each side of them; two dense dots on anterior disk of scutellum, and all angles of this sclerite. Clavus and adjacent corium whitish hyaline, deeply washed with olivaceous which is interrupted by numerous yellow dots and blotches; costal plaque yellowish, bordered at both ends by dusky and anteriorly by a nearly orange blotch; region from posterior end of costal plaque to crossveins and including first and fourth apical cells dusky, the veins bright yellow, the interior of cells in front of crossveins more or less hyaline; apical cells 2 and 3 nearly hyaline traversed by a row of small dark blotches paralleling apical margin. Upper part of face olivaceous with transverse pale markings, cheeks and clypeus brownish; abdomen fuscous with pale edgings; ovipositor sheaths each with a row of pale bristles; eighth sternite of female nearly transverse apically, its lateral angles truncate. Venation of tegmen as in Fig. 9; of hind wing as in *P. vacillans*. Length, 3-3.25 mm.

Holotype and one other female, Chapada, Brazil, April. Another specimen, scarcely typical, from Corumba, Brazil (U. S. N. M.).

***Parallaxis tessellata* var. *mendica* new variety.**

Ground color stramineous, markings chiefly as in var. *tessellata* but drab instead of olivaceous; costal plaque, costa posterior to it, and area between 1st and 2nd sectors whitish; apical cells more extensively whitish or hyaline, the veins pale yellow; underparts stramineous, with scanty drab edgings, ares, etc. Length, 3 mm.

Holotype female, Rio de Janeiro, Brazil (U. S. N. M.).

***Parallaxis tessellata* var. *beata* new variety.**

Ground color of head and thorax brighter yellow and all markings more pronounced than in var. *tessellata*; basal triangles of scutellum reddish. Band across pronotum fumose; clavus dusky fumose, only inner anterior margin, and a very few spots pale; tegmen otherwise of the same color and with hyaline areas about as in var. *tessellata*. Male claspers with a promi-

nent elliptical opening between them at base, strap-like, turned edgewise, with a fringe of long pale bristles on upper margin. Length, 3 mm.

Holotype male, Chapada, Brazil, April (U. S. N. M.).

Parallaxis respersa new species.

KEY TO THE COLOR VARIETIES

1. A dark bar across pronotum near posterior margin; larger color spots on clavus and corium bright sanguineous.....var. *respersa* new variety
- No dark bar on pronotum; large color spots on clavus and corium pale orange.....var. *decrepita* new variety

Parallaxis respersa var. *respersa* new variety.

Ground color of head and thorax ivory white; vertex with a heavy, broadly V-shaped black marking on disk which is connected with the usual median black line and with fainter are on each side anteriorly; posterior two-thirds of pronotum overlaid by reddish orange, across which is a transverse blackish vitta broader medianly, and interrupted there by a pale mark which extends toward anterior margin of pronotum, the latter pale edge ornamented with dark marks as follows: a median dot, with a transverse comma, and beyond that a V on each side. Scutellum yellowish, the basal angles reddish, with an interrupted subapical dark band. Corium and clavus chiefly whitish hyaline, each ornamented by two large bright sanguineous spots with dusky edgings; costal plaque whitish, overlaid by yellow and speckled with black; costa posterior to it orange-reddish; crossveins and apical veins bright yellow, adjacent membrane hyaline with dusky spots and edgings, first apical cell solidly dusky. Upper part of face yellowish with faint ares, cheeks and clypeus blackish; abdomen fuscous; eighth sternite moderately convex apically; bristles of ovipositor sheath pale. Venation much as in *P. tessellata* (Fig. 9), the stump veins more nearly anastomosing. Length, 3 mm.

Holotype female, Chapada, Brazil, April (U. S. N. M.).

Parallaxis respersa var. *decrepita* new variety.

Ground color of head and thorax yellowish, the markings much as in var. *respersa* but smaller and olivaceous instead of blackish. Posterior two-thirds of pronotum washed with olivaceous, paler medianly and without a transverse dark band as in var. *respersa*. Large color spots on tegmen pale orange, less distinctly margined with dusky than in the other variety; costal plaque not distinctly speckled; hyaline areas of tegmen larger. Length, 2.75 mm.

Holotype female, Corumba, Brazil, May (U. S. N. M.).

***Parallaxis clathrata* new species.**

Vertex ivory white anteriorly, washed with yellowish posteriorly, with several faint dusky traces, and two bolder sagittate dark markings in middle. Pronotum broadly margined anteriorly with yellow upon which are small dark markings; posterior two-thirds deep olivaceous. Scutellum with the basal triangles olivaceous, sometimes interrupted subapically by yellowish; otherwise yellowish more or less washed or spotted with olivaceous. Tegmen anteriorly and the veins posteriorly, chiefly yellow, a dark olivaceous or blackish blotch anterior to and posterior to costal plaque; three deeper yellow areas on clavus, and two on adjacent corium, outlined by dusky; apical portions of areas between sectors, antepical and apical cells (except 1 and 4 which are solidly dusky), hyaline, more or less heavily margined with dusky. Venation of tegmen as in Fig. 8; of wing as in *P. vacillans* (Fig. 7). Face fuscous below, yellowish to olivaceous above, with a pair of pale markings above and between antennal insertions, and a pair of dark dots near upper margin. Abdomen fuscous with pale edgings. Male claspers with a few pale bristles, eighth sternite of female convex almost subangulate medianly; ovipositor sheaths with numerous strong pale bristles. Length, 2.25-2.75 mm.

Holotype male, La Ceiba, Honduras, Oct. 22, 1916, F. J. Dyer; allotype female, Paraiso, Canal Zone, Panama, Feb. 7, 1911; paratypes, latter locality, Feb. 8, 1911; Tabernilla, Canal Zone, Feb. 6, 1911, Aug. Buseck; other specimens, La Ceiba, Honduras, F. J. Dyer; Ancon, Canal Zone, May 12, 1911, at light, A. H. Jennings (U. S. N. M.).

Genus *Eualebra* Baker.***Eualebra smithii* Baker.**

Eualebra smithii Baker, C. F., Psyche, Vol. 8, p. 402, Sept., 1899 [Chapada, Brazil].

The figures (10) of venation are made from the type. Baker suggests that the face of this specimen had collapsed in drying. While this may be true to a certain extent, it is the writer's impression that *Eualebra* is a notably depressed form somewhat similar to the subgenus *Hylodea* described on page 162. Van Duzee made a similar remark about the species he described.

Species not seen.

Eualebra notata Baker, C. F., Invertebrata Pacifica, 1, p. 7, Sept., 1903 [Champerico, Guatemala].

Eualebra rubra Van Duzee, E. P., Bul. Buffalo Soc. Nat. Sci., 8, 1907, pp. 73-74 [Kingston, Jamaica].

Genus *Dikraneura* Hardy

Ball and DeLong have recently described* 5 new species of this group and given useful keys embracing 19 species. They have adopted a method of numbering the apical cells that is the opposite of the usual practice of beginning at the costal side, and is correspondingly confusing. They have depended entirely on the stalking of the second (their third) apical cell for separating a group *Alconeura* as a new genus. This character is too variable to serve as the basis of so trenchant a separation hence *Alconeura* is here treated as a subgenus. The stalking of this cell is not the main dependence, as these authors state, for distinguishing the genus *Typhlocyba* from *Erythroneura*; in fact the writer has found it so variable that he has not felt justified in making any use of it, not even for the definition of species.

The figures illustrating venation in the paper referred to are carelessly drawn in a number of instances. In general the sectors are drawn as if visible to the base of tegmen, while a leading characteristic of the subfamily Eupteryginae is that the sectors usually are not visible basally. No fewer than six different styles of fusion of these veins basally are shown; a state of affairs which if actually exhibited by the specimens would compel their distribution to widely separated taxonomic groups.

KEY TO THE SUBGENERA

1. Second apical cell scarcely angulated or stalked at base.....:2
 Second apical cell usually angulated or stalked at base.....:3
2. First and fourth crossveins distinctly basad of second and third; first and fourth apical cells notably longer than second and third (Fig. 11)
 Notus Fieber
 Either the first or fourth crossvein, or both, but little basad of second and third; apical cells, at least the outer three, not so contrasted in length (Figs. 13-14).....*Dikraneura* Hardy (*Erythria* Fieber)
3. Form much depressed, the head especially being greatly flattened (Fig. 18) and distinctly wider than pronotum.....*Hylodea* new subgenus
 Form not especially depressed.....:4

* Ann. Ent. Soc. Am., 18, No. 3, Sept., 1925, pp. 324-337, Pls. 21-23.

4. One apical cell angulate or pedunculate basally

Alconeura Ball & DeLong

Two apical cells pedunculate.....*Kahaono* Kirkaldy

Subgenus *Notus* Fieber.

The characters mentioned in Fieber's original description of *Notus* are not so good as can be drawn from the venation of *Cicada flavipennis* Zetterstedt, the first species he mentions which is, therefore, presumably typical. The venation of the tegmen of this species is illustrated in Fig. 11. The differences noted in the key intergrade through a series of species, and the group like other segregates of *Dikraneura* deserves no more than sub-generic rank.

Dikraneura (*Notus*) *angustata* Ball & DeLong.

Dikraneura angustata Ball, E. D., and DeLong, D. M., Ann. Ent. Soc. Am., Vol. 18, No. 3, Sept., 1925, p. 328 [Tenn.].

A female from the Baker Collection, labelled Mex. 2301, evidently is this species. A greenish cast above is more emphasized than in the specimens originally described; the face is washed with brown, and the venter is slaty.

Subgenus *Dikraneura* Hardy.

The figures (12-13) of the venation of the type species of *Dikraneura* and *Erythria* show that there is no reason for recognition of the latter as a distinct genus.

1. Apical cells nearly uniform in length.....2
Fourth apical cell much longer than the others.....3
2. Tegmina pale bluish-green.....*kunzei* var. *lenta* new variety
Tegmina chiefly golden yellow.....*russea* new species
3. First apical vein recurved to costa, so that first apical cell is semicircular; base of second apical cell formed by a straight crossvein of appreciable length (Fig. 14).....*albonasa* new species
First apical vein running to exterior apical angle of tegmen, first apical cell not semi-circular; second apical cell subangulate basally.....4
4. Tegmen with large orange-red spots, and small bright red dots
lepida new species
Tegmen otherwise.....5
5. Fourth apical cell with a truncate extension costally at base, which encloses a large black spot.....*myersi* new species
Fourth apical cell without such an extension and without spot.....6

6. Tegmen with a yellow to orange vitta on clavus, a dark line on apex of each of first and second sectors, and on fourth crossvein

cruentata Gillette

Tegmen whitish to yellowish hyaline, a diffuse dark spot in first, and another, sometimes more distinct in fourth, apical cell

debilis new species

Dikraneura (Dikraneura) kunzei Gillette.

Dikraneura kunzei Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 721, figs. 31-33 [Ariz.].

Without evidence from internal genitalia for the study of which there is not sufficient material, I would not specifically separate a specimen collected at Durango, Mex., by F. C. Bishopp from *D. kunzei*. It may, however, be described as var. *lenta* new variety. Male: Whole upper surface appearing finely frosted, the vertex dull reddish, the pronotum dull greenish with a pinkish-yellow anterior border, scutellum pinkish-yellow with two darker lines on disk, tegmina pale bluish-green. Face fuscous, abdomen slaty, outer claspers yellowish with a few white bristles. The form in general profile, and shape of outer claspers, are the same as in *D. kunzei*. Length 3 mm. (U. S. N. M.).

Dikraneura (Dikraneura) russea new species.

Female: Vertex yellow with a golden dot each side of the median line anteriorly; the median line itself golden anteriorly, dusky posteriorly. Rather broad anterior margin of pronotum, golden-yellow, the remainder dark brown. Scutellum yellow, the basal triangles golden. Tegmen golden yellow to crossveins, and a little posteriorly, hyaline apically except for veins and margin which are golden. Face golden, legs stramineous, venter yellow, with brownish edgings, eighth sternite fuscous, slightly convex posteriorly. Male: Pale russet throughout above, median line of vertex brownish, apical portions of tegmina hyaline. Face and legs pale russet, venter and claspers yellowish. Claspers long triangular produced into rather long slender and not much upcurved processes posteriorly, each with a few stout pale bristles near middle. Length, 2.5-3 mm.

Holotype female, and allotype male, La Ceiba, Honduras, F. J. Dyer, dated Oct. 24, and Sept. 23, 1916, respectively (U. S. N. M.).

Dikraneura (Dikraneura) albonasa new species.

Vertex rounded but distinctly longer in middle than next eye; depth of body from clypeus to posterior part of pronotum remarkably greater than

in the other species here treated (Fig. 20); a creamy white mark margins the vertex and extends over sides of pronotum narrowing posteriorly, remainder of upper surface of head and thorax, and of the scutellum russet. Tegmen touched with russet at base of costa, whitish along costal plaque which has a black spot at each end, and olivaceous otherwise to vicinity of crossveins. Areas anterior to crossveins hyaline, and apical cells fumose hyaline, with a dusky blotch in apex of cell 2. Middle of face and clypeus testaceous, upper margin and cheeks whitish. Legs testaceous, venter brown with yellowish edgings; claspers pale yellowish, with pale bristles. Venation of tegmen as in Fig. 14. Length, 3 mm.

Holotype male, Chapada, Brazil, January (U. S. N. M.).

Dikraneura (Dikraneura) lepida new species

Suggestive of *D. maculata* Gillette, but more robust, the head especially so, being noticeably wider than pronotum, and with the vertex strongly produced, and thick anteriorly as seen from side (Fig. 19); the species differs from *maculata* also in color pattern. Head and thorax suffused with pinkish, vertex with two comma-like reddish markings in the middle anteriorly, their "tails" almost meeting, with two smaller commas reversed in position near the eyes, a pair of short reddish dashes along median line anteriorly, and two large orange spots near posterior margin. Pronotum with the anterior margin more decidedly pinkish, the disk and posterior margin more or less hyaline; scutellum yellowish overlaid by pinkish. Tegmen whitish hyaline, the clavus with three irregular spots, the corium with two in an oblique row with apical claval spot, four in an oblique row just posterior to apex of clavus, two between sectors anterior to, and three posterior to, crossveins, orange-red, the spaces between these spots sprinkled with bright red dots; apical cells more or less fumose with a submarginal series of darker spots. Upper part of face whitish, clypeus blackish, intervening portions livid, legs stramineous, venter yellow; claspers with a row of pale bristles. Length, 3 mm.

Holotype male, Chapada, Brazil, April (U. S. N. M.).

Dikraneura (Dikraneura) myersi new species

Vertex well produced, rounded angulate. Color above pale golden greenish, the apical cells fumose hyaline with black spot in base of fourth as described in key. Upper part of face, legs distally, and abdomen, colored like upper surface, pleura and legs basally, stramineous. Outer claspers long triangular, with a few pale bristles exteriorly at middle, upcurved apically. Length, 2.5 mm.

Holotype male, Soledad, Cuba, Feb. 18, 1925, J. G. Myers (M. C. Z.).

Dikraneura (Dikraneura) cruentata Gillette.

Dikraneura cruentata Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 717, figs. 16-18 [New York, B. C., Colo.].

Three specimens of the yellow form of this species from Soledad, Cuba, Feb. 9, 18, and March 2, 1925, J. G. Myers.

Dikraneura (Dikraneura) debilis new species

Slender, head and thorax stramineous, in one specimen the posterior two-thirds of pronotum are suffused with pale greenish-yellow; tegmina hyaline to greenish-yellow. A dusky cloud in fourth apical cell at about level of third crossvein, and another, sometimes more distinct spot within base of first apical cell; in one specimen this is circular and jet black. Lower surface stramineous, tip of ovipositor black, eighth sternite moderately convex medianly, and concave laterally; ovipositor sheath with a row of pale bristles. Outer claspers of male long-triangular, with a few pale bristles. Length, 2.5 mm.

Holotype female, Costa Rica, Pablo Schild (McAtee); paratype, Paraiso, Canal Zone, Jan. 17, 1911, Aug. Busck (U. S. N. M.). Allotype male and paratype females, Soledad, Cuba, March 13, and March 13, 14, and 18, 1925, respectively; and a female paratype Mina Carlota, Trinidad Mts., Cuba, March 22, 1925, J. G. Myers (M. C. Z.).

Species like this with the second apical cell subangulate basally, and with the base of that cell formed by the short median part of the posteriorly projecting almost V-shaped second crossvein, are not far removed from the segregate *Alconeura*.

Subgenus **Hyloidea** new subgenus

Venation of hind wing (Fig. 15) departing but little from the *Dikraneura* standard; that of tegmen characterized by stalking of 2nd apical cell but still exhibiting nothing unknown in the genus *Dikraneura*. Subgeneric recognition is accorded the insect because of its extraordinarily depressed shape throughout. The head is remarkably flattened (Fig. 18) and is distinctly wider than pronotum.

Subgenotype the following species:

Dikraneura (Hyloidea) depressa new species

Female: Head and thorax yellowish in ground color with a percurrent russet to dusky marking covering all but narrow anterior margin of vertex, disk of pronotum, and all but extreme lateral angles of scutellum; apical third of scutellum jet black. Tegmen lemon-yellow, a dusky blotch

on middle of clavus, a dusky band over inner crossveins, and a jet black spot on first crossvein; tegminal apex sometimes touched with dusky. Underside stramineous throughout except for the black apex of ovipositor; bristles on ovipositor sheath white. Eighth sternite convex medianly, slightly concave laterally. Male similar to female, marking of head and thorax more or less tinged with reddish laterally; tegmen anterior to fourth crossvein also with a pinkish cast. Venation as in Fig. 15. Length 2.25-2.75 mm.

Holotype male, allotype, and another female, Vega Alta, Porto Rico, Jan. 21, 1920, G. N. Wolcott (U. S. N. M.).

Subgenus **Alconeura** Ball and DeLong

1. Base of fourth apical cell expanded costally, enclosing a large black spot; pronotum with four broad, longitudinal orange-red vittae

quadrivittata Gillette

Base of fourth apical cell not especially expanded and without black spot; a black spot in middle of third apical cell.....2

2. Vertex pronotum, scutellum, and clavi with a broad, brownish vitta, bordered by ivory white.....*dorsalis* DeLong

Without such a vitta; pronotum marked as in *quadrivittata*; a transverse series of dark markings in front of crossveins, in addition to the usual cloudings paralleling the cross and apical veins

unipuncta Gillette

Dikraneura (Alconeura) quadrivittata Gillette.

Dikraneura quadrivittata Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, pp. 723-724, figs. 40-42 [L. J. Bah].

Ball and DeLong have shown that the type locality for this species is Long Island, Bahamas. It needs only a glance at the figure of tegmen given by Gillette, or that of Ball and DeLong, to show how slight a variation would serve to place the angulate but sessile third apical cell in the stalked category and thus give this species two stalked apical cells, a character which seems to be the only important one of the segregate *Kahaono* Kirkaldy. The type specimen has been available for the present study.

Dikraneura (Alconeura) unipuncta Gillette.

Dikraneura unipuncta Gillette, C. P., Proc. U. S. Nat. Mus., 20, 1898, p. 718, figs. 19-21 [Calif.].

Soledad, Cuba, March 14, 1925, J. G. Myers. A specimen taken at Washington, D. C., by the writer, July 2, 1913, is worth recording as the capture materially extends the known range of the species.

Dikraneura (Alconeura) dorsalis DeLong.

Dikraneura unipuncta dorsalis DeLong, D. M., Journ. N. Y. Ent. Soc., 32, No. 1, March, 1924, pp. 67-68 [Fla.].

Female specimens which must be this form are specifically distinguishable from *unipuncta* by the shape of the eighth sternite, which is longer and more pointed apically, the apex being notably beyond the postero-lateral angles, while in *unipuncta* the apex is only moderately angulate and extends but little beyond the posterior angles. Two females, one teneral, Mina Carlota, Trinidad Mts., Cuba, March 21, 1925, J. G. Myers.

Species not seen.

Erythria donaldsoni Baker, C. F., Invertebrata Pacifica, 1, p. 4, Sept. 1903 [Managua, Nicaragua].

Erythria guzmani Baker, C. F., Invertebrata Pacifica, 1, p. 4, Sept. 1903 [San Marcos, Nicaragua].

Erythria montealegrei Baker, C. F., Invertebrata Pacifica, 1, pp. 4-5, Sept. 1903 [Champerico, and Managua, Guatemala].

Erythria deschoni Baker, C. F., Invertebrata Pacifica, 1, p. 5, Sept. 1903 [Managua, Guatemala].

Dikraneura marginata Ball, E. D., and DeLong, D. M., Ann. Ent. Soc. Am., 18, No. 3, Sept. 1925, p. 331 [Florida, and Canal Zone]. This has been renamed *Dikraneura marginella* by C. F. Baker (Philippine Journ. Sci., 27, 1925, p. 160), because preoccupied by *D. marginata* Sahlberg, 1871.

Dikraneura sandersi Ball, E. D., and DeLong, D. M., Ann. Ent. Soc. Am., 18, No. 3, Sept. 1925, p. 332 [Panama City, Canal Zone].

Genus Typhlocybella Baker**Typhlocybella minima** Baker.

Typhlocybella minima Baker, C. F., Invertebrata Pacifica, 1, p. 3, Sept. 1903 [Managua, Nicaragua].

Specimens which almost certainly must be this species, have a submarginal vein in the wing just on the margin, which I conclude was overlooked in the original material. Venation illustrated in Fig. 16.

Specimens are at hand from Alhajuelo, Panama, March 4, 1912; Trinidad River, Panama, March 31, 1911; Paraiso, Canal Zone, Jan. 17, Feb. 7, 8, 1911, Aug. Busek; Paraiso, Canal Zone, Jan. 16, 1911, E. A. Schwarz and Aug. Busek; Costa Rica, P. Schild, and St. Vincent Id., H. H. Smith; Soledad, Cuba, Feb. 6 to April 1, 1925, J. G. Myers.

TRIBE JORUMINI

Jorumini are Eupteryginae which lack an appendix to the tegmen, and which have 1 or 2 closed and 1 open cell in the wing. (Figs. 17, 21). Only one genus is known, and all of the species examined have distinct ocelli. The venation of the tegmen (Fig. 17) is much the same in all the species, and that of the wing is as illustrated in Fig. 17, except in a single species.

Genus **Joruma** McAtee

KEY TO THE SPECIES

- 1. Chiefly scarlet species, the veins of wing, at least those near costa, red 2
Species colored otherwise, veins of wing dark..... 5
- 2. Vertex subangulate, longer than broad..... 3
Vertex rounded, length subequal to width..... 4
- 3. Head uniformly scarlet; eighth sternite of female distinctly emarginate medianly *coccinea* new species
Head with anterior border of vertex pale; eighth sternite of female convex *albifrons* new species
- 4. Tegmen with a median crossband, and the apical third hyaline *cingulata* new species
Tegmen chiefly hyaline, color almost restricted to the margins *tergata* new species
- 5. Wing with two closed apical cells (Fig. 21); vertex short and rounded; general color olivaceous to dusky..... *ascripta* new species
Wing with only one closed apical cell (Fig. 17)..... 6
- 6. Chiefly old gold in color..... 7
The tegmina at least olivaceous or darker..... 8
- 7. Eighth sternite of female long produced and subangulate *aurata* new species
Eighth sternite of female nearly straight across hind margin *subaurata* new species
- 8. Head and thorax old gold with disk of pronotum blackish; tegmina chiefly olivaceous *peltata* new species
- 9. Coloration otherwise 10

10. Outer claspers of male subtriangular, the basal width equal to about one-third of the total length.....11
 Outer claspers of male elongate, the basal width much less than a third of the total length.....12
11. Vertex well rounded, reddish anteriorly.....*proxima* new species
 Vertex moderately angulate, pinkish-brown with two black spots anteriorly*semenula* new species
12. Claspers as long as, or longer than, remainder of abdomen.....13
 Claspers decidedly shorter than remainder of abdomen; vertex subangulate, with a pale marginal line reddish.....*feminea* new species
13. Claspers longer than remainder of abdomen, surpassing hypopygium; vertex bluntly rounded with a large median dusky spot connected with a vitta on face.....*adusta* McAtee
 Claspers about as long as remainder of abdomen; vertex subangulate...14
14. Claspers surpassed by the hypopygium; vertex with a pale submarginal marking, interrupted medianly.....*ebria* new species
 Claspers somewhat surpassing the hypopygium; vertex without pale submarginal marking15
15. Eighth sternite of female emarginate each side of the convex apex; ninth segment of male seen from side as wide apically as basally
atratula new species
 Eighth sternite of female moderately angulate medianly, but not emarginate laterally; ninth segment of male tapering from base, the lower posterior angle well rounded off.....*pisca* McAtee

Joruma coccinea new species

Entire body, except the yellowish venter, and tegmina to near crossveins, scarlet; apical cells and nearly equal sized areas anterior to crossveins fumose-hyaline; legs stramineous, yellowish distally, the claws black; eighth sternite distinctly, though narrowly emarginate medianly, the margin distinctly convex each side of the emargination. Eyes blackish; ocelli dusky. Length, 3 mm.

Holotype female, Costa Rica, P. Schild (McAtee).

Joruma albifrons new species

Vertex less pointed than in *J. coccinea*; colored like that species, except that the anterior margin of vertex is ivory colored, making the black ocelli and a median, triangular, scarlet mark stand out conspicuously. The eyes are paler and the extreme lateral margins of pronotum are ivory color. Claspers of male long, narrow, and flat, with a row of reddish bristles, not reaching apex of hypopygium. A female placed with this species until further evidence is forthcoming, has a black dot and no triangular scarlet mark on middle of vertex anteriorly; the eighth sternite is evenly convex posteriorly. Length, 3 mm.

Holotype male, Chapada, Brazil, August, H. H. Smith; associated female Alhajuelo, Canal Zone, March 4, 1912, Aug. Busck (U. S. N. M.).

Joruma cingulata new species

Scarlet except for a broad whitish hyaline band across tegmen covering all but base and apex of clavus, apical cells and cell-like areas anterior to crossveins 3 and 4, slightly fumose hyaline; the wings beneath the anterior hyaline band are whitish hyaline, and the abdomen has a broad yellow band around it; ocelli black, legs stramineous, reddish distally; eighth sternite of female very slightly convex posteriorly, bristles on ovipositor sheath red. Length, 3 mm.

Holotype female, Chapada, Brazil, April; paratype female, same locality, September, H. H. Smith (U. S. N. M.).

Joruma tergata new species

Head and thorax scarlet, but somewhat more tinged with orange than in the preceding species; venter yellow, dorsum yellow edged with scarlet; legs reddish-testaceous; ocelli pale. Tegmina slightly fumose hyaline, tinged with red on the margins, more broadly on the costal; fourth apical cell broader basally than in the other species. Male claspers slender, inwardly and upwardly curved, with pale bristles. Length, 3 mm.

Holotype male, Chapada, Brazil, April, H. H. Smith (U. S. N. M.).

Joruma ascripta new species

Holotype male with the head and thorax dusky olivaceous above, ocelli black, basal triangles of scutellum dusky; tegmina olivaceous, denser on clavus and between inner two pairs of sectors, clearer bordering these areas, this yellowish olive color extending along costa beyond first crossvein; apical cells otherwise, and ample areas before crossveins 2 to 4, dusky hyaline. Upper part of face ochreous, lower yellowish, venter yellow, dorsum blackish with yellow edgings, legs stramineous; male claspers slender, straight; as seen from side they are somewhat thickened apically. Venation of wing as in Fig. 21.

Allotype female similar in pattern, much darker than male, vertex, pronotum, most of scutellum and of costa, blackish. Upper part of face red; venter slaty, seventh sternite mostly whitish; eighth sternite weakly subangulate medianly. A female from Brazil is somewhat paler, and one from Santa Domingo is less black along costa, and has the eighth sternite pale. Length, 2.25-3 mm.

Holotype male and allotype female, Costa Rica, Pablo Schild (McAtee); other females, Chapada, Brazil, April; and Santa

Domingo, W. I., 6. 8. 05, Aug. Busck (U. S. N. M.). The latter specimen due to the crumpled state of wings was erroneously made a paratype of *J. pisca* McAtee.

Joruma aurata new species

Pale old gold in coloration, deepest on vertex, pronotum, and clavus, tegmina hyaline posteriorly except on costa; ocelli black. Underparts yellowish; eighth sternite long, narrowed from base, rather angulate medianly. Length, 3 mm.

Holotype female, Corumba, Brazil, April (U. S. N. M.).

Joruma subaurata new species

Head and thorax old gold with brownish clouding, ocelli black; tegmen nearly hyaline, washed with golden especially laterally to vicinity of crossveins on costal, and to apex of clavus on radial, margin, apical cells and nearly equal sized areas anterior to crossveins dusky; face and ovipositor sheaths (bristles pale) old gold, ovipositor brownish, other underparts yellowish; genital plate short, nearly straight across posteriorly. Length, 2.5 mm.

Holotype female, Mina Carlota, Trinidad Mts., Cuba, March 22, 1925, J. G. Myers (M. C. Z.).

Joruma peltata new species

Vertex shorter and more rounded than in *J. feminea*, yellowish anteriorly, the ocelli black, washed with old gold on disk and posteriorly, with faint brownish clouding; pronotum broadly margined anteriorly, and narrowly elsewhere with old gold, otherwise black; scutellum old gold with 2 discal dusky spots, and fainter dusky lineations basally; tegmen with apical cells and equal sized areas in front of inner three, dusky, the first apical cell black, the costa in front of it whitish, remainder of tegmen sordid olivaceous, the veins old gold. Face golden, clypeus bluish-black; pleura blue-blackish with golden edgings; abdomen chiefly yellow but with broad blue-blackish markings on disk of tergites and sternites; the sheaths although short surpass the ovipositor, the bristles are dark; genital plate short, moderately convex; legs yellowish, hind femur with a subapical ventral spot, and hind tibia with apex, brownish. Length, 3 mm.

Holotype female, Soledad, Cuba, Feb. 18, 1925, J. G. Myers (M. C. Z.).

Joruma proxima new species

Male: Colored much like the female of *ascripta* but lacking the extra cell in wing. Vertex well rounded, most of vertex, pronotum, base of scutellum, costa and whole tegmen beyond apex of clavus, fuscous; apex of scutellum,

most of corium, and clavus yellowish olivaceous. Apex of head reddish, ocelli black, face and legs stramineous. Abdomen chocolate with yellowish edgings. Male claspers fairly broad at base, long triangular, upcurved apically, with pale bristles. Length, 3 mm.

Holotype male, Chapada, Brazil, August (U. S. N. M.).

Joruma semenula new species

General color of vertex, pronotum, scutellum, and anterior half of tegmina pinkish-brown; vertex with 2 oval black spots, obliquely placed, joined basally and resting on anterior end of the median longitudinal line, and a blackish area along inner margin of each eye; ocelli black; scutellum with a black spot in each basal triangle; apical cells of tegmen and a nearly equal area in front of crossveins dusky hyaline, costal region infusate from middle, posteriorly; face and legs drab, body blackish; outer claspers of male black basally, apical third abruptly upcurved, yellowish. Female genital segment moderately convex. Length, 2.5 mm.

Holotype male, allotype, and two damaged specimens not considered type material, Mina Carlota, Trinidad Mts., Cuba, March 25, 1925, J. G. Myers (M. C. Z.).

Joruma feminea new species

Disk of vertex and of pronotum dusky olivaceous; scutellum fulvous; tegmina fumose hyaline as to apical cells and somewhat smaller areas anterior to crossveins, otherwise olivaceous, with linear margins dusky. A narrow line around front of vertex, across eye, and alongside of pronotum, whitish to yellowish, bordered more or less completely by a reddish line; ocelli black; face olive-testaceous, tending to be reddish above; other underparts olivaceous yellow, tibiae and tarsi stramineous. Claspers of male rather narrow, nearly straight, each with a row of blackish bristles. Eighth sternite of female slightly pointed medianly; ovipositor sheaths slaty, each with a row of pale bristles. Venation as in Fig. 17. Length, 3-3.25 mm. Coloration more vivid in the females.

Holotype male, allotype female, and paratypes of both sexes, Costa Rica, Pablo Schild (McAtee).

Joruma ebria new species

Color pattern much as in *J. feminea*. Disk of vertex, of pronotum, and scutellum fulvous; extreme lateral margin of pronotum white, and marking along anterior margin of vertex, interrupted medianly, ivory; ocelli black; face reddish. Tegmina yellow olivaceous and fumose hyaline, the pattern as in *J. feminea*; costa tinged with reddish. Legs stramineous; abdomen testaceous. Length, 3 mm.

Holotype male, Chapada, Brazil, January (U. S. N. M.).

Joruma adusta McAtee

Joruma adusta McAtee, W. L., Florida Entomologist, Vol. 8, Nos. 3-4 (Dec., 1924), Feb., 1925, p. 35 [Brazil].

The Figures, 1 and 2, p. 33, erroneously labelled *J. pisca*, really illustrate this species; however, the venation in the two is practically identical.

Joruma atratula new species

Body blackish, tegmina fuscous, duskier in the apical cells; lower part of face, pleura, legs, and base of genitalia stramineous; 9th segment as described in key, blackish; apical half of outer claspers fuscous. A female, apparently teneral and therefore not made a type, is fuscous above, even yellowish on vertex, has a reddish band between eyes, the face yellowish-brown above, yellow below, the legs and genital plate stramineous; the genital plate is distinctly emarginate each side of the strongly convex median part of the hind margin; ovipositor sheaths black, the bristles pale. Length, 3 mm.

Holotype male, Mina Carlota, Trinidad Mts., Cuba, March 19, 1925, J. G. Myers (M. C. Z.). The female mentioned was collected at the same place on March 25.

Joruma pisca McAtee.

Joruma pisca McAtee, W. L., Fla. Ent., Vol. 8, Nos. 3-4 (Dec. 1924), Feb. 1925, p. 34 [Maryland].

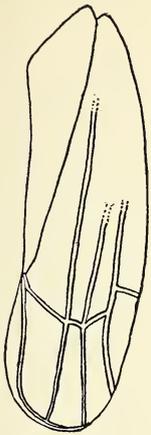
One of the Central American specimens cited is here assigned to another species (*J. ascripta*) while the other from La Ceiba, Honduras, is provisionally left with *J. pisca* until further specimens are received.

TRIBE TYPHLOCYBINI

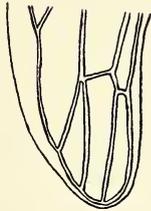
The species of *Typhlocyba* that have been described from the neotropics are recorded in my revision of that genus (in press, Proc. U. S. Nat. Mus., Vol. 68). I have no evidence of the occurrence of the genera *Erythroneura*, *Hymetta*, and *Eupteryx* in the region.

PLATE XIX

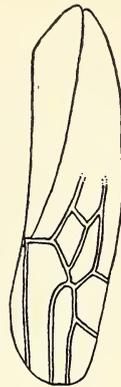
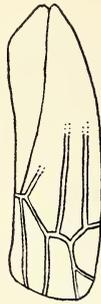
- Figure 1. Venation of tegmen and wing of *Alebra albostriella*.
Figure 2. Venation of tegmen of *Protalebra* (*Protalebra*) *brasiliensis*.
Figure 3. Venation of tegmen and wing of *Protalebra* (*Plagalebra*) *singularis*.
Figure 4. Venation of tegmen of *Protalebra* (*Paralebra*) *similis*.
Figure 5. Venation of tegmen of *Protalebra* (*Kallebra*) *ninettae*.
Figure 6. Venation of tegmen of *Protalebra* (*Aphanalebra*) *unipuncta*.
Figure 7. Venation of tegmen and wing of *Parallaxis vacillans*.
Figure 8. Venation of tegmen of *Parallaxis clathrata*.
Figure 9. Venation of tegmen of *Parallaxis tessellata*.



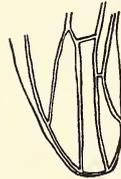
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2



3



4



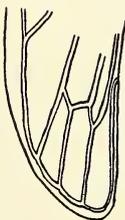
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6

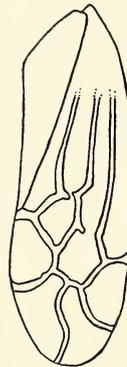


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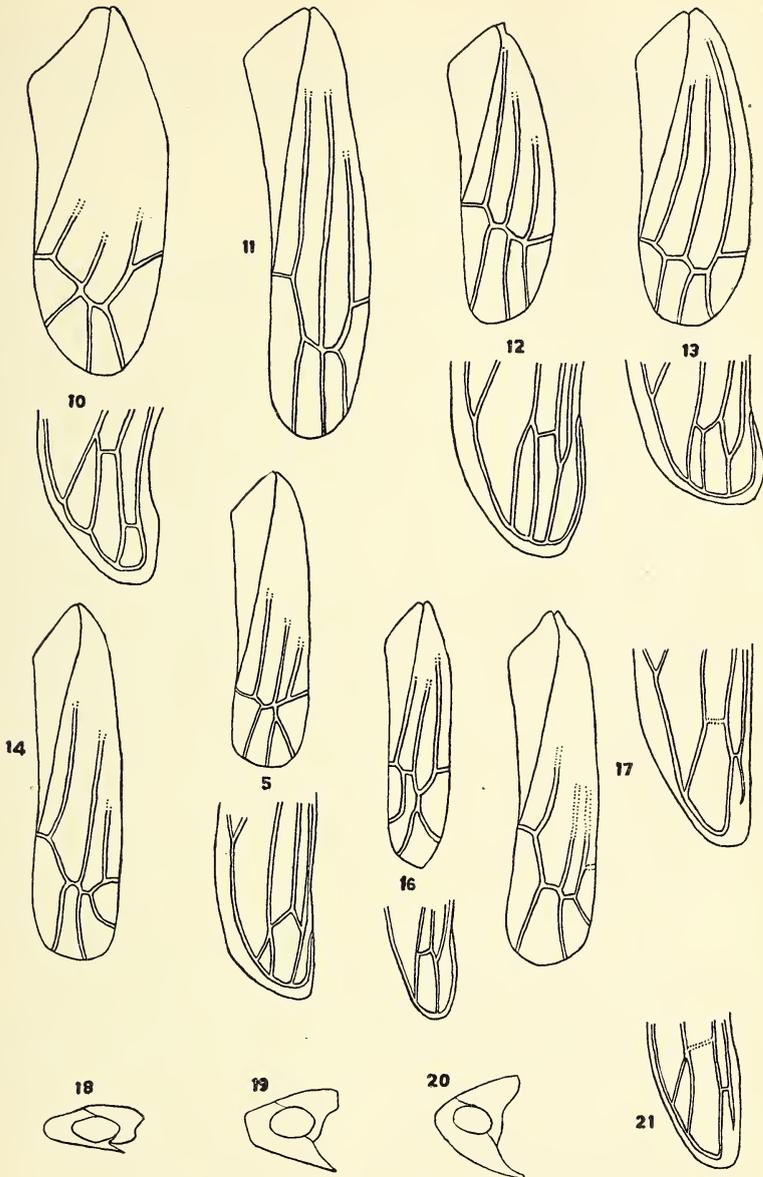
9



EUPTERYGINAE

PLATE XX

- Figure 10. Venation of tegmen and wing of *Eualebra smithii*.
Figure 11. Venation of tegmen of *Dikraneura* (*Notus*) *flavipennis*; of wing as in 12.
Figure 12. Venation of tegmen and wing of *Dikraneura* (*Dikraneura*) *variata* Hardy.
Figure 13. Venation of tegmen and wing of *Dikraneura* (*Dikraneura* = *Erythria*) *aureola* Fallén.
Figure 14. Venation of tegmen of *Dikraneura* (*Dikraneura*) *albonasa*.
Figure 15. Venation of tegmen and wing of *Dikraneura* (*Hyloidea*) *depressa*.
Figure 16. Venation of tegmen and wing of *Typhlocybella minima*.
Figure 17. Venation of tegmen and wing of *Joruma feminea*.
Figure 18. Profile of *Dikraneura* (*Hyloidea*) *depressa*.
Figure 19. Profile of *Dikraneura* (*Dikraneura*) *lepida*.
Figure 20. Profile of *Dikraneura* (*Dikraneura*) *albonasa*.
Figure 21. Venation of wing of *Joruma ascripta*.



EUPTERYGINAE

NEW CICADAS FROM CALIFORNIA AND ARIZONA WITH NOTES ON SEVERAL OTHER SPECIES

BY WM. T. DAVIS
STATEN ISLAND, N. Y.

In June, 1925, Prof. W. S. Wright, of the Natural History Museum, San Diego, California, made a very interesting collection of Cicadas at Buckman Springs, near Laguna Mts., in the southern part of San Diego County. He collected eight species, one an undescribed *Clidophleps*, and two others that, taken together with additional specimens in the writer's collection, are here considered as new varieties or races. Professor Wright also collected at Buckman Springs on June 23, a male of the beautiful green and black *Okanagana nigriviridis*, of which species but few have thus far been taken. Mr. Alonzo C. Davis collected a number of Cicadas of two species at Cactus Flat, San Bernardino Mts., on June 8, 1925, and also sent a number of other specimens from elsewhere in California. Professor Frederick M. Gaige sent specimens from Lamar, Colorado, collected in 1925, and Dr. R. H. Beamer, others from Oklahoma and New Mexico. This material, together with specimens that I have been able to examine in the collection of the U. S. National Museum, and others sent by several professional collectors form the basis of the present paper. I am very much obliged for the help that I have received.

Tibicen robinsoniana Davis.

Lately while examining the specimens in the P. R. Uhler Collection, U. S. National Museum, a male of this species was discovered labeled "Tenn." The species was described from Virginia and is also known from Missouri.

Tibicen figurata (Walker). Pl. XXI, fig. 1.

On October 7, 1925, Miss Louise Knobel found the female here figured at Hope, Arkansas. She reports that it was in a dying

condition along a road. It is remarkable on account of the dorsal line of pruinose spots on the abdomen, and is the only one I have seen so plainly marked. Some specimens have indications of such a line. Over forty have been examined.

A similar case was the female *Tibicen pruinosa* Say, mentioned and figured in this JOURNAL for March, 1923. *Figurata* belongs to a group of eastern North Am. Cicadas, and as remarked in the case of the female *pruinosa*, it is interesting to see pruinose spots appear on the abdomen as the home of such species as *dorsata* and *dealbata* is approached. These two species and their allies, normally have a dorsal line of pruinose spots on the abdomen.

Tibicen dorsata (Say). Pl. XXI, fig. 2.

The specimen figured is remarkable because it resembles in the pruinose markings on the abdomen *dealbata* Davis. Usually in *dorsata* the sides are not so whitened. This and nine others were kindly sent to me for examination by Prof. Frederick M. Gaige, who collected them on August 24 and 27, 1925, on the sand hills south of Lamar, Colorado, where there were some clumps of sage bushes. On August 25 he found *dealbata* coming out of the mud flats on the Arkansas River north of Lamar, where there were cotton woods.

Tibicen montezuma (Distant).

Biol. Cent. Amer, Homoptera, p. 8. Pl. 2, fig. 2.

While visiting the Arbuckle Mountains in Oklahoma, in July, 1925, Mr. Raymond H. Beamer of the University of Kansas collected five males and two females of what has been identified as *montezuma* Distant. He has contributed the following which I quote with his permission: "This species was taken over an area possibly ten or fifteen miles in extent, in cedars and oak. Its song was shrill and long continued while undisturbed. I found them exceedingly hard to locate, and some of them quite wild. As I remember its song very much resembled that of *Tibicen bifidus*."

Other specimens of this species, some of which are in the writer's collection, have been examined as follows: Gatesville, Coryell Co., Texas, July 16, 1888, male, U. S. Nat. Mus.; New Braunfels,

Comal Co., Texas, Aug. 14, 1921, male, July 1922, male and female, and July, 1923, male (O. M. Locke, Jr.); Anhalt, Comal Co., Texas, June 28, 1917, male, Cornell Univ.; Kerrville, Kerr Co., Texas, female (F. C. Pratt), U. S. Nat. Mus.; Comstock, Valverde Co., Texas, July 3, 1917, male (Dr. H. H. Knight); Juno, Devils River, Texas, July 3, 1917, male and female (Dr. H. H. Knight); Black Canyon near Bumble Bee, Arizona, July 30, 1917, female (Dr. H. H. Knight).

In the Transactions, Maryland Academy of Sciences, 1892, p. 154, Uhler states that *montezuma* occurs in Mex., Calif., Arizona, New Mex. and Western Texas, but he may have included specimens of other species in this distribution.

Tibicen inauditus Davis.

The six males of this species collected in Oldham Co., Texas, in 1917, 1918 and 1919, by Miss M. McGill, are referred to in this JOURNAL for March, 1921. Recently Mr. Raymond H. Beamer, of the University of Kansas, has sent for identification another male. It came from Las Vegas, New Mexico, June 11, 1925. This is about 150 miles west of the type locality. Miss McGill described the song as "very shrill."

Tibicen longiopercula new species. Pl. XXI, figs. 3 and 4.

Type male, Chiricahua Mts., Cochise Co., Arizona, June 10 (H. G. Hubbard collector). Collection U. S. National Museum.

Resembles *T. chiricahua* and *T. parallela*, particularly the first named, described and figured in this Journal for March, 1923.

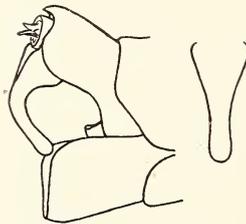
Head across eyes broader than the anterior width of the pronotum; front moderately produced and slightly more so than in *chiricahua*; no median sulcus; transverse rugæ well defined. Many white hairs on the face, the remainder of the under side of the body with but few hairs except on the legs. The opercula overlap at the base; are very long reaching the last ventral segment and end in rather conspicuous points that are bent outward as shown in the illustration. The last ventral segment is rounded and feebly notched at the extremity. Uncus bent as shown in the illustration, and armed on the inner surface from near the base to the rounded extremity with many short bristles. Sides of the body parallel for a considerable distance.

Body black; head with pale spots, one at base and apex of front, a small one near each eye and two on posterior margin. At first view the head appears black except for the small orange spot on apex of front, the remaining spots being so inconspicuous. Pronotum black with inconspicuous dull

testaceous spots centrally; posterior margin narrowly edged with testaceous. Mesonotum with two curved orange colored lines centrally extending backward from the front margin about half way to the cruciform elevation. Near the base of each fore wing there is an inconspicuous pale spot. The cruciform elevation is orange, black centrally, with a black band crossing each of the anterior limbs. Abdomen black above with a rather large dull orange spot centrally on each tympanum; pruinose each side on segments three to eight, which last has two orange spots, one on each side. Underside of body dark, variegated with orange on the head and thorax; conspicuously red on the metasternum near the insertion of the hind pair of legs which are lighter in color than the fore and middle pair of legs. The long opercula, which almost completely cover the underside of the abdomen, are conspicuously reddish and shining, especially near the extremities. The last ventral segment and valve are also reddish and shining. Fore wings with the basal area opaque; venation brown, darker about the marginal cells; first and second crossveins clouded. The basal membranes of both pair of wings are grayish, variegated with spots of bright orange at their extreme base, that is near the body.

MEASUREMENTS IN MILLIMETERS

| | Male Type |
|------------------------------------|-----------|
| Length of body | 28 |
| Width of head across eyes | 10 |
| Expanse of fore wings | 72 |
| Greatest width of fore wing | 12 |
| Greatest width of operculum | 6 |
| Greatest length of operculum | 11 |



TIBICEN LONGIOPERCULA. TYPE

This very distinct insect, of which only the type is known, may be taken for *Tibicen chiricahua* if viewed from above only, but when turned over the remarkably long and pointed opercula readily separate it from other realted species thus for described. The inner surface of the uncus is also very characteristic and

reminds one of a scrubbing brush, being very different from the smooth inner surface of the same organ in *chiricahua* and *parallela*. In the last named species the short uncus has many minute bristles on the outer part of the uncus.

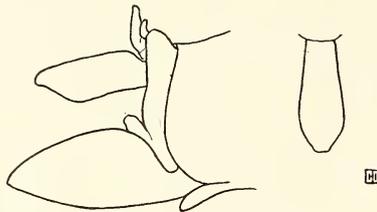
Okanagana formosa new species. Pl. XXII, figs. 1 and 2.

Type male from Coal Creek, Iron County, Utah, June 27, 1919, and allotype from the same place, June 25, 1919 (Tom Spalding). Davis collection.

This large and beautifully colored species resembles *Okanagana cruentifera*, but is slimmer, has a narrower head, a somewhat differently shaped uncus, and the hind margin of the pronotum or collar is orange instead of all black. From *Okanagana schaefferi* it differs in having the front less prominent, in not having the pronotum edged all around with orange and in the front femora, which have a broad orange stripe on the outer side instead of being all black except the distal tips as in *schaefferi*. The uncus is also not as short and stout as in *schaefferi*. Head slightly narrower than the front margin of the pronotum; front considerably produced and prominent. Median sulcus of the front well defined with the sides nearly parallel approaching near the top. Pronotum with the humeral angles rounded, and the anterior angles prominent. Last ventral segment with the sides nearly parallel to the rounded extremity. Uncus black, and when viewed in profile, with the top and lower lines nearly parallel until the extremity is approached. When viewed from behind, with a shallow notch at the extremity. The valve in the male extends beyond the uncus, is orange, blackened at the sides. The last ventral segment of the allotype is deeply notched with a very slight indication of an inner notch. Fore wings about as in *cruentifera* with the costal margin orange almost to the end of the wings, where it is slightly darkened; basal cell opaque. The venation is paler than in either *cruentifera* or *schaefferi*; only the marginal cells are surrounded by fuscous veins. The base of both pairs of wings, as well as the membranes or flaps, are bright red. Head black in the type; in the allotype there is an inconspicuous pale spot above each antenna. Pronotum black with the hind margin or collar orange, and irregular ferruginous areas each side of the central line. In the allotype there is a central pale line separating the ferruginous areas. Mesonotum black with the posterior margin and the following reddish orange; two spots each side, one at the base of each of the wings, the posterior extremities of the obconical central marks; the anterior extremities and the elevated central portion of the \times . Metanotum narrowly margined posteriorly with reddish orange. Tergum black with the hind margins of the segments very narrowly margined with reddish orange. In the allotype the two last segments are broadly margined with reddish orange. Beneath the legs are marked with reddish orange and black, and the fore femora are not encircled with black and pale at the extremities as in *schaefferi*. The abdominal segments are reddish orange centrally, each broadly marked with black near the outer margin.

MEASUREMENTS IN MILLIMETERS

| | Male | Female |
|---------------------------------|------|----------|
| | Type | Allotype |
| Length of body | 27 | 27 |
| Width of head across eyes | 7 | 8 |
| Expanse of fore wings | 68 | 72 |
| Width of fore wings | 11 | 13 |
| Length of valve | 4 | |



OKANAGANA FORMOSA. TYPE.

The writer formerly included these two specimens with *Okanagana cruentifera* Uhler, but now that a considerable series of that species has been examined, they are seen to be distinct.

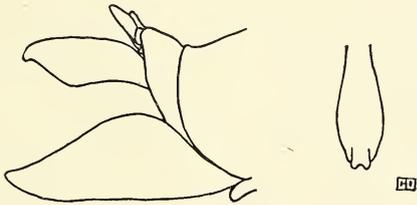
***Okanagana cruentifera* (Uhler). Pl. XXII, fig. 3.**

In this JOURNAL for June–Sept., 1919, *Okanagana cruentifera* is defined and figured from the Nevada specimens discovered in the Uhler collection, U. S. National Museum. Four additional specimens labeled “Nev.” from the Uhler collection have since been examined. One of them probably was before Uhler when the description was written. It bears a label “*Cicada cruenta*. Uhler, Nev.,” written by Uhler, and on a more recent label is written “*Cicada cruenta*. Uhler, Nev., Det. Uhl.” This specimen is here figured natural size from a photograph. A figure of the uncus is also given.

While *cruentifera* and *magnifica* of the same region bear considerable superficial resemblance, both having the same crinkled wing appearance with the venation coarse and somewhat clouded about the marginal areas, a comparison of the uncus (see this JOURNAL, 1919, p. 190), of the much less prominent front in *magnifica*, together with its larger size and shape of wings, will serve to separate the two.

Uhler's original description of *cruentifera* in the Trans. Maryland Acad. of Sciences, 1892, states that it is "A large and long-winged, narrow, dull black species with bright orange costa and blood red flaps to both wings." Some of the other features mentioned are, front of head prominent; "pronotum short, black, moderately pubescent, rugulose, emarginated in the lateral margin behind the middle, the edge in front of this with several short blunt teeth"; veins of the wings, "coarse, piceous black, as also the post-costal rib beyond the anastomosis, the basal areole long and narrow, infuscated, bordered anteriorly by an orange yellow vein." "Venter broadly red along the middle line, or with the segments bordered with red, and the lateral raised edge also slenderly red, tergum minutely pubescent, the posterior edge of the segments red, but with the two apical segments more broadly banded with red, the genital sheath red, short, sub-acuminate, tooth of the apical segment of female short and acute, posterior border of the last segment of the male deeply emarginate."

Other specimens examined since 1919, have been a male from Prof. Frederick M. Gaige, labelled Winnemucca, Humboldt Co., Nev., June 24, 1920 (B. C. Cain); a female from near Yreka, Siskiyou Co., Calif., July 29, 1925 (Mr. Wright) and a fine series of 10 males and 3 females from Cactus Flat, San Bernardino Mts., Calif., June 8, 1925 (Alonzo C. Davis).



OKANAGANA CRUENTIFERA UHLER.

It is now evident, with the present series of *cruentifera* available, that it is not as variable as once thought, and that the three females reported in this JOURNAL, March, 1921, from Colorado, must belong to some other species.

Also a number of specimens have been examined that might be confused with *cruentifera*, because they are to be found in the same region, and have the "blood red flaps to both wings," as described by Uhler for that species. They differ both in the shape of the uncus and in that of the wings, as well as in having the venation much less coarse. This insect may at present be considered as a race of *Okanagana tristis* Van Duzee, though it may also prove in the future to be a distinct species.

Okanagana tristis Van Duzee, race **rubrobasalis**. New race. Pl. XXII, fig. 4.

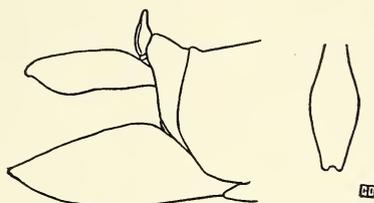
Type male, Nellie, San Diego Co., Calif., June 24, 1918 (Miss E. P. Hewlett).

Allotype female, Upland, San Bernardino Co., Calif., July 1, 1920 (Miss E. P. Hewlett). Davis collection.

Head slightly narrower than the front margin of the pronotum; front moderately produced; about as in *tristis* and less prominent than in *cruentifera*. Median sulcus of the front well defined. Pronotum with the humeral angles rounded, and the anterior angles prominent. Last ventral segment with the sides gradually converging toward the rounded extremity as in *tristis*, not as constricted at the sides as in *cruentifera*, nor as truncate at the extremity. Uncus when viewed in profile with the top and lower lines nearly parallel until near the extremity, which has beyond the sinuation a slight tooth. When viewed from behind, with a broad notch at the extremity. The valve in the male is long, red, with a black spot each side. The last ventral segment in the allotype is broadly and doubly notched. The inner notch is more pronounced in some of the paratypes. Fore wings narrow, with the costal margin pale (except the extreme outer edge which is dark) to the end of the radial cell, darker beyond; the subcostal vein is fuscous; basal cell opaque. The venation is fuscous about as in *tristis*, but the flaps are blood-color and not orange or reddish-orange as in *tristis*. Head black except an inconspicuous pale spot above each antenna. Pronotum entirely black in the type and allotype; in some of the paratypes there are two irregular rufous spots one each side of the central line, as is occasional in *tristis*. Mesonotum black with the posterior margin and the following pale: two spots each side, one at the base of each of the wings, the posterior extremities of the obconical central marks; the anterior extremities and the elevated central portion of the \times . Metanotum narrowly margined posteriorly with red. Tergum black and more shining than in *tristis*, with the hind margins of the segments narrowly margined with red at the sides. In the allotype the two last segments are broadly margined with orange. Beneath the legs are marked with orange and black. The abdominal segments orange centrally, as is usual in *tristis*, each spotted with black near the outer margin.

MEASUREMENTS IN MILLIMETERS

| | Male Type | Female Allotype |
|---------------------------------|--------------|--------------------|
| Length of body | 29 | 27 |
| Width of head across eyes | 8 | 8 |
| Expanse of fore wings | 72 | 74 |
| Width of fore wings | 12 | 12 |
| Length of valve | 5 | |



OKANAGANA RUBROBASALIS. TYPE.

The bright red color at the base of both pairs of wings, the more shining appearance, and generally broader wings, will serve to distinguish this race from *tristis*, which is more northern in distribution.

Of *rubrobasalis* nine examples can be recorded in addition to the type and allotype. Angeles Forest, Barley Flats, Calif., Alt. 5,500 ft., June 19, 1917, female (V. Duran); Confidence, Tuolumne Co., Calif., July 21, 1919, Alt. 4,000 ft., female (R. D. Hartman); Santa Barbara, Calif., July 1924, female (F. E. Winters); Upland, San Bernardino Co., Calif., July 1, 1920, two females (E. P. Hewlett), taken with the allotype; Nellie, San Diego Co., Calif., June 20, 1918, male (Miss Esther P. Hewlett, who records that "it was sitting on a brake fern making a deafening racket"); Buckman Springs, San Diego Co., Calif., June 17, 1925, male and female (Prof. W. S. Wright); Nevada, male, collection U. S. Nat. Mus.

Of the foregoing specimens the only one about which there is any doubt is the female from Santa Barbara, which has broader wings and is more shining than *tristis*, but which has the color at the base of the wings not as bright red as in the other eight examples.

The localities of the 27 specimens of *tristis* in the writer's collection extend all of the way from Mt. Rainier in Washington, southward to Tulare and Nevada counties in California. A male taken near Davis Creek, Modoc Co., Calif., June 1922, by Dr. A. W. Lindsey, is here figured.

Okanagana lurida Davis

Since the description of this species in this JOURNAL, June-Sept., 1919, and the note in the March, 1925, number, three more males have been examined. They are from the U. S. National Museum and were collected at Wawawai, Whitman Co., Washington, by M. C. Lane. Two were collected May 31, 1921, and one May 30, 1923. Wawawai is about 10 miles southwest of Pullman, the type locality. One of the males is much darker than the others and the valve is black edged with orange on the upper edge or margin. Upper parts of fore femora nearly all orange. The nearly clear basal cell appears in all specimens so far examined to be slightly longer and narrower than the basal cell in *bella* or *occidentalis*. The front of the head is more rounded than in *bella* which occurs in the same region.

Okanagana mariposa Davis.

Records for this large species are to be found in this JOURNAL for March 1915, June 1919, and March 1921. On June 17, 1925, Prof. W. S. Wright collected at Buckman Springs, San Diego Co., Calif., 11 males and 2 females, and on June 23, 1925, a single female. In all of the specimens so far examined from California, the basal portion of both pairs of wings show bluish-white reflections, but those from Buckman Springs are very noticeable in this respect, and are beautifully colored.

Okanagana arctostaphylae var. *opacipennis* new variety. Pl. XXIII, fig. 1.

Type female, Buckman Springs, San Diego Co., California, June 23, 1925 (Prof. W. S. Wright). Davis collection.

Resembles closely in size and general color *arctostaphylæ* Van Duzee described in this Journal, March, 1915, except that the front margin of the fore wing is more curved near the tip; the abdomen entirely black above except the two terminal segments (instead of having merely a dorsal line of black), and both pairs of wings deeply reddish-ferruginous in color and opaque. The color about each of the veins is less intense than in the

central parts of the cells. The cotype of *arctostaphylæ* in the writer's collection has the "elytra with a distinct purplish tinge," as described by Van Duzee, but they are nevertheless transparent and the label on the insect may be read through them as is generally the case in *Okanagana*. The red at the base of all of the wings is not apparent, but merges into the general color. The front of the head is as in *arctostaphylæ*, except that the median sulcus is very narrow and only about one half as wide as in the cotype of that species. The eyes and ocelli are encircled with black and the humeral angles of the pronotum are black. The last ventral segment of the female is doubly notched.

MEASUREMENTS IN MILLIMETERS

| | Female Type |
|-----------------------------------|-------------|
| Length of body..... | 25 |
| Width of head across eyes..... | 7 |
| Expanse of fore wings..... | 67 |
| Greatest width of fore wing | 10 |

The original description was made from four males and one female collected on manzanita bushes by Dr. F. E. Blaisdell at Mokelumne Hills, Calaveras Co., at our altitude of 1,800 feet. The type of variety *opacipennis* was also found on a manzanita bush. It is one of the most remarkably colored of all of the species of *Okanagana* so far described. A more common and also very beautiful species that frequents the manzanita is *Okanagana rubrovenosa* Davis, and of this Prof. Wright took a female at Buckman Springs on June 17 and a male on June 23, 1925. This species is known from as far north in California as Plumas and Lake counties.

Clidophleps blaisdelli (Uhler).

An examination of the specimens in the U. S. National Museum, has enabled the writer to make the following memoranda, and also to present natural size figures from photographs of two important specimens.

Male, "San Diego, Cal.," on one label, and "5-10-11" on another label (P. R. Uhler Collection). Pl. XXIII, fig. 2. Male, "San Diego, Cal.," on one label, and "May 11, 1890" on another label (P. R. Uhler Collection). This specimen was marked by Uhler "*Tibicen Blaisdellii* Uhler, Cal." A still later label reads: "*Tibicen Blaisdellii* Uhl. Cal. Det. Uhl." Pl. XXIII, fig. 3.

In the original description of *blaisdellii*, Trans. Maryland Academy of Science, January, 1892, is the statement: "Only males have yet been examined. Specimens have thus far proved scarce. This curious species was discovered in the vicinity of San Diego, Cal., May 10-11, by Dr. F. E. Blaisdell, of Coronado, to whom the species is dedicated. . . ." The two specimens here mentioned and figured are therefore no doubt part of the original lot and perhaps the only ones before Uhler at the time he made the description of *blaisdellii*. The original description gives "Length to apex of abdomen 20-24; expanse of wing-covers 59-66; and width of base of pronotum $9\frac{1}{2}$ -11 millims."

See Mr. Van Duzee's notes on this species, Journal, N. Y. Ento. Soc., March, 1915, and Trans. San Diego Soc. of Natural History, vol. 2, p. 47, 1914. Also notes by the writer, this Journal, March, 1917.

Clidophleps wrighti new species. Pl. XXIII, figs. 4 and 5.

Type male, Upland, San Bernardino Co., California, June, 1922 (Miss Esther P. Hewlett).

Allotype female, Buckman Springs, San Diego Co., California, June 23, 1925 (Prof. W. S. Wright). Davis collection.

Generally smaller than the average examples of *blaisdelli*, *distanti* and its varieties; pronotum black at the sides, not bordered with yellow, venation coarser; the red at the base of all of the wings brighter, the uncus differently shaped and as figured.

Head as broad as the front margin of the pronotum; front produced as in *blaisdelli*. Median sulcus of the front well defined. Pronotum with the humeral angles produced with the angles rounded, sides serrulate, and anterior angles well defined. Opercula with the extremities angled as in *blaisdelli*. Last ventral segment rounded at the extremity with a slight sinuation centrally. Last ventral segment in the allotype broadly and doubly notched. Uncus when viewed in profile bent downward at the extremity which is considerably rounded, and deeply sinuate on the lower surface of the apical third (not half as in allied forms); shorter than valve. Basal cell of the fore wings clear. Costa of the fore wings pale to the end of the radial cell, black beyond; all of the other veins coarse and black.

General body color black, variegated with orange. Head black both above and beneath with a pale spot centrally on the posterior margin, being a continuation of the pronotal stripe. Pronotum black with a central stripe and the posterior border orange. No orange at the sides. Mesonotum black with the following orange: tips of the two obconical marks;

anterior extremities and top of \times ; posterior margin extending to the base of the wings. In the depression on each side of the \times there is a patch of long silvery hairs. Metanotum black, margined posteriorly with orange. Dorsum of the abdomen black with much silvery hair, the posterior margins of the segments orange. The uncus black. Valve nearly entirely pale with the lower surface darker. The legs are black striped with orange. The lower surface of the abdomen is covered with silvery hairs; each of the segments margined posteriorly with orange.

MEASUREMENTS IN MILLIMETERS

| | Male Type | Female Allotype |
|----------------------------------|-----------|-----------------|
| Length of body..... | 21 | 20 |
| Width of head across eyes..... | 6 | 6 |
| Expanse of fore wings..... | 54 | 55 |
| Greatest width of fore wing..... | 9 | 9.5 |
| Length of valve..... | 3 | |



CLIDOPHLEPS WRIGHTI, TYPE.

In addition to the types the following specimens from California are in the writer's collection: Upland, June 18, 1920, two males (Miss E. P. Hewlett); Buckman Springs, June 23, 1925, two males and a female (Prof. W. S. Wright). Some of these are smaller than the type.

At Buckman Springs on June 17, 1925, Prof. Wright also collected a male and female *Clidophleps blaisdelli* Uhler.

Platypedia rufipes Davis.

This species was described and figured in this Journal, June, 1920, p. 101, from Los Angeles Co., California. At that time seven specimens were examined. In 1925 Mr. Alonzo C. Davis collected six males and nine females at Cactus Flat, San Bernardino Mts. on June 8th; and Prof. W. S. Wright collected two males and four females at Buckman Springs, San Diego Co.,

Calif., on June 17, and twelve males and seven females at the same locality on June 23. In the series from Cactus Flat the fore wings are slightly broader than in those from Buckman Springs, and in each series there are large individuals expanding over 50 millimeters.

Platypedia laticapitata Davis.

This species was described and figured in this Journal, March, 1921, from a male and female collected at Upland, San Bernardino Co., Calif., in June and July, 1920. In 1922, Miss Esther P. Hewlett collected at the same locality seven males and four females in June, and two females in July. More recently Mr. Alonzo C. Davis has sent to me a female from Sierre Madre, Los Angeles Co., Calif., June 21, 1919, and a male from Pasadena, Calif., June 15, 1924. The range is thus extended slightly.

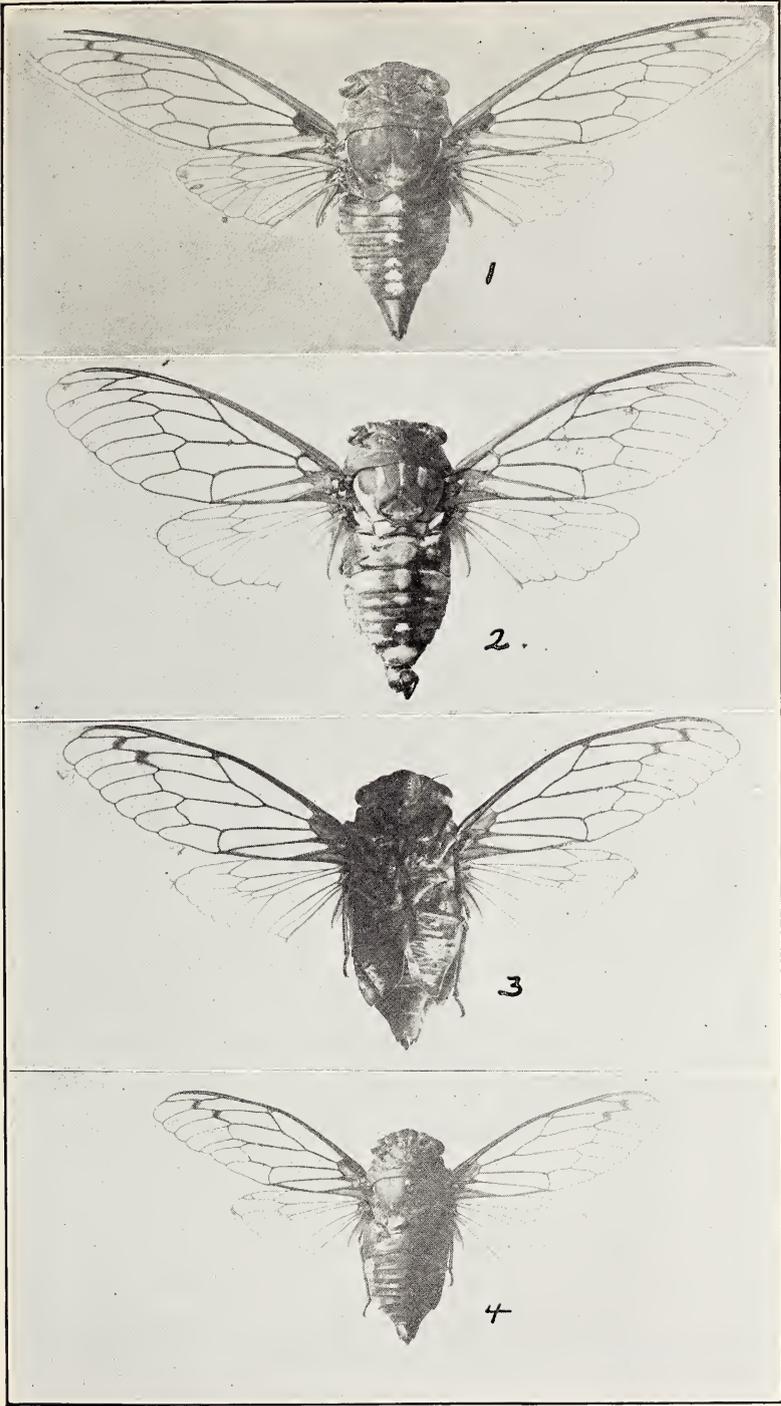
Note. The writer has lately placed in the collection of the Am. Museum of Natural History a number of types of cicadas described in this Journal, and it is his intention to place his remaining types in the same collection.

THE ENTOMOLOGY OF HAKLUYT'S "VOYAGES," II

"Our General considering the great distance, and how farre he was yet off from his Countrey, thought it not best here to linger the time any longer, but waying his anchors, set out of the Island, and sayled to a certaine little Island to the Southwards of Celebes, where we graved our ship, and continued there in that and other businesses 26. dayes. This Island is thoroughly growen with wood of a large and high growth, very straight and without boughes, save onely in the head or top, whose leaves are not much differing from our broome in England. Amongst these trees night by night, through the whole land, did shew themselves an infinite swarm of fiery wormes flying in the ayre, whose bodies beeing no bigger than our common English flies, make such a shew and light, as if every twigge or tree had bene a burning candle." (From "The Famous VOYAGE OF SIR FRANCIS DRAKE into the South sea, and therehence about the whole Globe of the earth, begun in the yeere of our Lord, 1577.")—Ed.

PLATE XXI

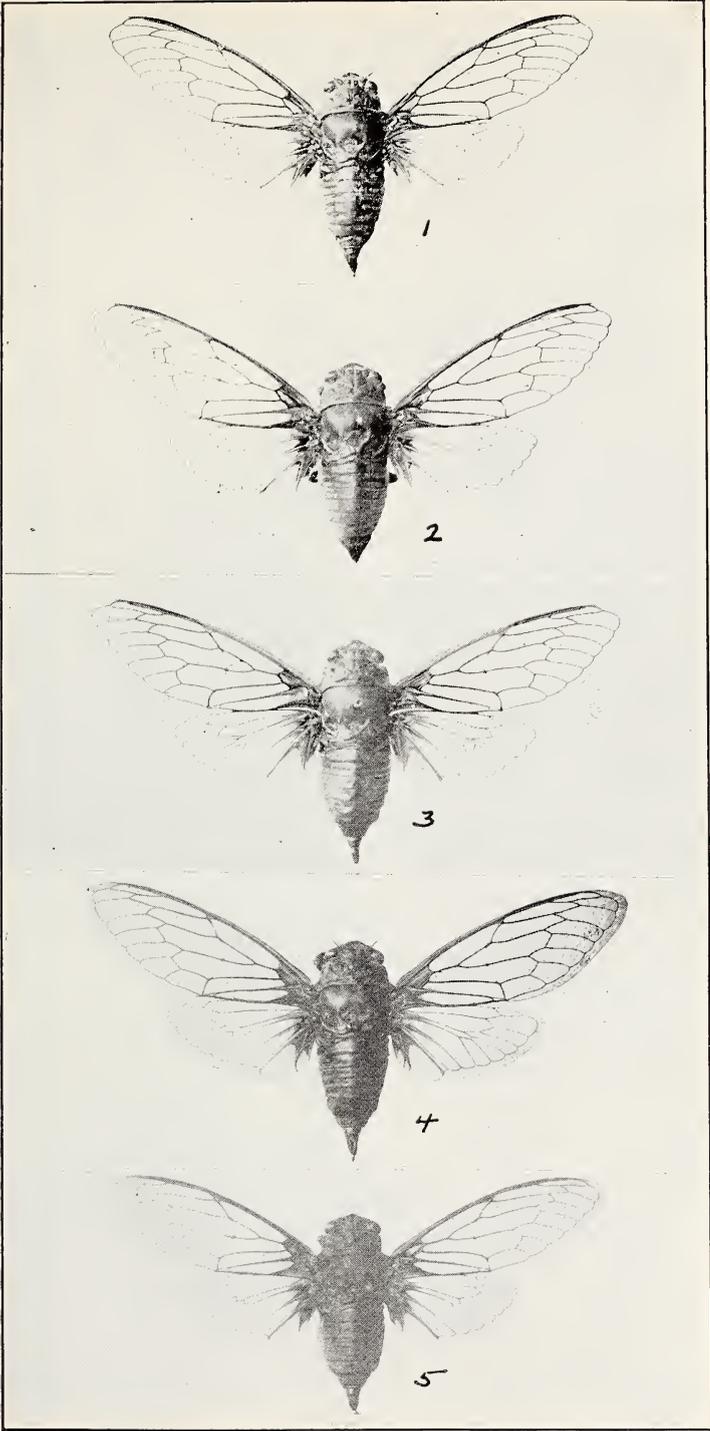
- Figure 1. *Tibicen figurata* (Walker). Showing dorsal spots.
Figure 2. *Tibicen dorsata* (Say). With whitened sides.
Figure 3. *Tibicen longiopercula* Davis. Type. Under side enlarged.
Figure 4. *Tibicen longiopercula* Davis. Type. Natural size.



CICADIDAE

PLATE XXII

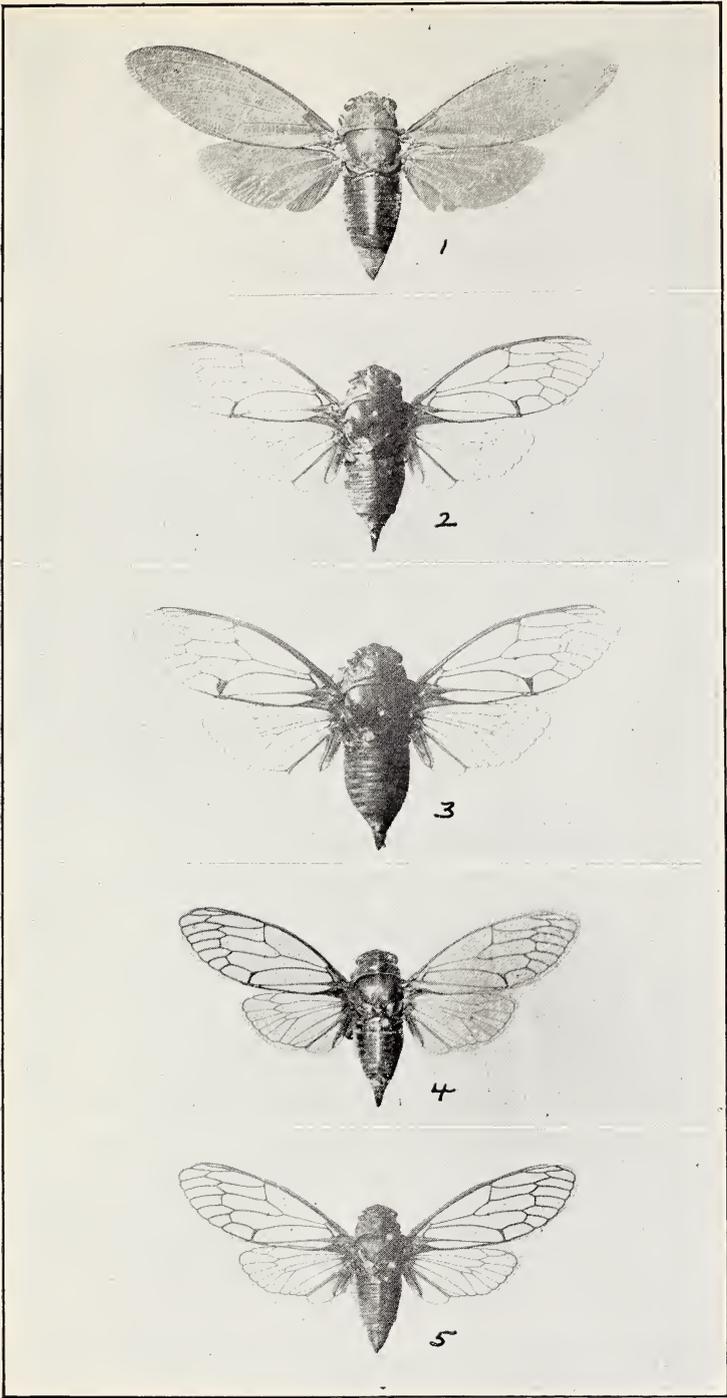
- Figure 1. *Okanagana formosa* Davis. Type.
Figure 2. *Okanagana formosa* Davis. Allotype.
Figure 3. *Okanagana cruentifera* (Uhler).
Figure 4. *Okanagana rubrobasalis* Davis. Type.
Figure 5. *Okanagana tristis* Van Duzee. Modoc Co., Calif.



CICADIDAE

PLATE XXIII

- Figure 1. *Okanagana aretostaphylæ* var. *opacipennis* Davis. Type.
Figure 2. *Clidophleps blaisdelli* (Uhler).
Figure 3. *Clidophleps blaisdelli* (Uhler).
Figure 4. *Clidophleps wrighti* Davis. Type.
Figure 5. *Clidophleps wrighti* Davis. Allotype.



CICADIDAE

A PRELIMINARY REPORT ON THE SEASONAL MIGRATIONS OF INSECTS

BY HOWARD J. SHANNON
JAMAICA, N. Y.

Certain of the broader aspects of insect migrations as they occur in the Northeastern United States were presented eleven years ago (*Sci. Monthly*, 3: Sept., 1916, 227-240 and *Harper's Magazine*, 131: Sept., 1915, 609-618). Since that time more intensive studies have been in progress. They have been directed toward a discovery of our little known migratory species, and also toward an analysis of the factors operative in producing the phenomena observed. We will first review the conceptions advanced in 1915. It was suggested that apparently occasional movements of certain insects, such as dragonfly migrations for example, were really regular seasonal events, and followed constant definite directions from year to year. It was also suggested that a greater number of orders and species of insects than had hitherto been shown were also regular migrants with the seasons; and notwithstanding dispersal movements on a large scale which affect the Rocky Mountain locust and other forms, there was actually a regular and ascertainable north-to-south and south-to-north movement in our hemisphere and territory.

This conception as applied to certain dragonflies was then supported by data gathered in the field and by certain sparse records in our North American literature. It was also supported by a detailed tabulation of all authentic European records—a total of thirty-four then discoverable in the literature. Since that time further records have appeared. Dr. Raymond Osburn has reported a Connecticut flight (*Jour. N. Y. Entom. Soc.*, 1916, vol. 24, 90-92) and Dr. R. Heber Howe, Jr., announces observations in Massachusetts (*Proc. Boston Soc. Nat. Hist.*, vol. 36, No. 2, III). With both observers the flights were

autumnal and moved southward. It was also predicted that spring northward flights would be observed in this country, *even though none were known*, if we except the possibly inconclusive observations by Bradford Torrey on the Massachusetts coast (Amer. Nat., vol. 14, pp. 132-133 and p. 594). Such spring and early summer flights have since been studied by the writer, all consistently moving northward or along coast-lines in accordance with that direction. A total of more than 60 dragonfly flights have been observed, including both seasons of the year.

An elaborate tabulation of data at all comparable with bird-migration records has long been lacking. Nor have the intervening eleven years offered other than inconsiderable progress in this direction. Experimental studies in fields, quite apart from migration phenomena in fact, have offered some of the more significant suggestions of recent years. Also notable studies of Diptera migrations in Africa should be noted, and will be referred to again in their proper place.

Detailed records, then, it has been the writer's attempt to supply. They are necessarily limited to quite local territory. Five stations, among others, were chosen along the eastern Atlantic coast. No. 1 is located at Long Beach, L. I., about mid-way of its length of eight and one-half miles of shore; No. 2 on the same beach about three miles to the westward, and No. 3 on the Far Rockaway shore almost diagonally northwestward from the western extremity of Long Beach. No. 4 is located at Norton's Point, the western tip of Coney Island, while No. 5 is located at Longport, N. J., about one hundred miles farther south on the shore of Great Egg Inlet. At all these points records have been made. The most time has been spent at Stations 1 and 2 which accounts for the fuller records from these points. Here as well as elsewhere movements of Odonata have been tabulated, also those of Lepidoptera, Hymenoptera, Coleoptera and Diptera. Plant and other ecological relationships have also been considered in these localities.

Our most widely known insect migrant, *Anosia plexippus*, could not be ignored. In fact considerable attention has been given

to this butterfly. Its autumn behavior offers, in the first place, excellent material for study. Moreover recent literature has revealed rather striking misconceptions regarding these autumnal aspects of its life-history. Considerably over sixty flights have been observed. Its spring appearance also is revealed to us in such sparse data that careful observations were made. Specimens have been taken in various years; the relative proportion of the sexes determined; their microscopic appearance; their behavior as they enter our territory and the characteristics of the subsequent generation.

Other Lepidoptera migrants of autumn and spring have been tabulated, an elaboration of the suggestions made nine years ago and supported at that time by brief data only (Amer. Mus. Jour., vol. 17, No. 1, pp. 32-40). Over forty such flights have been detailed.

Special attention has been given to the Diptera exclusive of the Culicidæ. This is virtually an untouched field. For little is offered in the literature concerning such phenomena in North America excepting accounts of wandering *Sciara congregata* larvae and records of flies found in out-of-the-way places (Mr. S. C. Ball, Pap. Dept. Mar. Biol. Wash., 12, 1918, pp. 193-212). Only a brief description by Scudder of a moving column of *Ilythea spilota* along the New Hampshire coast offers any real picture of a dipterous migration as conceived by the writer (Psyche, vol. 5, No. 172-174, pp. 402-403). European literature is hardly more satisfactory. Only notes of what appeared to the observers as swarmings of Syrphids are noted, interspersed with several brief accounts of flights along the British coast during the notable visitation of the year 1864. Professor Eimer's brief account of Syrphids travelling southwestward in autumn when they companioned a dragonfly swarm is significant; as also, Dr. Roubaud's studies of the seasonal migrations of the Tsetse fly in Africa. He found that *Glossina morsitans* and other species performed annual movements in Dahomey, and of undoubtedly considerable extent, in direct response to the meteorological conditions affecting them and their environment.

What then does the writer mean by a Diptera migration? Care has been taken to rule out purely ephemeral movements due to brief or accidental reactions occurring in regions where flies congregate. On the other hand true migrations, but of a probably delimited character, may be seen in the case of certain small flies like the kelp fly. I have seen this species, *Fucellia maritima*, moving along in swarms of many hundreds, or even thousands, through localities by the seashore where its habitat is made. Quite probably Scudder's *Ilythea* flight was of this nature.

More significant dipterous phenomena occur. Nothing less than veritable streams of various flies sometimes appear moving more or less in unison and passing in hundreds, which readily total into thousands, during the several hours through which such a seasonal procession usually persists. They occur every year and more than once a year, usually at a certain definite period. Often the flight consists mostly of moderate-sized species like *Cochliomyia macellaria* Fabr., *Phormia regina* Meig., and others intermingled with fewer larger forms like *Calliphora erythrocephala* Meig. Syrphids are in the great majority only rarely. So the migratory trends of *Eristalis tenax* Linné stressed on the map are not emphasized because of the necessarily profuse numbers present. It is readily identified on the wing, is a common participant, and can be perceived for considerable distances winging far out over the water-barriers or approaching the shore after such a passage. So it serves to define certain otherwise conjectural air-lanes of travel. Since 1915 fifty such Diptera movements have been observed, all autumnal and moving westward on Long Island (except for the over-water flights noted) and southwest in New Jersey.

Certain species are identified from year to year. They are taken with negligible exceptions only when active in full driving flight as participants in definite migratory behavior. *Cochliomyia macellaria* has been taken at either Stations 1 or 2 in a total of five different years, at Station 5 in one year; *Stomoxys calcitrans* Linné at either Stations 1 or 2 in a total of six different years, at Station 5 in one year; *Eristalis tenax* Linné has

been taken at either Stations 1 or 2 in a total of five different years, at Station 4 in one year, at Station 5 in six different flights of the same year. Other species show a similar constancy. Also other families beside the Muscidae and Syrphidae are represented which justify the statement that a migratory tendency is widely distributed in the Diptera, and involves many individuals and species in annual movements of undetermined extent.

No claim is made that individuals moving southwest at Longport, N. J., one hundred miles south of Long Island, are the same ones that passed through this locality. An identity of species may be deceptive. On the other hand Dr. Howard has said, "and if it (*Musca domestica* Linné) were obliged to fly great distances the writer has little doubt of its ability to do so." Incidentally this species has been taken at either Stations 1 or 2 in a total of five different years participating in apparent migrational flight. Only marking experiments however will prove decisive. The accurate identification of all species I owe to the kindness of Mr. Charles W. Johnson who has gone over the hundreds of specimens taken.

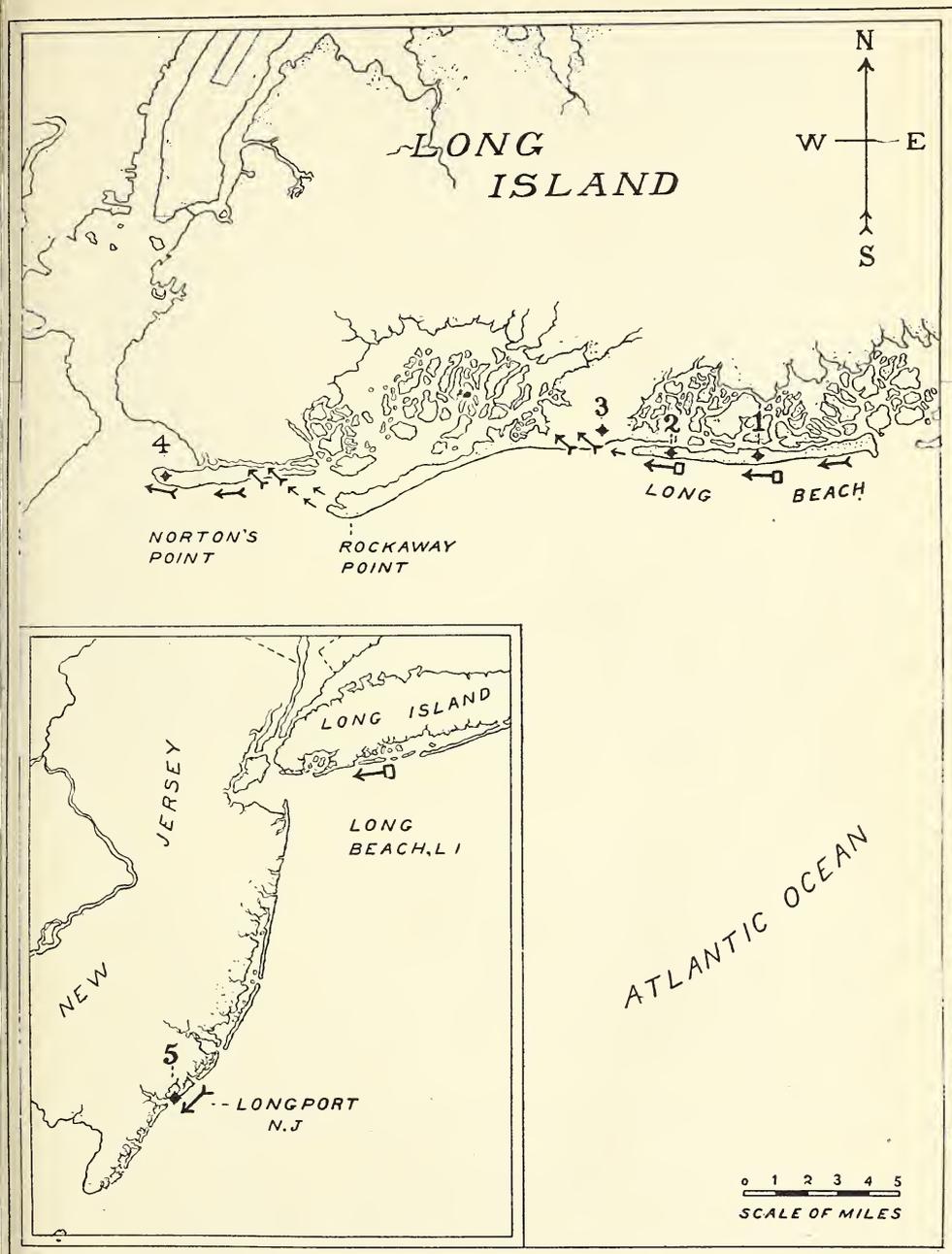
It has become possible to map out broadly the seasonal periods when various orders became migratory; also by a study of meteorological conditions it is often possible to predict the occurrence of flights early in the morning of the days when they occur. Spring behavior in all orders has received less attention. This is partly due to weather conditions in recent years and also to the writer's abbreviated opportunities at that time. No conclusive records of spring Diptera migrations have been obtained; it seems inevitable they should occur.

This report would be incomplete if it failed to acknowledge the unfailing encouragement offered to the writer, during the progress of these studies, by Mr. Andrew J. Mutchler of the American Museum of Natural History.

EXPLANATION OF PLATE XXIV

AUTUMN MIGRATIONS OF DIPTERA AND OBSERVATION STATIONS

Cube-tipped arrows illustrate the annual migrations of *Cochliomyia macellaria*, *Eristalis tenax* and other species. Feathered arrows show occasionally observed flights (probably annual) of *Eristalis tenax* and other species; *unfeathered* arrows the presumable earlier steps in flights over the water from points of land southeastward. Similar behavior is exhibited by *Anosia plexippus* and certain other Lepidoptera and Odonata.



MIGRATIONS OF DIPTERA

SYNONYMY OF BUCKTON'S AUSTRALIAN MEMBRACIDAE

BY FREDERIC W. GODING

The synonymy of the Membracidae in Buckton's Monograph of the Membracidae has been worked out by comparing his descriptions and figures with the material upon which the Monograph of the Australian Membracidae was based, although some of his descriptions and figures are so crude that it was difficult to be certain of two or three of them. However, it is believed that the following synonymy is correct.

Genus EUTRYONIA Godg.

Hypsoprora cassis Buckt. = *E. monstrifer* Walk.

Genus ZANOPHARA Kirk.

Daunus decisus Buckt. = *Z. gracilis* Godg.

Daunus succisus Buckt. = *Z. tasmaniae* Fairm.

Centruchoides tasmaniae Buckt. = *Z. tasmaniae* Fairm.

Cæron tumescens Buckt. = *Z. tasmaniae* Fairm.

Cæron contortum Buckt. = *Z. tasmaniae* Fairm.

Ibiceps falcatus = *Z. tasmaniae* Fairm.

Genus SEXTIUS Stal.

Sextius virescens Buckt. = *S. virescens* Fairm.

Pterostieta rubrilinea Buckt. = *S. depressus* Godg.

Pterostieta spreta Buckt. = *S. depressus* Godg.

Pterostieta rubridorsata Buckt. = *S. depressus* Godg.

Pterostieta interposita Buckt. = *S. bipunctus* Fabr.

Pterostieta xantha Buckt. = *S. bipunctus* Fabr.

It is possible that the three forms of Sextius are varieties of one species.

Genus EUFRENCHIA Godg.

Oxyrhachis neglectus Buckt. = *E. neglectus* Buckt.

Genus EMPHUSUS Buckt.

Ibiceps ansatus Buckt. = *E. ansatus* Buckt.

Genus CENTROTYPUS Stål.

Ibiceps lamifer Buckt. = *C. lamifer* Buckt.

Genus DOGRANA Dist.

Sphærocentrus luteus Buckt. = *D. luteus* Buckt.

Philya parvula Buckt., is not a Membracid; it belongs to the Tettigiinæ, and is *Phrynomorpha parvula* Kirk.

Another genus and species must be added to the fauna of Australia:

***Sarantus australensis* new species**

It differs from *wallacei*, Stål (Trans. Ent. Soc. Lond. ser. 3, i, p. 537; Walk. Jour. Linn. Soc. x, p. 193, pl. 3, fig. 12), only in the pubescence which is orange-yellow instead of white and absent on the pronotal posterior process, and in the tegmina which are translucent-yellow with a broad percurrent dark ferruginous central stripe, not ferrugino-fuscous with apical part vitreous. Long. 10, lat. 3.5 mm. Type—♀; Brisbane, Queensland (Batchelor), July, 1901.

LEPIDOPTEROUS LARVAE AS AIDS IN MAGIC

Dr. W. H. R. Rivers, in "Medicine, Magic and Religion" (London, 1924), records the activities of a sorcerer among the Kai, people of the north-eastern portion of New Guinea, in which the feeding habits of lepidopterous larvae are utilized. It is believed by the Kai that a soul-substance pervades all parts of the body and extends to everything that has been in contact with the body. The sorcerer, therefore, secures a fragment of the body of his intended victim or something that he has touched, such as a hair, a drop of perspiration, remains of food, etc., in the belief that he is in possession of a part of the person's soul. This fragment is placed in a piece of bamboo which is hidden and kept warm in the arm-pit of the sorcerer. Soon after, the fragment is wrapped in a leaf of which caterpillars are fond, with the expectation that as the leaf is eaten by caterpillars, the body of the victim will be eaten by worms. Additional dispositions and rites accompany the fragment before the victim succumbs.—H. B. W.

NOTES ON COREIDAE IN THE COLLECTION OF THE
U. S. NATIONAL MUSEUM WITH DESCRIPTION
OF A NEW CATORHINTHA (HEMIPTERA-
HETEROPTERA)

H. G. BARBER

ROSELLE, N. J.

Acanthocephala femorata Fab. = *granulosa* Dallas, Stål, Distant.

Hemipterists have for a long time listed and treated as distinct the Neotropical *Acanthocephala granulosa* Dallas and *A. femorata* Fab. from the southern United States. I have examined two of Distant's specimens of *granulosa* from the Biologia material deposited in the U. S. N. M.—a male from Teapa, Tobasco, and a male from Guatemala. These differ in no important respects from many specimens in the collection from several localities in Mexico and Central America. These agree with the Dallas type figured in the Biol. Centr. Am., Tab. 12, Fig. 9, and answer in all important respects Dallas' description. In the long series before me there is noticeable some variation in the character of the humeral angle as well as the nature of the hind tibial expansion, the premedian tooth may be obtuse or rounded. Coloration of the general surface as well as the antennæ show variations from testaceous-brown to black. After a careful comparison of these Neotropical specimens with many of what we recognize as *A. femorata* from Fla., Miss. and Texas, I am forced to the conclusion that they are one and the same and will therefore have to bear Fabricius' name. It is probably due to the mistake of Distant, concurred in by Uhler, in placing *A. Thomasi* Uhler as a synonym of *granulosa* that has delayed the discovery of this synonymy. I believed with Distant that *A. luctuosa* Stål is a synonym of *granulosa* and thus = *femoratus* Fab.

Acanthocephala Thomasi Uhler.

I have examined Uhler's type of this species in the U. S. N. M. collection, a male from Arizona, as well as a long series of both

sexes from the same state and from New Mexico. Uhler's species is very distinct from *granulosa* Dallas and not a synonym of that species as indicated by Distant in the *Biologia* and later agreed to by Uhler. It falls even in a different subgenus, *Acanthocephala* Laporte (Stål), as it has the posterior tibia widely expanded almost throughout and in the female with a distinct angle before the middle. *Thomasi* is relatively more elongate than *granulatus* with the corium of a reddish brown color. The terminal segment of the antennæ, the fore and intermediate tibia, all of the tarsi and the odoriferous orifices bright ochraceous red. The declivous face of the pronotum is more granular, the lateral margin of the pronotum is provided with closer set, finer and more acute tubercles; the posterior margin, before the base of the scutellum more strongly depressed. The antennæ are relatively longer and the first three segments piceous as well as all femora and the hind tibia except at extreme apex. The legs are distinctly longer in both sexes. In the male the hind femora are relatively less swollen, less curved and more gradually contracted at base; the hind tibia within, very narrowly and almost evenly expanded, very slightly widened towards base; this expansion narrower than the tibia itself, finely serrated along edge almost from the base, serrations formed into teeth on apical half. Outer expansion of hind tibia wide, slightly wider at about one-third way from base and very lightly narrowing toward apex; just before apex abruptly truncate. In the female nearly the basal half of the hind tibia within narrowly expanded, this almost evenly not abruptly rounded, its width less than one-third the greatest diameter of the outer expansion, very narrowly extended along the remainder of the tibia to near apex and finely serrated along inner edge; the outer wide expansion continued to very near the apex with an obtuse angle at its widest part just before the middle; towards apex from this tooth the outer margin of this expansion for some distance is almost parallel with the tibia, then just beyond its middle point it begins to gradually round off to end abruptly truncated just before apex; the simple part of the tibia being about as wide as the tibia.

Amblyomia bifasciata Stål.

Van Duzee in his *Catalogue*, p. 92, quotes Bank's *Catalogue* as authority for record of this species from the "Western States."

This record is undoubtedly an error based on a misidentification of Stål's species. No specimens of this species from the United States are to be found in the collections.

Mozena obesa Montandon.

Originally described from Florida. It has a wide range in the southern and western states, as I have seen specimens of it from Miss., Riley Co., Kan., and Nebraska.

Capaneus spurcus and **auriculatus** Stål.

Several specimens of the first named species from Arizona are in the collections as determined by Uhler. However *auriculatus* does not occur in the Uhler or other collection of the museum from the U. S. Uhler in 1876 records it from Mexico, Texas and New Mexico. Without more evidence I think this species should be excluded from our faunal lists.

Capaneus incubitor Fab.

Following Uhler's Catalogue Van Duzee listed this species as belonging to the genus *Capaneus*. It was described by Fabricius as *Lygaeus incubitor* from Carolina and so far as I can determine is a Coreid of unknown identity. Fabricius's complete description in his *Rhyngotorum*, p. 204, "L. thorace obtuse spinoso serratoque ante marginem niveo, corpore grieso" does not give much clue as to its identity. Furthermore its occurrence in Carolina would rather preclude it from that genus. Stål in his *Hemiptera Fabricana* questions this species as apparently it was missing.

Archimerus calcarator Fab.

This was recognized as a species distinct from *alternatus* Say by Uhler although he never described it. Specimens of this species from his collection at the U. S. N. M. bear the label *Archimerus inornatus* Uhl. written in his familiar handwriting.

Hymeniphera clavipes Fab. = **lobatus** Uhler not Burm.

Uhler's single specimen of this species in the collection of the U. S. N. M. from Is. of Grenada was labeled and listed by him as *lobatus* Burm. Although *H. lobatus* is a fairly common spe-

cies in the Greater Antilles, so far as my rather extensive records show, it is absent from the Lesser Antilles where it is replaced by the South American *clavipes* which I have seen from Trinidad.

Corecoris alternatus Dallas.

In my paper in Univ. Iowa Stud. Nat. Hist., X, 18, 1923, I listed the above species as questionably a synonym of *C. fuscus* Thunb. But from a more recent examination of five well marked specimens of Dallas's species from Colombia in the collections, I find that although the two species are closely related Dallas's species has good differential characters. The humeral angles are not bluntly rounded but form a distinct obtuse angle; the pronotum has two broad longitudinal black bands almost coalescing behind; the posterior margin before the scutellum is distinctly sinuate before the scutellum; the alternating yellow and black fascia of the connexivum form clean cut bands.

By means of the labeled Grenada specimens in the Uhler collection I find that Distant was correct in assigning Uhler's *C. batatas* as well as his *diffusus* (not Say) to *fuscus* Thunb. Uhler misidentifying *batatas* as *fusca* and mistaking *C. confluentus* Say for *Sagotylus triguttatus* H. S. did not recognize the true *confluentus* Say and called it *diffusus* Say. In his Check List of 1886 Uhler made another error in placing *cinnamomeus* Hahn as a synonym of *diffusus* Say. Thus from the evidence at hand it looks as if Uhler did not know *diffusus* at all and mistook the true *confluentus* for it. I would therefore arrange the synonymy as follows:

Corecoris fuscus Thunberg.

- = *confluentus* Say (= *Sagotylus triguttatus* Uhler 1876, not H.S.)
- = *batatas* Uhler 1893 and 1894 (not Fab.)
- = *diffusus* Uhler 1893 and 1886 (= *confluentus* Say).

Corecoris diffusus Say. (*cinnamomeus* Uhler 1886 not Hahn).

Sephina limbata Stål.

This is another species cited in error from the United States. Van Duzee questions the record "Calif." in his catalogue. In

the Uhler collection are two specimens of this species labeled in his familiar handwriting "Santa Cruz." This locality undoubtedly refers to Santa Cruz Island, Bay of California, from which Uhler received a number of Hemiptera recorded in his report on the fauna of Lower California. It is a fairly common neotropical species.

Sephina indierae Wolcott. Jn. Dept. of Agric. of Porto Rico, VII, 1923 (1924).

I have had the opportunity of examining two specimens of this recently described species deposited in the collections of the U. S. N. M. It is closely related to *S. maculata* Dallas from Jamaica, though considerably larger with the humeral angles more rounded and the ocelli placed further back in reference to the eyes. The maculations of bright red are of a different pattern in the two species. In *indierae* the lateral margins of the pronotum are bordered with black, somewhat expanded at the humeral angles, the red curved fascia not reaching the lateral margins as in *maculata*, but extending to the posterior margin; the black discal spot is rounded in front not truncated before; the transverse black fascia of the corium reaches the lateral margins.

Chelinidea Hunteri and **canyon** Hamlin.

Lest bibliographers overlook these records I wish to call attention to the reference in Proc. Royal Soc. Queensland, XXXV, No. 4, pp. 2, 3, 1923. The first named species is recorded from near Hermisillo, Mex. I have seen specimens of it from Tucson and Ft. Grant, Ariz., in the collection. The last named species is from Rio Frio Canyon, Texas. Hamlin also describes n. var. *texana* of *C. vittiger* Uhler from So. Texas and Mexico.

Margus repletus Van Duzee.

This recently described species also occurs near Los Angeles, Sta. Monica and Palm Springs, California, according to the data on the specimens of this in the U. S. N. M.

Catorhintha guttula Fab.

I have seen Uhler's specimens of *C. selector* from Grenada. Distant correctly assigned this to *C. guttula* Fab.

***Catorhintha divergens* new species**

Color pale flavo-stramineous, pronotum posteriorly and corium, except narrowly along costal margins, suffused with ferrugineous. Fascia before the eyes (sometimes effaced) and two longitudinal stripes on basal antennal segment, a small black spot on the sides of ventral segments 2 to 5, black. Dorsum of abdomen sanguineous with a central elongate stramineous patch showing through the transparent membrane, the outer and inner limiting nervures dark brown. In fully colored examples the lateral margins of the pronotum are piceous and the punctures of the general surface darker. Beneath pale stramineous.

Head rather flat, about as long as wide, pale stramineous, with the surface roughly punctate, the inner orbits of the eyes reddish brown; the tylus somewhat strongly elevated and projected well beyond the jugae; the antenniferous tubercles unarmed; the post-ocular callosity not so prominent as in *selector*; the bucculae posteriorly much reduced, extending back on a line with the middle point of eyes; basal segment of rostrum not quite reaching base of head, extending back on a line with the posterior margins of the eyes, second segment about twice as long as the third segment and subequal to the fourth, the piceous apex of the latter reaching back to a point midway between the intermediate coxae. Antennae stramineous with the clavate basal segment outwardly provided with two black striae which coalesce near base, this segment subequal to third which is one third shorter than second, the terminal segment is broadly ferrugineous in the middle and a little longer than the second segment. Pronotum only a little wider than long; anterior angles prominent but obtusely rounded, between which lies the depressed narrow collar; the surface coarsely, ferrugineously punctate in somewhat transverse rows except on the anterior callosities; provided with a distinct median longitudinal pale callosed carina, evanescent just before the transverse ridge; the lateral edge compressed and lightly sinuate before the middle; humeral angles prominently projected, almost acute. Scutellum very evidently longer than wide, distinctly and evenly punctate, the apex pale and smooth. Corium suffused with ferrugineous especially laterally and posteriorly, the costal margins narrowly pale throughout; the clavus and corium coarsely and evenly punctate with ferrugineous except on the veins. Membrane vitreous; veins prominent, those along the inner and outer margins broken up and more or less irregular and embrowned.

Type: female, Paradise Key, Florida, collected by E. A. Schwarz and H. S. Barber, Feb. 21, 1919 (U. S. N. M. Collection). Paratypes: a male, Vera Cruz, Mex. (P. R. Uhler); two females Tampico, Mex., Dec. 15, collected by E. A. Schwarz; one female Tehautepec, Mex., collected by F. Knab; one female Santiago de las Vegas, Cuba, June 21, 1917, collected by P. Cardin. (All

in the collection U. S. N. M.) One male and two females Santiago de Las Vegas, Cuba, collected by S. C. Bruner, of the Agricultural Experiment Station.

Quite distinct from any other known *Catorhintha* from our fauna, being more elongate with much more prominent humeral angles than is usual in the genus. The post-ocular callosity is not very obvious. In the Tehautepec specimen the lateral margins of the pronotum narrowly and the punctures of the pronotum, scutellum and hemielytra are heavily infuscated with a distinct fuscous patch on the corium opposite the apex of the commissure; the membrane is non-transparent, fuliginous, with darker veins.

I take this opportunity to call attention to the fact that Stål's key to the Coreidæ (Ofv. Vet. Akad. Forh., 1867, p. 548, Section 66 (43)) is erroneous concerning the length of the bucculae so far as the genus *Catorhintha* is concerned. It should fall in his section 43 (66) close to *Ficana* if not identical with it (vide Fracker 1923).

Anasa Uhleri Stål.

This is another species undoubtedly cited in error as belonging to our fauna, probably based on a misidentification of Stål's species. There is a large paler variety of *tristis* from Arizona which has been confused with *Uhleri*. The two species are certainly very close. Besides the characters given by Stål it is broader across the pronotum posteriorly, the lateral margins of which are more obviously sinuate near the middle.

Paryphes rufoscutellatus Gray.

Still another extra limital species which occurs in Mexico and Lower California. No specimens from the United States are to be found in the extensive collection at the museum. Lower California should be substituted for California.

Savius jurgiosus Stål.

This Mexican species has not been recorded from the United States. There is a single specimen of it in the collection from Brownsville, Tex.

Darmistidus maculatus Uhler, 1893.

This is a synonym of *Xenogenus extensus* Distant as proved by a single specimen, without the head, from St. Vincent in the collection U. S. N. M. labeled in Uhler's handwriting *Darmistidus maculatus*.

THE INSECTS OF THE YÜ LI CH'AO CHUAN

The "Yü Li Ch'ao Chuan" or "Divine Panorama," a Taoist work distributed over the Chinese Empire by persons wishing to accumulate good deeds against the day of judgment, has been translated recently by Herbert A. Giles* and among the agencies of torture mentioned therein, insects play a small part. It is believed by the Taoist that his Purgatory is made up of Ten Courts of Justice lodged in dissimilar places at the bottom of a vast ocean which is located in the depths of the earth. Each court is divided into wards in which diverse kinds of torture are inflicted.

Insects are mentioned first in the fourteenth ward of the third court, presided over by His Infernal Majesty Sung Ti, where the sinners are tormented by insects and reptiles. In the sixth ward of the sixth court they are enclosed in a net of thorns and nipped by locusts. The ninth court is presided over by P'ing Têng and in the thirteenth ward of this court they are stung by wasps and in the fourteenth, tortured by ants and maggots, then stewed and wrung out. Such tortures are mild in comparison with the non-entomological ones of being boiled in oil, having the fingers ironed with hot irons, being licked by flames, pricked with steel prongs, pierced through the ribs, etc. However, provision is made for the wicked Chinaman to obtain partial or complete remission, and thus escape the tortures, by fasting, by prayer, by the circulation of copies of the Divine Panorama as warnings to others and by other devices.—H. B. W.

* Strange Stories From a Chinese Studio, Appendix 1 (New York, 1925).

BOOK REVIEW

Insects Injurious to the Household and Annoying to Man, by Glenn W. Herrick. The Macmillan Company, New York, 1926. \$3.00. (Revised edition.)

Red ants, cockroaches, "buffalo bugs," clothes moths, bed bugs, fleas, houseflies and mosquitoes. Lives there a housekeeper who at some time or another has not experienced dismay at finding her domicile invaded by at least one of these pests about which her knowledge is very meager? Professor Herrick's book, which has been written especially for the housekeeper, contains adequate accounts of all insects that live in houses and are injurious or annoying to the dweller or infest his furnishings and food-stuffs. In addition there are chapters devoted to human parasites, to the insects that annoy the camper and to the poisonous species. Full information is given for their control and the revised edition embodies the results of recent investigations and discoveries. This book which is a model of its kind is printed in clear type, contains numerous illustrations and is attractively bound. It deserves a permanent place in the home library and certainly should be in the possession of every one interested in domestic science. Entomologists too, in particular those in official capacities will find the revised edition of value for reference purposes and for the new information that it contains.—H. B. Weiss.

Applied Entomology, by H. T. Fernald. McGraw-Hill Book Company, 1926. (Second edition), 395 pp. \$3.50.

It is not unusual for a review to commence by directing attention to the minor mistakes of the author and to end by damning the book with faint praise. In the present notice I shall avoid at least such conventional extremes. Professor Fernald after years of teaching experience presents the science of applied entomology in broad, general outlines, such as are needed by the agricultural college student whether in later years he specializes in entomology or not. Chapters are devoted to insects and related creatures, the external and internal structure of insects, their development, insecticides and relationships, the major portion of the book being adhibited to discussions of the various orders

of insects, each group being treated in such a fashion as to bring out its general features, distinctive characters, diversities and the more important injurious insects therein with accounts of life-histories and control measures. Entomology taught with this book as a classroom text will give the student a good foundation and an orderly knowledge of the subject. Although the changes in the second edition consist mainly in a rearrangement of the chapter on the Hymenoptera and the addition of a chapter dealing with injurious animals related to insects, other revisions have been made here and there in the text so that the accounts are abreast of the times.—Harry B. Weiss.

NEW OR FORTHCOMING BOOKS ON INSECTS

How Insects Live, An Elementary Entomology. By Walter H. Wellhouse. The Macmillan Company.

Bees, Wasps, and Ants. By Charles A. Hall. (Peeps at Nature Series.) The Macmillan Company.

Insects of Western North America. By E. O. Essig. The Macmillan Company.

THE ENTOMOLOGY OF HAKLUYT'S "VOYAGES," III

"But after we came neere unto the sun, our dried Penguins began to corrupt, and there bred in them a most lothsome & ugly worme of an inch long. This worme did so mightily increase, and devoure our victuals, that there was in reason no hope how we should avoide famine, but be devoured of these wicked creatures: there was nothing but that they did not devour only yron excepted: our clothes, boots, shooes, hats, shirts, stockings: and for the ship they did so eat the timbers, as that we greatly feared that they would undoe us, by gnawing through the ships side. Great was the care and diligence of our captaine, master, and company to consume these vermine, but the more we laboured to kill them, the more they increased; so that at the last we could not sleepe for them, but they would eat our flesh, and bite like Mesquitos. (From The last VOYAGE OF THE WORSHIPFULL M. THOMAS CANDISH ESQUIRE, intended for the South Sea, the Philippinas, and the coast of China, with 3. tall ships, and two barks. Written by M. John Jane, a man of good observation, imployed in the same, and many other voyages." 1591)—Ed.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF FEBRUARY 17, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on February 17, 1925, in the American Museum of Natural History, Vice-President Henry Bird in the chair, with 12 members and four visitors present.

Mr. Weiss for the Program Committee announced Dr. Willem Rudolfs as the speaker at the meeting of March 3.

Mr. C. Gay, 36 Bridge St., New York City, was elected a member of the Society.

Mr. Barber announced the new Entomological journal, "The Pan-Pacific Entomologist."

The president announced the death on February 3 of Col. Thomas L. Casey. Action was deferred until after the meeting of the Brooklyn Entomological Society, of which he was a member.

Mr. E. Graywood Smyth made the address of the evening, "Personal Observations on the Food Habits of some species of *Epilachna* in Mexico and Guatemala, with special reference to the Mexican Bean Beetle (*Epilachna corrupta*) which may possibly invade New York State during the coming season," illustrated by specimens of several species, their larvæ, and maps showing the infested regions and the rate of progress. Among the facts brought out were the appearance of *corrupta* only after the beginning of the rainy season, their occurrence in the more temperate parts of Central America and their rapid spread in the United States after being accidentally introduced in Alabama. The food plants of *corrupta* and of several other species were determined and the relationship of some species, like *defecta* and *mexicana*, was established. Mr. Smyth's description of the regions in which he had spent many months was interesting, especially as to Cuernavaca, the locality for many Mexican species because of its relative accessibility. In reply to a question from Mr. Davis, Mr. Smyth said that mountain ranges isolate an intervening valley in which Cuernavaca is situated.

Mr. Smyth's remarks were discussed also by Messrs. Weiss, Nicolay, Angell and Mutchler, the latter exhibiting an illustrated article from a Washington newspaper, contributed by Mr. Shoemaker, in which the Bean Beetle was luridly portrayed.

Mr. Barber exhibited the pentatomid *Perillus splendens* which occurs in Southern California and Arizona. The specimen shown was, however, caught by Mr. Davis at his home, 146 Stuyvesant Place, attracted by the light.

MEETING OF MARCH 3, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on March 3, 1925, in the American Museum of Natural History, Vice-President Henry Bird in the chair, with 17 members and six visitors present.

Mr. Weiss reported for the Program Committee that Dr. Child and Mr. Barber would speak on March 17 and Dr. Felt on April 7.

The following new members were elected:

Frederick Lemmer, 688 Nye Ave., Irvington, N. J.

John M. Sheridan, 84 Amity St., Brooklyn.

Mr. Davis read a card from Mr. L. B. Woodruff written en route from Porto Rico to St. Thomas with Dr. Lutz.

Dr. Willem Rudolfs, biochemist in Entomology and chief, Sewage Investigations, N. J. State Agricultural Experiment Station, spoke on "Entomological and Other Life found in Sewage Disposal Plants," illustrated by photographs and drawings. He said in part that the bacteria and protozoa played a most important part in the decomposition of sewage in disposal plants, especially in those like the so-called Imhoff tanks at Plainfield, N. J. Six hundred to seven hundred protozoa per cubic centimeter are present in the sewage that leaves the house, which number may increase to 150,000 in the sludge and 250,000 in the liquid. These probably find their way into the sewage by wind or by the washing of vegetable food and are saprophagous in habit. Most of them belong to the flagellate division, a few are ciliate and two are stalked. Seventy species were found in the tanks and about 100 in the filter beds; original drawings were exhibited for the first time of these species, most of which are still undescribed. The insects are found chiefly in the filter beds and include springtails, bristle tails, earwigs, cockroaches, booklice, true bugs, beetles, caddis flies, butterflies, flies, ants, bees, mainly as larvæ. Spiders and snails also occur. The insects of importance are the springtails, flies and mosquitoes. One species of springtail, *Achorutes viatica*, has been of service in some localities by keeping the stones in the filter beds free from film. On the other hand, the millions of house flies and billions of Psychodid flies that breed in the disposal plants are a serious detriment. They have been partially removed by flooding the filter beds for 24 hours. *Culex pipiens* also breeds in great numbers and experiments as to its feeding habits indicate that its control may in time be accomplished. Apart from insects a small red spider has proved of interest in its relation to Psychodid larvæ.

Messrs. Weiss, Bird, Davis and others discussed Dr. Rudolf's remarks, leading him to explain the differences between fresh sewage with an acid odor and stale sewage with a rancid odor.

Mr. Davis recalled a sewer at Washington, D. C., where he and Mr. Shoemaker had collected insects as a striking example of the latter class or worse.

The economic view was also discussed, Mr. Davis feeling that we are trying to eat off the surface of the earth and throw it into the Atlantic ocean.

Mr. Jones exhibited a type specimen of *Hyaloscotus fumosa* Butler, one of the series obtained in Northern California by Lord Walsingham in 1872, which he had deposited in the American Museum of Natural History, having received it in exchange from the British Museum by vote of the trustees.

Mr. Mutchler exhibited a specimen of *Cychnus viduus* found at Hemlock Falls, February 21, by Miss Anita Neu.

Mr. Angell spoke of *Lucanus placidus* labeled West Farms by Mr. Angus, possibly in error.

Mr. Sherman called attention to the recent work by Mr. Snodgrass on the "Anatomy and Physiology of the Honey Bee."

MEETING OF MARCH 17, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on March 17, 1925, in the American Museum of Natural History, Vice-President Henry Bird in the chair, with 19 members and two visitors present.

The Program Committee reported papers by Dr. Felt and Mr. Watson arranged for the following meeting.

Mr. Barber exhibited and discussed a box of Hemiptera from Cuba, submitted by S. E. Bruner, Las Vegas, dwelling especially on the distribution of the species, of which 8 were purely Cuban, 5 known to occur from other West Indian Islands, 9 known also from Florida, and 40 from a wider range, *i.e.*, West Indies, South and Central America and Mexico.

Dr. Childs, with copious illustration by original drawings, discussed the "Mid-intestinal Epithelium of four American species of Diplopods," with comparative reference to insects and other arthropods. The five layers of which the walls of the midgut are composed were described with the changes that occur in their cells at different stages of the life cycle. They were then treated under inanition and it was shown that similar results were produced during hibernation.

Mr. Mutchler exhibited the N. Y. *Times* magazine, showing Dr. Howard as the St. Patrick of the insect world.

Mr. Frederick Lemmer exhibited several specimens of the Geometrid moth, *Nacophora quernaria*, including a very black example of the variety *atrescens* Hulst, taken in the Orange Mountains some years ago on the 13th of June. He referred to the note on this species in *Entomological News* for December, 1922, where Shoemaker and Davis figure a somewhat differently marked example of this strikingly beautiful native moth. It, like Mr. Lemmer's specimen, was taken in the Orange Mountains, but at an earlier date, namely, April 23.

ENTOMOLOGICAL OBSERVATIONS OF CAPTAIN COOK

Captain James Cook, of the Royal Navy and Fellow of the Royal Society, sailed westward on March 31, 1770, from Cape Farewell in New Zealand, coming in sight of New South Wales on April 19 and anchoring in Botany Bay on April 28. After collecting a large quantity of plants on the shore, his expedition proceeded on May 6 to sail further along the coast of New South Wales stopping at various places for exploration. At one such place beyond Cape Capricorn, it is stated by Andrew Kippis, Cook's biographer, that—"In proceeding up the country they found gum trees, the gum upon which existed only in very small quantities. Gum trees of a similar kind, and as little productive, had occurred in other parts of the coast of New South Wales. Upon the branches of the trees were ants' nests, made of clay, as big as a bushel. The ants themselves, by which the nests were inhabited, were small, and their bodies white. Upon another species of the gum tree was found a small black ant, which perforated all the twigs, and, having worked out the pith, occupied the pipe in which it had been contained. Notwithstanding this, the parts in which these insects, to an amazing number, had formed a lodgment, bore leaves and flowers, and appeared to be entirely in a flourishing state. Butterflies were found in such multitudes, that the account of them seems almost to be incredible. The air was so crowded with them, for the space of three or four acres, that millions might be seen in every direction; and the branches and twigs of the trees were at the same time covered with others that were not upon the wing."

The complete account of Cook's life and voyages written by Andrew Kippis, a contemporary in 1788, has been reprinted recently under the title "Captain Cook's Voyages" (New York, 1925).—H. B. W.

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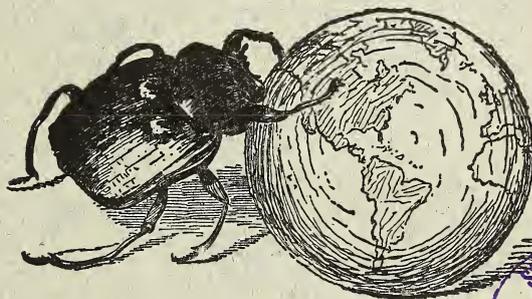
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SEPTEMBER, 1926

No. 3

UNDESCRIBED SPECIES OF CRANE-FLIES FROM CUBA AND JAMAICA (TIPULIDAE, DIPTERA)¹

BY CHARLES P. ALEXANDER

AMHERST, MASS.

The new species described at this time are based upon two interesting species in the Museum of Comparative Zoölogy, taken by Mr. Wight in Jamaica, and kindly loaned me for study by Dr. Nathan Banks; a very striking species of *Teucholabis* from Cuba, kindly given to me by Professor Bruner; and a very interesting series of Cuban Tipulidae taken at and near Soledad by Messrs. John G. Myers and George Salt. The types of the Cuban species are retained in the writer's collection through the kindness of the collectors. I would express my sincere thanks to all the above named gentlemen for their kind coöperation in making known the interesting crane-fly fauna of the Greater Antilles.

Limonia jamaicensis new species.

General coloration yellowish brown, the pleura variegated with darker; anterior vertex silvery; antenna black; halteres yellow, the knobs dark brown; femora with a dark brown subterminal ring, preceded by a narrower yellow ring; wings relatively long and narrow, with a brownish yellow tinge, sparsely spotted with brown.

Male.—Length about 7.5 mm.; wing, 10.5 mm.

Female.—Length about 8 mm.; wing, 10.5–11 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar verticils relatively elongate, the longest exceeding the segments. Head brownish

¹ Contribution from the Department of Entomology, Massachusetts Agricultural College.

black, the anterior vertex and frons pale silvery; anterior vertex (δ) reduced to a narrow strip.

Pronotum light yellowish brown, the sides pruinose. Mesonotum light yellowish brown, scarcely darker medially, the sides of the sclerite behind the humeral region broadly pruinose; remainder of the mesonotum darker brown, the lateral margins of the postnotal mediotergite paler. Pleura light brown, the surface with a sparse pruinosity; darker brown areas distributed as follows: On anepisternum and dorsal portions of sternopleurite; meron and on all the postnotal pleurotergite excepting the ventral portion. Halteres yellow, the knobs dark brown. Legs with the coxæ dark brown, pruinose; trochanters obscure yellow; femora brown, paler at extreme base; a broad darker brown subterminal ring, preceded by a narrower light yellow one, the extreme tip of the segment obscure yellow; tibia dark brown; tarsi beyond base broadly yellowish brown, the terminal two segments, dark brown. Wings relatively long and narrow, faintly tinged with brownish yellow, the costal region clearer yellow; small brown spots and seams, as follows: Tip of *Sc*, origin of *Rs*, fork of *Rs*, along the cord and outer end of cell *1st M*₂; tip of *R*₁ and *r*; a series of marginal clouds at the ends of all the longitudinal veins; veins dark brown, more yellowish in the costal region. Venation: *Sc* long, *Sc*₁ extending to shortly before *r-m*, *Sc*₂ at its tip; *Rs* weakly angulated at origin; *r* at tip of *R*₁ and near midlength of *R*₂₊₃; veins *R*₂₊₃ and *R*₄₊₅ long, running generally parallel to one another, both deflected at tips toward the wing-apex; basal deflection of *R*₄₊₅ relatively long, nearly as long as cell *1st M*₂, the latter of moderate size, subrectangular, shorter than vein *M*₃ beyond it; *m-cu* beyond the fork of *M*.

Abdomen dark brown, the extreme margins of the tergites narrowly pale, of the sternites more broadly so; male hypopygium with the ventral dististyles pale ochreous. In the female, the tergites are uniformly dark brown, the sternites bicolorous. Male hypopygium with the basistyles relatively large, the ventro-mesal lobe very large. Ventral dististyle much smaller than the basistyle, the rostral prolongation very large, arising near the base of the style, directed caudad, the narrowed apex further directed mesad; rostral spines two, placed at the angle of the rostrum, blunt and peg-like, the outer peg somewhat stouter. Dorsal dististyle a slender rod, narrowed distally, at apex dilated into a triangular head that runs out into an acute point. Gonapophyses broad and flattened, the apex of each a slender, gently curved lobule. Ovipositor with the valves relatively short and small.

Habitat.—Jamaica.

Holotype, δ , near Troy, May 23 (A. E. Wight). Allotopotype, ♀ , May 14. Paratopotype, ♀ , with the holotype.

Types in the Collection of the Museum of Comparative Zoölogy.

Helius creper new species.

Allied to *H. niveitarsis* (O. S.); general coloration dark reddish brown; tarsi yellowish white; wings with cell *1st M*₂ small, irregularly pentagonal. Male.—Length about 5.5 mm.; wing, 6.5 mm.

Rostrum longer than the head, brownish black, the palpi concolorous. Antennæ black throughout. Head black.

Pronotum brown. Mesonotum dark reddish brown, the præscutum somewhat darker medially, the sutural region paler; scutellum dark brown. Pleura shiny brown, somewhat darker than the præscutum. Halteres brown, the base of the stem slightly paler. Legs with the coxæ and trochanters brownish testaceous; femora and tibiæ brown, the tarsi paling into yellowish white. Wings with a faint brown tinge, the stigma elongate-oval, darker brown; veins dark brown. Venation: *Sc* ending about opposite *r-m*, *Sc*₁ subatrophied; *Rs* relatively short, varying from twice the length to only one-half longer than the basal deflection of *R*₄₊₅; veins *R*₂₊₃ and *R*₄₊₅ long, the former sinuous; *r-m* elongate; cell *1st M*₂ small, irregularly pentagonal, the basal sections of *M*₁₊₂ and *M*₃₊₄ longest, the second sections of *M*₁₊₂ and *M*₃₊₄ and the basal section of *M*₃ subequal or the latter still shorter; veins issuing from cell *1st M*₂ elongate; *m-cu* beyond midlength of cell *1st M*₂, in cases near the outer end of the cell, thus greatly reducing the second section of *M*₃₊₄.

Abdomen dark brown, including the hypopygium.

Habitat.—Jamaica.

Holotype, ♂, near Troy, May 12 (A. E. Wight). Paratopotypes, 2 ♂ ♂, May 12–14. Paratypes, several ♂ ♀, Blue Mountains, July, 1926 (Crampton and Gowdey).

Types in the Collection of the Museum of Comparative Zoölogy.

Gonomyia (Gonomyia) brevicula new species.

Belongs to the *subcinerea* group; scapal segments orange; head yellow, with a dark spot on vertex; pleura with two conspicuous brown stripes; halteres elongate, dark brown; wings with *Sc* very short, *Sc*₁ ending far before the origin of *Rs*, *Sc*₂ at its tip; abdominal tergites uniformly dark brown.

Female.—Length about 4 mm.; wing, 5 mm.

Rostrum and palpi black. Antennæ with the scape orange; flagellum dark brown. Head yellow, the center of the vertex with a dark spot.

Pronotum light yellow. Lateral pretergites clear light yellow. Mesonotal præscutum dark brownish gray, without evident stripes, the lateral margin narrowly light yellow; pseudosutural foveæ shiny brown; scutum dark brown, the caudal margin a little paler; postnotal mediotergite yellow, darker medially, the caudal margin narrowly dark brown, this being a continuation of the dorsopleural stripe. Pleura yellow, with two con-

spicuous dark brown longitudinal stripes, the more dorsal extending from the cervical sclerites caudad, passing above the halteres, to the postnotum; ventral stripe occupying the dorsal portion of the sternopleurite and the meron, including the bases of the middle coxæ. Halteres elongate, dark brown. Legs with the coxæ yellow, the middle coxa darkened as described above; trochanters brown; remainder of the legs dark brown. Wings with a faint brownish tinge, the stigmal region faintly darker; veins dark brown. Venation: Sc short, Sc_2 close to the tip of Sc_3 , the distance on costa between the latter and the origin of R_s about two-thirds the length of the latter vein alone or fully one-half longer than $m-cu$; R_s gently arcuated, longer than R_{2+3} ; distance on costa between tips of R_1 and R_2 about two-thirds $m-cu$; basal deflection of R_{4+5} relatively short, a little less than m ; $m-cu$ at fork of M .

Abdominal tergites uniformly dark brown, the extreme caudo-lateral portions of the intermediate tergites vaguely paler, the shield and base of tergal valves of ovipositor dark brown; sternites brownish yellow, darker on the median area of the basal sternites, the caudal margins of the segments very narrowly of a lighter yellow.

Habitat.—Cuba.

Holotype, ♀, Hanabanilla Falls, near Cumanayagua, April 7, 1925 (J. G. Myers).

Gonomyia brevicula is most closely related to *G. remota* Alexander, of Mexico. These species, together with *G. brevissima* new species, form a peculiar section of the *subcinerea* group, distinguished by the yellow coloration of the antennal scape and the short to very short subcosta. The three species now known to be included in this group may be separated by means of the following key:

1. $m-cu$ approximately its own length before the fork of M ; Sc very short, the distance on costa between Sc_1 and the origin of R_s greater than the length of the latter vein; a narrow brown seam along the anterior cord; only the dorsal pleural stripe well-defined. (Cuba).....*brevissima* new species
- $m-cu$ at or close to the fork of M ; Sc longer, the distance on costa between Sc_1 and the origin of R_s less than the length of the latter; wings unmarked except for the stigmal blotch; pleura with two dark longitudinal stripes2
2. Sc_2 lying detached some distance beyond the tip of Sc_1 ; abdominal tergites dark, with broad caudo-lateral yellow triangles. (Mexico)*remota* Alexander.
- Sc_2 at the tip of Sc_1 ; abdominal tergites uniformly darkened. (Cuba).....*brevicula* new species.

Gonomyia (Gonomyia) brevissima new species.

Belongs to the *subcineræa* group; scapal segments orange; præscutum light brown; pleura with a conspicuous dorsal brown stripe; wings with a faint brown seam along the cord; *Sc* very short, Sc_1 ending far before the origin of *Rs*; *m-cu* some distance before the fork of *M*; abdominal tergites dark brown, the sternites yellow.

Female.—Length about 3.3 mm.; wing, 4.3 mm.

Rostrum and palpi black. Antennal scape orange-yellow; basal flagellar segment brown, the remainder of the flagellum passing into black. Head brownish yellow, the center of the vertex apparently with a dusky spot.

Pronotum yellow. Lateral pretergites light yellow. Mesonotal præscutum light brown, the lateral margin narrowly light yellow; pseudosutural foveæ shiny reddish brown; scutal lobes brown, the median area of the scutum brownish testaceous; scutellum dark; postnotal mediotergite infuscated, darker posteriorly. Pleura yellow with a single narrow dark brown stripe extending from the cervical sclerites to the postnotum, passing above the root of the halteres; the sternopleurite is very vaguely darker than the ground-color of the pleura but does not form a stripe. Halteres brown. Legs with the coxæ and trochanters yellowish testaceous; remainder of legs brown, the femoral bases a trifle paler. Wings with a faint brownish tinge, the stigmal region oval, slightly darker brown; faint dusky seams along the cord and outer end of cell *1st M*₂, more distinct on the anterior cord; veins dark brown. Venation: *Sc* very short, Sc_1 ending a distance before the origin of *Rs* that is greater than the length of the latter and approximately two and one-half times as long as *m-cu*; Sc_2 not well indicated but apparently at the tip of Sc_1 ; *Rs* relatively short, strongly arcuated, approximately as long as R_{2+3} ; cell *1st M*₂ relatively small; *m-cu* approximately its own length before the fork of *M*.

Abdominal tergites dark brown; sternites yellow.

Habitat.—Cuba.

Holotype, ♀, Trinidad Mts., altitude 1,600 feet, March 24, 1925 (J. G. Myers).

Teucholabis (Teucholabis) bruneri new species.

General coloration black, the head, pronotum, scutellum and pleura largely shiny reddish to yellow; knobs of halteres orange; femora largely reddish; wings whitish with a conspicuous brown pattern; *Sc* short, Sc_1 ending opposite the origin of *Rs*; cell R_3 at wing-margin much wider than cell *2nd R*₁.

Male.—Length about 5.5 mm.; wing, 6.8 mm.

Rostrum dark reddish; palpi dark brown. Antennæ black, the basal segment of the scape dark reddish. Head dark reddish throughout.

Pronotum shiny obscure yellow, the lateral margins of the anterior notum and the medially depressed portion of the posterior notum a little darker.

Mesonotal præscutum dull black, the small humeral triangles obscure orange-yellow; scutal lobes black, the median area obscure yellowish brown; scutellum broad, shiny yellow, the parascutella black; postnotum black, including the pleurotergite. Pleura shiny orange-yellow, the sterno-pleurite and meron blackened. Halteres black, the knobs orange. Legs with the coxæ and trochanters shiny orange; femora orange-yellow, the tips narrowly blackened, more extensively so on what seems to be the clavate posterior femur; tibiæ and tarsi black; all legs of the unique type were detached when received and their association is not entirely certain; another pair shows a distinct oval swelling near four-fifths the length of the tibia, together with a dilation of the bases of the basitarsi. Wings whitish, with a conspicuous brown pattern; cell *Sc* uniformly infuscated; conspicuous brown seams along the cord and outer end of cell *1st M*₂, darkest in the region of the subtrigonal stigma; wing-apex conspicuously darkened; a small triangular brown seam at origin of *Rs*; a conspicuous brown wash extending longitudinally in cells *M* and *Cu*; caudal margins of cells *1st A* and *2nd A* infuscated; veins black. Venation: *Sc* short, *Sc*₁ ending immediately beyond the origin of *Rs*, *Sc*₂ not far from its tip and lying before this origin; *Rs* long, arcuated; *r* in alignment with the cord and close to the tip of *R*₁; veins *R*₂₊₃ and *R*₄₊₅ strongly divergent, the latter ending about at the wing-tip; cell *R*₃ at wing-margin about one-half wider than is cell *2nd R*₁; cell *1st M*₂ strongly widened distally; *m-cu* immediately beyond the fork of *M*.

Abdomen black, the basal sternite more reddish; hypopygium black.

Habitat.—Cuba.

Holotype, ♂, Summit of the Pico Turquino, Sierra Maestra, altitude 6,630 feet, July 20, 1922 (S. C. Bruner and C. H. Ballou).

This handsome and very distinct species of *Teucholabis* is named in honor of Professor S. C. Bruner, to whom I am indebted for many kind favors.

***Teucholabis (Teucholabis) myersi* new species.**

General coloration dark brown, with a microscopic appressed pubescence that appears like a pruinosity; pleura with a broad pale longitudinal stripe; tips of the femora broadly dark brown; wings subhyaline, with three small brown clouds, in addition to the stigmal spot; cell *1st M*₂ large; cell *M*₄ narrowed distally; abdominal segments bicolorous, the caudal margins of the segments paler.

Female.—Length about 5 mm.; wing, 5.1 mm.

Rostrum and palpi black. Antennæ black throughout, the flagellar segments oval. Head brown, with a microscopic gray pubescence.

Pronotum dark brown. Mesonotal præscutum brown, the interspaces with an appressed microscopic gray pubescence; scutum dark brown, the median area paler behind, the lobes with a microscopic gray pubescence; scutellum testaceous, the parascutella dark; postnotum dark brown, with a sparse microscopic pubescence. Pleura dark brown, with a broad paler longitudinal stripe that extends from the fore coxæ to the base of the abdomen, passing above the coxæ and beneath the halteres, the surface of the stripe with conspicuous microscopic gray setulæ. Halteres light brown, the knobs obscure yellow. Legs with the coxæ and trochanters yellowish testaceous; femora yellow, the tips broadly and conspicuously dark brown; tibiæ yellow, the tips narrowly dark brown; tarsi dark brown, the proximal half of the basitarsi paler. Wings subhyaline; stigma short-oval, dark brown; conspicuous but paler brown clouds at *m-cu*, *m* and near the distal end of vein 2nd *A*; veins dark brown, the costal vein beyond the base more yellowish. Venation: *Sc*₁ extending to opposite two-fifths the length of the gently arcuated *Rs*, *Sc*₂ opposite the origin of *Rs*; *r* about one-half its length from the tip of *R*₁ and two-thirds its length beyond the origin of *R*₂₊₃; cell 2nd *R*₁ at margin somewhat wider than cell *R*₃; cell 1st *M*₂ large, strongly widened distally, approximately as long as the longest veins issuing from it; *m* arcuated, longer than the outer deflection of *M*₃; *m-cu* at fork of *M*; cell *M*₄ long and narrow, narrowed at the margin; vein 2nd *A* rather strongly sinuous.

Abdominal tergites dark brown, the caudal margins of the segments conspicuously silvery yellow; sternites similar, the basal sternites yellow. Ovipositor with the bases of the valves dark brown, the apices yellow, the tergal valves strongly upcurved.

Habitat.—Cuba.

Holotype, ♀, Soledad, February 20, 1925 (J. G. Myers).

Teucholabis myersi is named in honor of the collector, my friend, Dr. John G. Myers. The fly is very different from the other described species of the genus in the restricted wing-pattern.

***Eriocera cubensis* new species.**

Head brownish gray; antennæ uniformly black; pronotum and mesonotum orange; pleura yellowish orange, unmarked; legs beyond the narrow pale femoral bases entirely black; wings whitish subhyaline with a heavy brown pattern; *m-cu* near midlength of cell 1st *M*₂; abdomen orange yellow basally, the distal portion black.

Male.—Length, 11–13 mm.; wing, 10.3–13 mm.

Rostrum and palpi black. Antennæ black, the scapal segments weakly pruinose; antenna relatively short, if bent backward not extending far beyond the base of the wing. Head brownish gray.

Pronotum and mesonotum light orange, more intense on the præscutum and scutum, the pleura more yellowish orange. Halteres brown, the knobs brownish black. Legs with the coxæ and trochanters yellow; remainder of the legs black, only the femoral bases narrowly yellowish, slightly more extensively so on the fore legs, very narrow on the hind legs. Wings whitish subhyaline, with a heavy brown pattern; cells *C*, *Sc* and *Se*₁ uniformly dark brown; broad conspicuous seams at arculus; origin of *Rs*; along cord and outer end of cell *1st M*₂; at *r*; wing-margin conspicuously seamed, broader and darker colored at the wing-tip; veins *M* and *Cu* broadly seamed with brown; the general effect of this heavy brown pattern is to restrict the ground-color to the centers of the cells; veins dark brown. Venation: *Se*₁ ending about opposite three-fourths the length of *R*₂₊₃; *Rs* long, in alignment with the short basal deflection of *R*₄₊₅; *r* about twice its length from the tip of *R*₁ and varying from a little more than its length to fully twice its length beyond the origin of *R*₂; cell *M*₁ lacking; *m-cu* sinuous, placed near midlength of cell *1st M*₂, longer than the distal section of *Cu*₁.

Abdomen with the two basal segments orange, thence passing through brown into black, the latter color involving segments five to nine.

Habitat.—Cuba.

Holotype, ♂, Trinidad Mts., near water-fall, altitude 1,600 feet, March 24, 1925 (J. G. Myers). Paratopotype, ♂.

By the writer's key to the Antillean species of *Eriocera* (Ent. News, 27: 347; 1916), the present species runs out at couplet 3 by the wing-pattern and uniform black coloration of the legs. Like all of the other known Antillean species, it belongs to a small group of handsomely colored flies that seem to be confined to the islands of the Greater Antilles.

PETER PINDAR AND THE ENTOMOLOGY OF HIS POEMS

BY HARRY B. WEISS

NEW BRUNSWICK, N. J.

For some reason or another, Walton in his excellent paper on "The Entomology of English Poetry,"¹ omitted any reference to the insects mentioned in the Hudibrastic verses of Peter Pindar, the blustery, calumniator of the Eighteenth Century. Upon reading over the lampoons of Pindar, one finds frequent mention of insects, sometimes those not highly regarded. In some instances the creatures are utilized merely as nuclei or starting points around or upon which his effusions are built and are not in themselves centres of admiration. In others, they are simply named in his verses, usually as objects of ridicule.

More appreciation of his work, or at least more amusement therefrom, can be gained if one is somewhat familiar with the times in which he lived and with his life or parts thereof. Permanent popularity and satirical writings seldom travel hand-in-hand. Literature does not seem to be overburdened by accounts of his life, at least not accounts that are readily accessible. Thackeray, in his essays on "The English Humourists of the Eighteenth Century," does not mention him even in passing, and in his "George the Third" sketch of court and town life, a most excellent place in which to introduce Pindar, nullibicity is his portion. Poor, scurrilous Peter!

Peter Pindar, or more accurately John Wolcot, was born at Dodbrooke in Devonshire in 1738. Some of his early years were spent at Fowey in Cornwall with his uncle, a physician, and he too studied for that profession at Fowey, at Bodmin, France, and at London. When nearly thirty, or in 1767, he accompanied Sir William Trelawney, newly appointed Governor of Jamaica and a neighbor, to the West Indies where he was made "Physician-General" to Jamaica. Here he was quite a favorite on account of his sociability. As his time was not fully occupied

¹ Proc. Ent. Soc. Wash. Vol. 24, Nos. 7-8, 1922.

by his official duties and as Trelawney was anxious to give him a better living in the Church in which there was then a vacancy, Wolcot went back to England, was ordained by the Bishop of London, and returned to Jamaica as a clergyman, where according to Allibone's "Dictionary of English Literature" he amused himself by shooting ring-tailed pigeons on Sundays.

This seems to be quite an unusual pastime for a divine, but it appears that there was some slight reason, for Wolcot at least, to indulge in such a diversion. In Chambers' "Cyclopaedia of English Literature" where the account appears to be a little more sympathetic it is stated that Wolcot's congregation consisted mainly of negroes, whose principal market-day and holiday was Sunday. This resulted in the church attendance being very poor, in fact, sometimes no one attended; thereupon Wolcot and his clerk would wait virtuously for ten minutes and then proceed to the nearby shore and shoot. Mr. Saintsbury in his essay "Twenty Years of Political Satire" speaks of him as an "unclerical cleric" and says that such a person as Wolcot, whose morals were "avowedly and ostentatiously loose," could never have been ordained at any other time than the Eighteenth Century.

After Trelawney's death Wolcot accompanied Lady Trelawney back to England in 1768 and resumed the practice of medicine at Truro in Cornwall. Allibone's, seemingly unfriendly, account says that after his return he spent twelve years in attempts to establish himself at Truro, Helstone and other towns in Cornwall.

In 1778 he published "A Poetical Epistle to the Reviewers" and a volume of "Poems on Various Subjects." In 1780 he moved to London and two years later entertained the public with his "Lyric Odes to the Royal Academicians," continuing to write copiously for nearly twenty-five years, directing his pasquinades which often showed wit and vigor against kings, lords and commoners. His attacks, eagerly read and widely circulated, were leveled at King George III, the Queen, Boswell, Pitt, Sir Joseph Banks, Sir William Hamilton, West, the British Museum, the Royal Society and other things and persons. According to some accounts the ministry thought it worth while to purchase his silence for a time by paying him £300 per year.

In 1800 William Gifford took the field against Wolcot, fully justified most likely, and drew a most uncomplimentary portrait of him in his "Epistle to Pindar." Wolcot, considering the attack as personal which no doubt it was, fell upon Gifford with a club as he was entering Wright's shop in Piccadilly. During the brawl Gifford, so the version in Allibone's states, acquired the club which he assiduously applied to Wolcot's person, the combat being finished by the crowd rolling Peter in the gutter and from all accounts the gutters at that time were not sanitary.

It is recorded that Wolcot, before moving to London, inherited some £2000 at the death of his uncle, and that in 1795 by a shrewd bargain with his booksellers he obtained an annuity of £250 payable semi-yearly for the copyright of his works. He enjoyed this income for nearly twenty years to the great loss and sorrow of his booksellers. He continued until within five years of his death to disembody a stream of satires, political and otherwise, not even blindness or old age stopping his bitter and witty attacks; however, during the last ten years or so of his activity public interest in them was ebbing and turning to other things.

Mr. Saintsbury, in his estimate of Wolcot, speaks of his cleverness, his amusingness, his dirtiness, his ill-nature and his rather poor sense of style, saying that if Wolcot "had only been a little more of a scholar, and a great deal more of a gentleman, he would have been a very great man indeed," and sums up his literary mood by noting its resemblance to that of a cat, "not a cat in a rage, but a cat in a state of merriment, purring and mumbling, and rolling about" and occasionally biting or scratching.

Wolcot died at his home in Somers' Town, January 14, 1819, and was buried in the churchyard of St. Paul's, Covent Garden.

The account in Allibone's terminates tragically as follows: "The 'end' of such a life was not 'peace.' 'Is there anything I can do for you?' asked Taylor, as his friend lay on his death bed. 'Give me back my youth' was the melancholy response that closed a vain and unprofitable career."

Although I do not question the truth of what are supposed to be Wolcot's dying words, similar ones, I may remark, have been

spoken by persons long before they reached their death beds and are not always to be taken seriously. As for his career being "vain and unprofitable," Wolcot certainly added to the gayety of his time and no doubt thoroughly enjoyed being the satirical rowdy that he was.

The following extracts of his writings, in which insects are mentioned, are from the volume, "The Works of Peter Pindar, Esq.," published by Jones and Co., London, about 1854 or 1855, according to the advertisements in the back of the book. In all likelihood the volume does not represent the complete works of Wolcot. The following two poems are from Pindar's "Tales of the Hoy," the latter one being facetiously attributed to the authorship of Lord Salisbury.

THE DRUNKEN FLY

Poor little reeling, thoughtless soul,
To tumble drunk into the bowl!
Death to thy thread had clapped his knife;
Go, wipe thy nose, and wings, and thighs,
And brighten up thy maudling eyes,
And thank the captain for thy life!

In future, get not *quite* so drunk!
Thy girl, perhaps a lass of *spunk*,
May wish thy amorous powers to prove;
And should'st thou, drunk, the wanton chase,
Ebriety may bring *disgrace*;
And *who* would look a *fool* in love?

VERSES ON A FLY

That Pitched on the Cheek of a Most Beautiful
Young Lady.
Happy, happy, happy fly!
Were I *you*, and *you* were I!
But *you* will always be a fly,
And *I* remain Lord Salisbury!

The next, of which only the first four verses are quoted, was "written in the Year 1768, at Santa Cruz, in Company with a Son of the late Admiral Boscawen, at the House of Mr. Mackerriek, a Merchant of that Place." The missing portions deal mainly with the unsightly appearance which the two guests will

have the next morning when they present themselves to the young Spanish ladies of fashion.

ELEGY TO THE FLEAS OF TENERIFFE

Ye hopping natives of a hard, hard bed,
 Whose bones, *perchance*, may ache as well as ours,
 O let us rest in peace the weary head,
This night—the first we ventured to your bowers.

Thick as a flock of starlings on our skins,
 Ye turn at once, to brown, the lily's white;
 Ye stab us also, like so many pins—
 Sleep swears he can't come near us whilst ye bite.

In vain we preach—in vain the candle's ray
 Broad flashes on the imps, for blood that itch—
 In vain we brush the busy hosts away;
 Fearless, on *other parts* their thousands pitch.

And now I hear the hungry varlet cry,
 "Eat hearty, Fleas—they're some outlandish men—
 Fat stuff—no Spaniards all so lean and dry—
 Such charming venison ne'er may come agen."

The following lines are from Ode XI of a number of "Expos-
 tulatory Odes to A Great Duke and a Little Lord."

My lords, I won't consent to be a bug,
 To batten in the royal rug,
 And on the backs of monarchs meanly crawl,
 And more, my lords, I hope I never shall.
 Yet certain vermin I can mention, love it.
 You know the miserables that can prove it.

Pindar's "Ode to the Glow-Worm," quoted in full, appears to be the only poem in which admiration for insects is shown.

ODE TO THE GLOW-WORM

Bright stranger, welcome to my field,
 Here feed in safety, here thy radiance yield;
 To me, O nightly be thy splendour given;
 Oh, could a wish of mine the skies command,
 How would I gem thy leaf with liberal hand,
 With every sweetest dew of heaven!

Say, dost thou kindly light the fairy train,
 Amidst their gambols on the stilly plain,
 Hanging thy lamp upon the moistened blade?
 What lamp so fit, so pure as thine,
 Amidst the gentle elfin band to shine,
 And chase the horrors of the midnight shade?

Oh! may no feathered foe disturb thy bower,
 And with barbarian beak thy life devour:
 Oh! may no ruthless torrent of the sky,
 O'erwhelming, force thee from thy dewy seat;
 Nor tempests tear thee from thy green retreat,
 And bid thee 'midst the humming myriads die!

Queen of the insect-world, what leaves delight?
 Of such these willing hands a bower shall form,
 To guard thee from the rushing rains of night,
 And hide thee from the wild wing of the storm.

Sweet child of stillness, 'midst the awful calm
 Of pausing Nature, thou art pleased to dwell;
 In happy silence to enjoy thy balm,
 And shed, through life, a lustre round thy cell.

How different man, the imp of noise and strife,
 Who courts the storm that tears and darkens life;
 Blessed when the passions wild the soul invade!
 How nobler far to bid those whirlwinds cease;
 To taste, like thee, the luxury of peace,
 And shine in solitude and shade!

Apparently flies tumbled in the punch during Pindar's time
 as they do now, upon occasion.

THE TOPER AND THE FLIES

A group of topers at a table sat,
 With punch that much regales the thirsty soul:
 Flies soon the party joined, and joined the chat,
 Humming, and pitching round the mantling bowl.
 At length those flies got drunk, and for their sin,
 Some hundreds lost their legs, and tumbled in;
 And sprawling 'midst the gulph profound,
 Like Pharoah and his daring host, were drowned!
 Wanting to drink—one of the men
 Dipped from the bowl the drunken host,
 And drank—then taking care that none were lost,
 He put in every mother's son agen.

Up jumped the Bacchanalian crew on this,
 Taking it very much amiss—
 Swearing, and in the attitude to *smite*:—
 “Lord!” cried the man, with gravely-lifted eyes,
 “Though I don’t like to swallow flies,
 I did not know but *others might*.”

TO A FLY

Taken Out of a Bowl of Punch
 Ah! poor intoxicated little knave,
 Now senseless, floating on the fragrant wave;
 Why not content the cakes alone to munch?
 Dearly thou pay’st for buzzing round the bowl:
 Lost to the world, thou busy sweet-lipped soul—
 Thus Death, as well as Pleasure, dwells with Punch.

Now let me take thee out, and moralise.—
 Thus ’tis with mortals, as it is with flies,
 For ever hankering after Pleasure’s cup:
 Though Fate, with all his legions, be at hand,
 The beasts, the draught of Circe can’t withstand,
 But in goes every nose—they must, will sup.

The following effusion is only part of a lampoon that was aimed at Sir Joseph Banks, President of the Royal Society.

SIR JOSEPH BANKS AND THE BOILED FLEAS

Some discontents arising among the more enlightened members of the R—— Society, on account of Sir Joseph’s non-communication of wisdom to the Royal Journals, spurred the knight on at last to open his mouth.—He told an intimate friend that he had made a discovery that would astonish the world, enrich the journals, and render himself immortal.—With the most important confidence and philosophic solemnity, he affirmed that he was upon the very eve of proving what had never entered into the soul of man, *viz.* that *fleas* were *lobsters*.—Accordingly, Jonas Dryander was ordered to go and collect fifteen hundred fleas, and boil them; which, if they changed to the fine crimson of the lobster, would put the identity of the species beyond the possibility of a doubt.—At length, the beds of the president were ransacked by his *flea-crimp*, Jonas.—Fifteen hundred of the hopping inhabitants were caught, and passed the dreadful ordeal of boiling water; with what success, O gentle reader, the Ode will inform thee.

Sir Joseph has his flatterers, too, in hand,
 Who say soft things—yea, very soft, indeed,
 For which the gentle flattering band
 Gain buttered toast, sweet flattery’s oily meed.

A girl for novelty where'er it lies,
 In mosses, fleas, or cockle-shells, or flies,
 Sir Joseph ever seeks for something new:
 Of this, whene'er he sits, he gravely talks,
 Or whilst he eats, or drinks, or runs, or walks,
 Amidst his royal and attendant crew.

One morning, at his house in Soho-square,
 As with a solemn awe-inspiring air,
 Amidst some royal sycophants he sat,
 Most manfully their masticators using,
 Most pleasantly their greasy mouths amusing,
 With coffee, buttered toast, and bird's nest chat;
 In Jonas Dryander, the favourite, came,
 Who manufactures all Sir Joseph's fame—
 "What luck?" Sir Joseph bawled—"say, Jonas, say."—
 "I've boiled just fifteen hundred,"—Jonas whined—
 "The devil a one changed colour could I find;"
 Intelligence creating dire dismay!—

Then Jonas cursed, with many a wicked wish,
 Then showed the stubborn fleas upon a dish—
 "How," roared the President, and backward fell—
 "There goes, then, my hypothesis to hell!"
 And now his head in deep despair he shook;
 Now closed his eyes, and now upon his breast,
 He, muttering, dropped, his sable beard unblest;
 Now twirled his thumbs, and groaned with piteous look.

Pindar stated that he "would not have so frequently taken the liberty of putting vulgarisms into the worthy President's mouth, had he not known that Sir Joseph was the most accomplished swearer of the Royal Society."

In 1786 Pindar produced "The Lousiad, a Heroi-comic Poem" in four cantos, a lengthy and most nonsensical and amazing piece of banter during the course of which he makes game of the King, the Queen, members of the Royal household, noblemen, Court favorites, the cook-major, and other persons and various things that annoyed him. The entire satire is pyramided upon the finding of a louse, which occupies the stage only for a short time at the beginning, speedily giving way to more important objects of Pindar's derision.

At the beginning the reader is informed as follows: "It is necessary to inform thee, that his majesty actually discovered, some time ago, as he sat at table, a *louse* on his plate. The emotion occasioned by the unexpected appearance of such a guest can be better imagined than described. An edict was, in consequence, passed for shaving the cooks, scullions, &c. and the unfortunate louse condemned to die. Such is the foundation of the *Lousiad*.—With what degree of merit the Poem is executed, the *un-critical* as well as *critical* reader will decide." The cooks kick up a fine row about the edict, hold meetings, make speeches, etc., but are finally shaved in the end of the fourth canto. Pindar says "As many people persist in their incredulity with respect to the attack made by the barbers on the heads of the harmless cooks, I shall exhibit a list of the unhappy sufferers: it is the Palace list, and therefore as authentic as the Gazette.

A TRUE LIST OF THE SHAVED AT BUCKINGHAM HOUSE

| | | |
|----------------------|---------------------|----------------------------|
| Two master cooks, | Six under scourers, | Five pastry people, |
| Three yeoman ditto, | Six turnbroches, | Eight silver scullery, for |
| Four grooms, | Two soil-carriers, | laughing at the cooks. |
| Three children, | Two door-keepers, | |
| Two master scourers, | Eight boys, | |

In all, fifty one.

"A young man, named John Bear, would not submit, and lost his place."

The poem is much too long to cite in full and, although the opening lines do not do justice to its contents, they are quoted because of the louse.

The Louse I sing, who, from some head unknown,
 Yet born and educated near a throne,
 Dropped down—(so willed the dread decree of fate!)
 With legs wide sprawling on the monarch's plate:
 Far from the raptures of a wife's embrace;
 Far from the gambols of a tender race,
 Whose little feet he taught with care to tread
 Amidst the wide dominions of the head;
 Led them to daily food with fond delight,
 And taught the tiny wanderers where to bite;

To hide, to run, advance, or turn their tails;
When hostile combs attacked, or vengeful nails:
Far from those pleasing scenes ordained to roam,
Like wise Ulysses, from his native home;
Yet like that sage, though forced to roam and mourn,
Like him, alas! not fated to return!
Who, full of rags and glory, saw his boy
And wife again, and dog that died for joy.
Down dropped the luckless *louse*, with fear appalled,
And wept his wife and children as he sprawled.

THREE NEW SPECIES OF DELTOCEPHALUS

BY E. D. BALL AND D. M. DELONG

The specimens described here as new species were collected by the senior author and have been in his collection for several years. Although not described they have been previously considered as belonging to *Lonatura*. Since this genus has recently been revised by the junior author it seems best to describe these species treating them as *Deltocephalus*.

Deltocephalus plagus new species.

In coloration resembling *bilineatus*, but with shortened elytra, and apparently related to the *collinus* group. Length, 3.5 mm.

Vertex bluntly angled, slightly longer on middle than width between eyes. Pronotum shorter than vertex, more than twice as wide as long. Elytra short as in *collinus*, exposing last three dorsal segments of abdomen.

Color: Buff, with a pair of approximate brown stripes arising at apex of vertex and extending across basal angles of scutellus. Also a pair of brown stripes on pronotum just back of each eye. Elytra subhyaline, infuscated, nervures pale. Dorsum of abdomen with four slightly broken longitudinal stripes. Face with several pairs of rather indefinite arcs, one pair extending over margin of vertex and conspicuous from above.

Genitalia: Female last ventral segment slightly longer than preceding, posterior margin sinuate either side of a slightly produced rounded median lobe which occupies the median third. Ovipositor exceeded by pygofers in length.

Described from a single female collected by the senior author at Madison, Wisconsin, September 21, 1917. Type in Ball Collection.

Deltocephalus perpusillus new species.

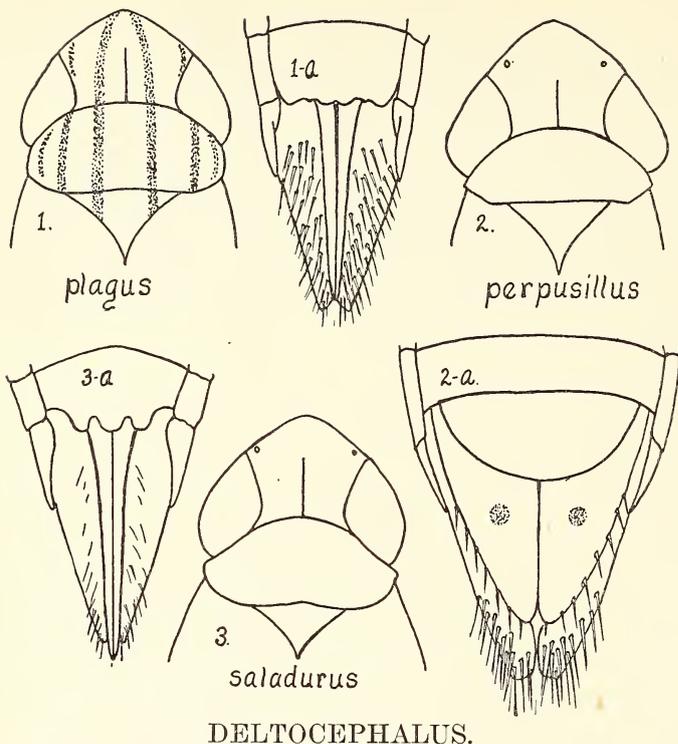
A very minute species closely resembling *auratus* in form and coloration. Length, 1.8 mm.

Vertex very blunt, a little longer on middle than width between eyes at base. Pronotum two-thirds as long as vertex and more than twice wider than long. Elytra almost as long as abdomen but of the brachypterous wing type.

Color: Orange yellow as in *auratus*. Ocelli and a spot on disc of each male plate black. Elytra subhyaline, nervures yellow.

Genitalia: Male valve strongly produced and convexly rounded. Male plates produced the length of valve beyond its apex, gradually narrowed to blunt and rather broad tips. Plates greatly exceeded by pygofers.

Described from a single male specimen from Sidney, Montana, collected June 14, 1913, and now in the Ball collection.



DELTOCEPHALUS.

Deltocephalus saladurus new species.

In general appearance resembling *striatus* but with head much narrower between eyes, blunt and bulbous, rounding to front and with distinct genitalia. Length, 3 mm.

Vertex longer than basal width between eyes, very blunt and almost rounded at apex. Pronotum as long as vertex, strongly rounded before and behind so that the lateral margins are very short. Elytra rather broad, shortened, not covering abdomen, exposing last two segments.

Color: Dirty white to brownish. Ocelli and impressed line on vertex black, reflexed arcs of front conspicuous on margin of vertex. Elytra gray subhyaline, nervures paler. Dorsal margins of abdominal segments brownish. Face dull brownish yellow with pale arcs. Ovipositor brown.

Genitalia: Female last ventral segment long, side margins rather short, posterior margin concavely produced from the side margins to form three prominent rounded lobes which are almost equal in size and occupy the median half of the posterior margin.

Described from a series of five female specimens from Wells, Nevada, collected by the senior author July 20, 1912, and now in his collection.

NEW MEMBRACIDÆ, I

BY FREDERIC W. GODING

The Australian species of Membracidæ described below were received after the publication of the Monograph of the Australian Membracidæ.

Subfamily Centrotinæ

Eutryonia gracilis new species.

Piceous, densely and coarsely punctured, with golden pubescence.

Head with eyes nearly equal to width between humerals, longer than wide between eyes, base broadly arcuate, rugose, apex acute recurved, genæ with three denticles; eyes very large, globular, pearly gray, produced beyond sides of pronotum; ocelli nearly equidistant, slightly above a line through center of eyes.

Pronotum tumid, elevated above in a long slender erect compressed process, emitting from its summit each side a long horizontal style slightly recurved, their front margin forming a crescent, sides parallel and suddenly acuminate, a carina extending from beneath each tip down to scutellar notch, the two tubercles on hind margin small; a percurrent median carina; humerals prominent, obtuse; posterior process slender, triquetrous, seen from side broadly sinuate, the apical third following the curve of apical margin of tegmina, the apex almost reaching their tips, basal two-thirds yellow. Sides scutellum broadly uncovered, concolorous, punctured, apex covered.

Tegmina ample, far surpassing apex abdomen, pale ferruginous, punctured, base and costal margin dark ferruginous and densely punctate; clavus hardly acuminate, two veins, the exterior vein joining margin at middle; radial and interior ulnar veins percurrent, exterior ulnar vein forked at middle, enclosing interior discoidal cell; five apical cells and two discoidal cells, the exterior cell one-half size of interior cell, its base sessile. Wings with four apical cells.

Below the body concolorous, legs pale ferruginous, front and middle tibiae slightly dilated.

Type, ♀; long. 6 mm.; lat. inter hum. 2 mm.; alt. 5 mm.; cotype, ♂; differs only in pale margins abdominal segments, and slightly smaller size; Kuranda, Queensland (Dodd). In collection F. W. G.

It differs from the other members of the genus in the slenderer form, long slender lateral branches and slender summit of front pronotal process, without luteous marks, and the basal third of posterior pronotal process yellow.

The genus *Gelastorrhachis* Kirk. is identical with *Eutryonia* Godg., *G. diadema* being *Eutryonia monstrifer* Walk.; *G. clavata* Kirk. is a good species of *Eutryonia*. *Sarantus nobilis* Kirk. = *S. wallacei* Stål.

***Acanthucus flavidorsus* new species.**

Ferruginous, densely yellow pubescent, punctured, suprahumeral and apical third of posterior pronotal process piceous, middle third yellow.

Similar to *trispinifer* Fairm.; it differs in the base of third apical cell of tegmina being strongly curved posteriorly, suprahumeral piceous and slightly inclined forward, its tips recurved; middle third of posterior pronotal process yellow and apical third piceous, its tip extending behind abdomen almost to tips tegmina.

Type, ♀; long. 5 mm.; lat. 1.5 mm.; alt. pron. 2 mm.; cotype, ♀, and three ♀ paratypes, one slightly smaller and darker color; all from Tweed River, N. S. W., Australia (Froggatt). In collection F. W. G.

***Sertorius acuticornis* new species.**

Purplish-black, shining, coarsely and evenly punctured, with short pale yellow pubescence.

Head finely punctate, base broadly sinuate, with eyes slightly wider than base pronotum, genæ rounded from eyes to clypeus which is triangular, a tubercle each side of base, apex acute, not recurved; eyes prominent, brownish gray; ocelli large, equidistant, slightly above center of eyes.

Pronotum elevated and convex in front, produced each side high above humerals in a rather long flat compressed acuminate horn directed outward, well upward, hind margin straight, front margin curved backward, both margins sharp; humerals prominent, rather acute; percurrent median carina; posterior process deeply notched each side at base, slender, sides parallel to middle, then gradually acuminate, dorsum seen from side broadly sinuate, apical third decurved with apical margins tegmina almost to their tips, the process triquetrous. Broad sides scutellum densely creamy pubescent.

Tegmina ample, fuscous hyaline; clavus piceous coriaceous and punctured on basal third, membranous posteriorly, a small decolorated spot just behind its apex which is not gradually acuminate, its exterior vein joining margin just in front; radial vein of corium forked at base of first apical cell, exterior ulnar vein forked slightly behind middle at the base of interior discoidal cell, interior ulnar vein percurrent to base of fifth apical cell, a transverse venule close to bases of two ulnar veins; five apical elongate cells and two discoidal cells, the exterior slightly smaller, nearly triangular, base sessile; wings with four apical cells.

Below the body dull black, sides of chest densely and extensively pale yellow pubescent; legs fuscous, tarsi paler, tibiæ not dilated.

Type, ♀; long. 7 mm.; lat. 2.5 mm.; alt. pron. 2 mm.; paratypes, ♂, slightly smaller, and ♂, equal to type, Kuranda, Queensland (Dodd). Collection F. W. G.

Somewhat resembles *australis* Fairm., the suprahumeral much longer and stronger, with different shape and direction, longer posterior pronotal process, and darker tegmina.

Sextius tenuis new species.

Pale ferruginous yellow, tips suprahumeral and median carina piceous, distinctly and evenly punctured.

Head quadrangular, base slightly sinuate, apex truncate; eyes prominent, globular, pearly gray; ocelli slightly above center of eyes and slightly nearer to them.

Pronotum strongly depressed, median carina very distinct, percurrent; suprahumeral short, conical, directed outward forward and well upward, a distinct carina extending along front margin which with tips are fuscous; posterior process with altitude and width at base equal, very slender, apex decurved to tips tegmina. Sides scutellum yellow.

Tegmina hyaline, veins pale ferruginous yellow, apical part with very few irregular transverse venules, the venation approaching the normal; five apical cells and two discoidal cells, the exterior one-half size of interior cell. Wings with four apical cells.

Below the body and legs yellow, front and middle tibiae slightly dilated.

Type, ♀; long. 5 mm.; lat. 1.5 mm.; alt. 2 mm.; Homebush, N. S. W. (Lea); cotype, ♂, slightly smaller than type but similar, South Australia (Tepper); paratype, ♀, similar to type, Victoria, Australia (Stowell). In collection F. W. G.

Differs from the other species of the genus in smaller size, slenderer and much more depressed, the direction of suprahumeral the tips of which are considerably above the line of dorsum, while in the other species they are level with or extend below dorsal line; from *longinotum* Kirk., the only species of the genus already described with posterior process long as tegmina, it differs in much slenderer posterior process, the higher tips of suprahumeral, and the more nearly normal venation of corium.

Subfamily Darninae

PARAGARA new genus.

Densely and evenly punctate, and densely golden pubescent.

Head triangular, longer than broad, rounded forward from base and curved downward and backward from middle to apex; base sinuate; ocelli distant from base, on a line with superior margin of and approaching eyes which are large and prominent.

Pronotum tumid, forming a dome-like elevation, unarmed above humeral and in front, with a strongly elevated percurrent carina but not foliaceous; humeral prominent; seen from the side, the outline is semicircular from

base in front to base posterior process; base of posterior process broad, covering scutellum, seen from above gradually acuminate to apex which extends beyond tip of abdomen and interior angle of tegmina; seen from the side it is roundly elevated from base to apex and tectiform and moderately high, gradually elevated in a curve above apex of abdomen.

Tegmina one-half as broad as long, basal half opaque, apical half sordid hyaline vitreous, apices obliquely narrowed to obtuse exterior angle; three longitudinal veins emitted from base of corium, radial forked well towards apex to receive exterior discoidal cell, ulnar veins simple, space between radial vein and costa broad coriaceous and densely punctate; two discoidal cells, nearly equal, interior cell sessile, its base a transverse venule between ulnar veins behind middle; five apical cells, third sessile base truncate; basal half clavus coriaceous, punctate, not gradually acuminate, venation not easily seen. Wings with four apical cells.

Abdomen robust; legs slender, tarsi all short. Genotype, *P. tholoidea*.

***Paragara tholoidea* new species.**

Piceous brown, golden pubescent; head piceous.

Pronotum with median carina, piceous brown, base posterior process, coriaceous part of tegmina, ferruginous, segmental margins and apex abdomen paler; apical half tegmina sordid hyaline, a transverse band at apical third, and spot on apex of clavus, brown; legs pale ferruginous.

Type, ♀; long. 3 mm.; lat. 1 mm.; cotype, ♂, similar, slightly smaller, Napo River, near Tena, Ecuador (Felton). In collection F. W. G.

The pronotum closely resembles that shown in the figure of *Gargara sinuata* Funkh., in *JOUR. N. Y. ENT. SOC.*, xxii, pl. 6, f. 7, from Banguay Island, East Indies, the apical part of the posterior process being curved away from the abdomen.

ANCHOMENUS DECORUS AB. SYRACUSENSIS NOV.¹

BY MELVILLE H. HATCH

Under stones on damp ground about a mile south of Syracuse, N. Y., at the foot of a slope and on the south side of what is known in the Zoölogy Department of Syracuse University as Branchipus Pond, in the fall of 1922 and the spring of 1923, the author took seven specimens of what appear to be an undescribed aberration of *Anchomenus decorus* Say, to which the name *syracusensis* is given, and which is defined in the following key. Their occurrence with great numbers of the typical form as well as the structural identity of the two suggests an extremely close genetic relationship. Type: ♂, Onondaga Co., N. Y., iv-7-1923, M. H. Hatch, 1430. Paratypes: ♂, Onondaga Co., N. Y., x-6-1922, M. H. Hatch, 1423; 5 ♀'s, same data as type. Type and paratypes in collection of author.

Those members of Casey's section *Stictanchus*, subgenus *Pseudanchus*, genus *Anchomenus* having the basal impressions of the thorax narrow, the head and elytra greenish, the pronotum and elytra punctate, each puncture with a pale seta, and the gula, legs, and pro- and mesosternum testaceous may be defined as follows:

- A¹. Pronotum, scutellum, and side pieces of pro- and mesosternum testaceous.
- B¹. Three basal segments of antenna and part of fourth pale; rarely with the second to fourth segments varying to nearly black; 7.5-8.5 mm. long; Rhode Island to Iowa.....*decorus* Say
- B². Three basal segments of antenna pale; elytral intervals more flattened and thorax less narrowed behind than in *decorus*; 8.2 mm. long; Quebec (Montreal).....form *testaceonotus* Hausen
- B³. First basal segment of antenna alone paler.
- C¹. More slender than *decorus*; 7.4 mm. long; Texas
.....form *arenarius* Casey
- C². Less slender than *decorus*; 6.8 mm. long; Arizona
.....form *tepidus* Casey

¹ Contribution from the Zoölogical Laboratory of the University of Michigan.

- A². Pronotum and scutellum coppery green, only slightly lighter than the green head and elytra; side pieces of pro- and mesosternum greenish, though lighter than pronotum; basal two segments of antenna testaceous, third and basal portion of fourth varying from testaceous to nearly black; 8 mm. long; Syracuse, N. Y.ab. *syracusensis* nov.

The three "forms" of *decorus* are all known from uniques, and a more complete statement of their peculiarities may be found by consulting the original descriptions.

Most of my specimens of *decorus* from Michigan and New York have the distance between the front angles of the pronotum 88 per cent. to 91 per cent. of that between the hind angles. In the Michigan males these measurements are subequal.

I am indebted to Mr. Jos. I. Beaulne, of Montreal, for a transcript of Hausen's original description.

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STUDIES ON CHEMICAL CHANGES DURING THE
LIFE CYCLE OF THE TENT CATERPILLAR
(MALACOSOMA AMERICANA FAB.).
I. MOISTURE AND FAT¹

BY WILLEM RUDOLFS

BIOCHEMIST, NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS

Aside from studies on the chemical composition of the silk worm, information regarding changes taking place during the life cycle of insects is extremely rare. There are a number of reports published on the moisture content of insects during pupation, some on changes of weight during this period (gross determination of changes), a few isolated results are available on chemical composition of larvæ, pupæ and eggs, but more detailed analyses made during the complete life cycle are wanted. The information on hand concerned with the chemical composition of the silk worm, made in an effort to gather data for the better understanding and propagation of this economically important insect, deals practically entirely with the larvæ and their food plants, and some with the cocoons. Some work has been done on the CO₂ output of insects but this registers activity of the insect and not definite accumulation and decomposition of all materials.

The importance of chemical information is obvious if we wish to interpret biological activities in concrete terms. If sufficient analyses of different insects are amassed, our fundamental knowledge of the biochemical changes will throw light upon problems in ecology and insect control, give new aspects and impetus, and doubtless render important results. The relation between biochemical activities and geochemical factors are especially interesting. The relation between insect and food plants, geographical distribution of insects and composition of soils, which in turn affects food plants, the effect of climate on insect distribution and activities will all need in the end correlation with biochem-

¹ Paper No. 283 of the Journal Series, New Jersey Agricultural Experiment Stations, Department of Entomology.

ical changes taking place in the insects. From an economical point of view the most important problem for the near future is securing more knowledge about the physiology of insects. If we have a better understanding of the changes taking place in the eggs, larvæ, pupæ and adults control measures will present themselves which are now overlooked or discarded as inadequate. In this relation Swingle's (3) paper on digestive enzymes of an insect is especially interesting. Fortunately we have a mass of material published on the structure of insects, which will be of a tremendous aid in interpretation and application. Comparative anatomy and classification will be guides and help, since without this ground work chemical data obtained would necessarily be of limited importance and use.

Methods and material

About one thousand egg masses of the tent caterpillar were collected¹ in 1924, kept in an insectary and lots of 50-70 egg masses used for analyses. The caterpillars upon hatching were analyzed in lots of 50-1000, depending upon the size, and pupæ and adults again were analyzed in groups of about 50 individuals. At the outset individual egg masses were used and also some analyses were made of individual larvæ, pupæ and adults.

The material was analyzed for moisture content, total ash, insoluble ash, ether extract² (fats), total nitrogen and sulfates, while analyses of amino acids, ammonia, albumoid nitrogen, sugars, phosphorus, carbonates and chlorine were made occasionally. Official methods were employed unless otherwise noted. Weight, length, and width of the heads of adults were obtained. To study possible effects of atmospheric conditions batches of egg masses were submitted for 66 hours to a constant temperature of 80° F. and constant atmospheric moisture content of 73.4 per cent. with lots taken directly from the insectary analyzed at the same time.

Results

The results given in this paper are a part of the data secured. Other results will be published at an early date. The results reported here are on lots as stated above.

¹ Thanks are due Mr. Carl Ilg, assistant in the Entomology Department, for the collection of all the material used.

² Terms fat, fatty substances, etc., refer to ether extract.

The egg masses contain on an average from 300 to 400 eggs. It is extremely difficult to remove the gelatinous cover from the eggs. At first the cover was removed as far as possible by hand, analyzed, compared with the analyses of the formed larvæ taken out of the egg cases and with the analyses of the whole mass. Later on a method was found to dissolve the gelatinous cover without apparent attack on the larvæ in the egg cases. It was found that the cover has practically no ash content and consist mainly of nitrogenous material. Microscopic examination of the larvæ from egg masses treated to dissolve the gelatinous covers and egg cases showed that the tiny larvæ were non-transparent, indicating that they were not harmed nor their gut contents removed by the treatment. However the results presented in the graphs are based on the whole egg masses. The following figure (1) represents the per cent. moisture and per cent. of ether soluble material during the different stages in the life cycle of the insect.

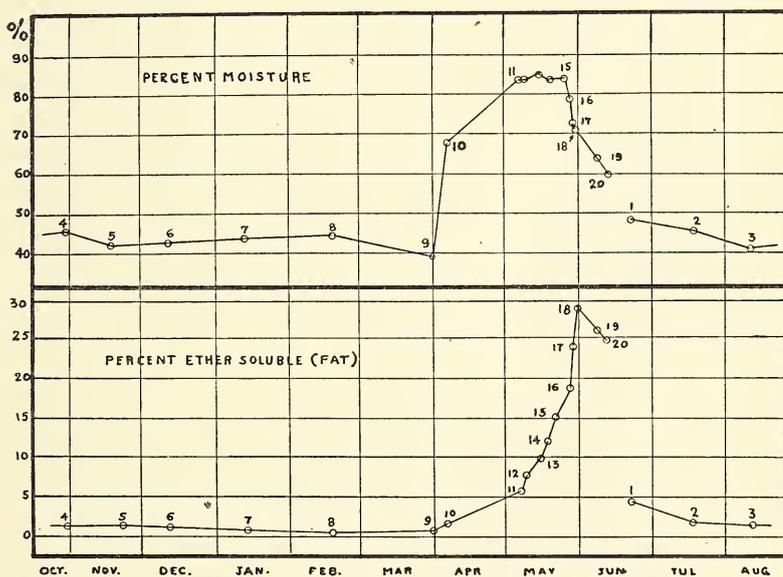


FIG. 1. Per cent. moisture and per cent. fats present during the life cycle of tent caterpillars. 1=eggs in liquid stage; 2=larvae nearly all formed; 3-8=eggs; 9=newly hatched larvæ; 10-15=growing larvæ; 16=ready for pupation; 17=prepupal stage; 18=larvæ just pupated; 19=ready for emergence; 20=adults.

The moisture content of the egg masses shortly after deposition was 48.5 per cent. The well formed larvæ remain approximately 9 months in the egg cases and during this time the moisture fluctuated somewhat until upon hatching the young caterpillars contained 39.4 per cent. moisture. The first 6 days after hatching the moisture content increased to 68.5 per cent., while by the time the caterpillar larvæ had an average weight of 50 mgr. (end of second instar) the moisture content had reached 85.1 per cent., it remained there with minor fluctuations until the larvæ were full grown (average weight 685 mgr.). As might be expected when the larvæ made ready for pupation (becoming flabby and shrunken) the moisture content went down. After pupation the per cent. moisture was 71 and the adults (26 males and 22 females) contained still 60 per cent. moisture.

Ether soluble materials (fats) of the egg masses (eggs in the liquid stage) was 4.45 per cent., decreasing very rapidly during the first few weeks, until at the time of hatching only 0.56 per cent. was left. Since the tiny caterpillars constitute about 48 per cent. of the total mass, the total fat present in the newly laid eggs was about 9 per cent. In spite of the fact that the young caterpillars needed large quantities of food for their growth activities they were able to store up some fatty materials. From the time when they weighed but 20 mgr. (second instar; No. 11 on the curves) until they were full grown (No. 16) fat increased very rapidly. All figures are based on the dry weight of the caterpillars including the gut contents. Full grown caterpillars kept in a cage ejected in 40 hours a little less than one fourth of their total wet weight. The droppings contained 1.06 per cent. ether soluble material of a very dark green color (chlorophyll). Calculated on this basis the full grown larvæ contained (before they were ready for pupation) about 19 per cent. fat while the flabby and shrunken larvæ analyzed 18.71 per cent. fat; this checks very well and numbers 10 to 16 contained actually one-fourth more fat than is shown in the graph. During the prepupal stage (larvæ in semi-liquid form taken out of their cocoons) fat content appeared to increase but at the same time moisture content decreased. After pupation the fat content appeared to decrease from 28.82 per cent. to 24.72 per cent. in the adults.

One would expect that the fat and moisture content of the egg masses would decrease with the formation of the larvæ; also that fat would decrease after the larvæ stopped taking food. However, this was not the case. Keeping in mind that the fat content is based on the dry weight of the material we see that fat increased rapidly during the prepupal period. From the time no food was taken (no. 16) until the larvæ had just pupated (no. 18) the actual fat content increased with 67 per cent. of the fat content present at the first (no. 16) stage. It seems clear therefore that the organism while in a transition stage, at a time when one would presume that all cells are engaged in the formation of substances needed for metamorphosis, certain parts are still continuing the production of fatty substances. The amount of fatty material formed in this period is less than half used up during the chrysalis stage.

Snodgrass (2) says that "the fat bodies separate from one another in the pupa and float about in the body cavity as a mass of globular cells. They give up their oil droplets either by absorption or by the dissolving of their thin walls which scatter their contents broadcast in the blood."

From our results it would seem that when the oil droplets are set free and apparently visibly disappear or scattered in the blood of the insects they may in reality be emulsified by substances in the blood and possibly partly hydrolyzed later on. The reason for this assumption is that the fatty substances present in the chrysalis are only partly used while an appreciable amount seems to be retained for energy and for the formation of the eggs. It might be stated here that during the time of metamorphosis a remarkable fluctuation of the nitrogen-fat ratio occurs. About 10 per cent. of the total fat present disappeared from the time the larvæ had just pupated until the adults emerged. This 10 per cent. seems to be used in the processes of reconstruction. The balance of the fatty material in the female was used in part for the formation of the eggs, some for energy supply of the adult and some deposited in the eggs. Snodgrass states that the male moths upon emergence contain an abundance of fat tissue, the cells of which are filled with droplets of fatty oil, while the body of the female contains no fat tissue

but her ovaries are full of mature eggs ready to be laid. Our figures show that the body of the adult contains an average of 19 mgr. of fatty substances, while the newly laid egg masses contained 3 mgr. on an average. It seems then that the female adult had still a quantity of fatty material in its body although it could not be detected by microscopic examination.

The amount of moisture in the egg masses varying from 42 to 48 per cent. seems comparatively low. Tichomiroff (4) found from 64.4 to 65.8 per cent. moisture in the eggs of *Bombyx Mori*. Our low results are caused by the fact that moisture is here calculated on the basis of egg masses. Larvæ taken out of the egg cases in November contained 61.9 per cent. moisture and 60.2 in January. The moisture content of newly hatched caterpillar larvæ was about 40 per cent., while Kellner (1) reports about 76 per cent. for newly hatched silk worms. Moisture in growing caterpillars fluctuated between 82 and 86 per cent. This agrees with the findings of Kellner for larvæ of the silk worm containing from 83 to 88 per cent. moisture.

The rapid increase of fats in growing caterpillars was not observed by Vaney and Maignon (5) in the silk worm. They found a progressive decrease of fat but a rapid increase in glycogen reaching its maximum when the larvæ were full grown and decreasing continuously during pupation. They concluded that the pupæ used fats for their metamorphoses. It can be seen from our figures that total fats calculated on a dry basis increased persistently in the larvæ and during the first stages of metamorphosis until the pupæ were well formed (fig. 1). From then on reduction took place and the decrease of fats kept pace with the decrease of moisture.

The relation between fat and moisture graphically shown in fig. 2 is of special interest. Calculating the fat contents on the basis of the same moisture throughout the life cycle, the curve shows a rapid decrease of fats in the eggs until the larvæ are well formed and from then on practically no decrease until January, showing that only extremely small quantities of fat are necessary for maintenance of the larvæ while confined in the egg cases. A more rapid decrease occurred apparently when hatching was approaching. The slight rise just before hatching

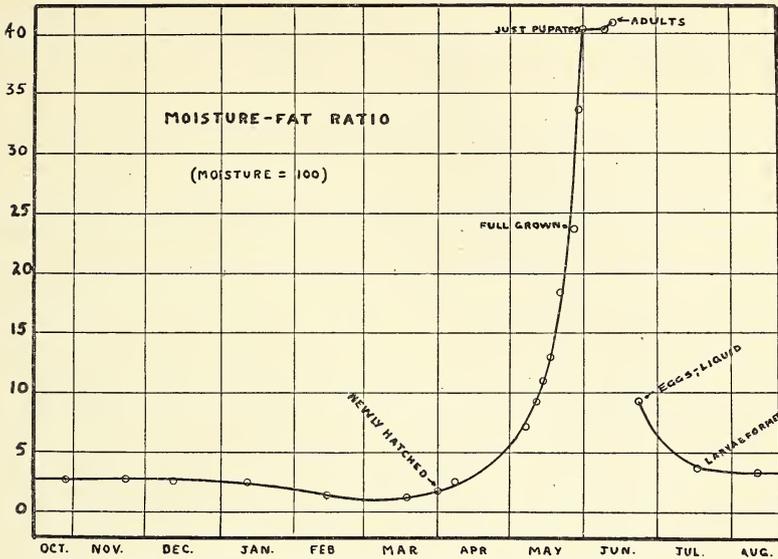


FIG. 2. Relation between moisture and fats during different stages of the life cycle of tent caterpillars. Fat calculated to a constant moisture basis of 100.

is due to calculating fat on the whole eggmass for the months June–March. The rapid increase of fat during May terminating at the time when the larvæ had just pupated shows that the conclusions drawn from figure 1 are correct. Since moisture decreased more rapidly during the period between “full grown” and “just pupated” the results for fat are accentuated. During the pupal stage moisture and fat decreased at a same rate resulting in a flattening of the curve, while in the last stage moisture again decreased more rapidly than fatty substances.

The amount of fat present in the newly deposited eggs (without egg cases or cover) was about 9 per cent. This quantity diminished rapidly during the first weeks, indicating that metabolic activities during embryonic development are great. Consequently if control measures were to be used against the eggs these should be employed at this time rather than at the time when the larvæ in the eggmasses are comparatively inactive. This might hold as well for other insects. Metabolic processes do not seem as great in the pupal stage and it would presumably

be more difficult to kill the insect at this stage than at any other, even if substances are found which will penetrate the hard skin of the pupæ.

Summary

Chemical analyses made on the tent caterpillar during its life cycle are reported in part.

Moisture content decreased gradually in the egg masses, increased rapidly in the young growing caterpillar (first two instars), remained constant until they were fullgrown, and decreased again rapidly from the time they were ready for pupation until the adults emerged.

Moisture was lowest at the time of hatching (39.4 per cent.) and highest during third to fifth instars, namely 83–85 per cent.

Ether soluble material (fats) decreased fairly rapidly in the eggs after deposition, decreased slowly until the larvæ hatched, increased gradually during the first two instars, increased rapidly during the next three instars, and increased at an accelerated rate during the first part of metamorphoses, while it decreased during the second part.

Fat calculated on a dry basis was lowest upon hatching (0.66 per cent.) and highest when larvæ had just pupated (28.8 per cent.).

The relation between moisture and fatty substances during the life cycle is graphically shown.

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NOTES ON NEW AND INTERESTING DELPHACIDS

BY H. L. DOZIER

DELAWARE AGRICULTURAL EXPERIMENT STATION

The following notes and descriptions have been kept in manuscript for several years and they are now published with the view that they will be of interest and help to some of the present workers in the group.

Achorotile foveata Spooner. In examining a series of eight brachypterous females taken by Prof. H. Osborn in Yellowstone Park, Wyo., I find that they agree in every particular with the description. The number of pustules on each side of the abdominal segments is not constant, however, and I believe this species to be identical with the European *albosignata* of Dahlbaum.

Laccocera zonata Van D. A series of eighteen brachypterous females taken by Prof. Osborn at Kallspell, Mont., are typical.

Laccocera obesa Van D. Twenty-six brachypterous females taken at Kallspell, Mont., by Prof. Osborn. One macropterous female taken by C. N. Aineslie at Springer, N. Mex.

Lepticus oculatus Crawf. A series of fourteen nymphs of several instars were taken sweeping young bulrushes and sedges in swampy field near Sandusky, Ohio, Oct. 6, 1921, by the writer. These agree perfectly with the description by Crawford, which was based on a single immature male from Managua, Nicaragua, but have the vertex a little more constricted near apex than is shown by his figure. Three specimens in last instar were taken by Prof. Osborn at Delphos, Kansas, together with numbers of *Pentagramma vittatifrons*. These last instar nymphs taken together with numbers of *Pentagramma vittatifrons* agree perfectly with the description and confirms my suspicion that *Lepticus oculatus* of Crawford is an immature *Pentagramma*.

Bakerella maculata Crawf.

1914 Proc. U. S. Natl. Mus., xlv, p. 601, one fig.

Male genitalia quite distinctive. A small species hard to place unless the male is available.

Head as broad as thorax; vertex nearly square, strongly carinated; frons only a little longer than broad, sides strongly rounded, median carina forked slightly above the ocelli, strongly divergent, lateral carinae terminating well within laterals of clypeus; antennae stout, very short, first segment less than one-third as long as the second. Pronotum moderately long, not quite as long as vertex, tricarinate, the lateral carinae curved out, not reaching the hind margin. Scutellum almost twice as long as pronotum, tricarinate. Elytra typical, long; in brachypterous form, short, and well rounded apically. Legs very short, hind tibiae scarcely longer than femora; calcar only slightly longer than breadth at base, margin not dentate.

General color yellowish-brown to dark brown, usually the latter, carinae slightly paler. Frons with a number of whitish spots. Abdomen usually dark fuscous or yellowish marked with fuscous. Legs fuscous, tibiae banded with pale.

Male pygofer and apertures resembling *Liburniella ornata*, latter elliptical, broadest sub-basally; anal tube projecting rather prominently, small with two elongate, very slender processes on ventral margin; genital styles fairly short, pincer-like, scarcely divergent, roundedly acute at apex; anal style distinctly whitish.

Female ovipositor and sheath very dark fuscous, the anal tube prominently white.

Length of body 2.4 mm.

Crawford described this genus and species from a macropterous pair from Acapulco, Mexico, and gave a good figure of the male genitalia. I am describing the brachypterous form from a series of two females and two males, collected by the writer Aug. 6, 1921, sweeping grass and sedges near edge of a bayou at Pascagoula, Miss., and a pair taken sweeping in a marsh near Sandusky, Ohio, Oct. 6, 1921.

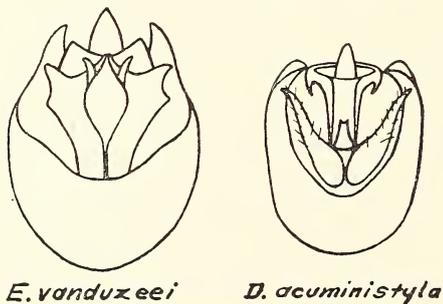


FIG. 1. Male genitalia of *Euidella vanduzeei* and *Delphacodes acuministyla*.

***Euidella vanduzeei* Muir and Giffard.**

1924 Bul. 15, Ent. Ser., Haw. Sugar Exp. Sta.

Closest allied by genitalia to *Euidella magnistylus* Crawford and *weedi* but quite distinct.

Macropterous form—Head narrower than pronotum. Vertex nearly square, carinae distinct; frons rather long, tricarinate, narrow at apex widening below the eyes. First segment of antennae a little shorter than the second, the latter somewhat tuberculate. Pronotum about as long as the vertex, tricarinate, lateral carinae strongly curved outwards and not attaining the hind margin. Scutellum nearly twice length of pronotum, tricarinate. Elytra long, nearly hyaline, veins becoming fuscous apically beyond the cross-veins.

General color pale to soiled testaceous-yellow, except the partially infuscated antennae, abdomen and genitalia, and the fuscous eyes.

Female ovipositor sheath cylindrical, pale, ovipositor itself darker.

Male pygofer moderately large, fuscous, ventral margin of aperture sinuately rounded; genital styles dark fuscous and very prominent, long and rather thick, hirsute, divergent, converging beyond the middle, thence to bifurcate inner tip, the exterior margin with more or less sharp projections beyond the middle; the entire styles resembling the antlers of a moose; ventral margin of anal tube with a median triangular notch, a tooth on each side; anal style medium-sized.

Brachypterous form: similar to the macropterous form but having the elytra very short, cut off truncate with edges well-rounded, veins unicolorous.

Length of body 2.50–3 mm.; length to tip of macropterous elytra 3.50 mm.

Descriptions made from two macropterous males and two females and a brachypterous series of seventeen females and nine males collected by the writer at Pascagoula, Miss., Aug. 8, 1921, and a brachypterous female from Biloxi, Miss., July 30, 1921, sweeping grass and sedges in wet area. A male collected by Prof. J. S. Hine at Cameron, La., Aug. 14, 1903, is identical.

The writer has carried this species in manuscript for several years, awaiting the opportunity to settle the identity of *weedi* to which it is very close. The species has since been described by Muir and Giffard under the name *Euidella vanduzeei* from Florida material.

***Delphacodes (Liburnia) acuministyla* new species.**

A very small species, closest allied in structure of male genitalia with *consimilis* and *pellucida*.

Brachypterous form. Head slightly narrower than prothorax. Vertex subrectangular, a little longer than wide, rather weakly carinated and slightly produced beyond the eyes. Frons elongate, narrowed between the

eyes, enlarging below the eyes, tricarinate, the median carina forked a little below the apex of head. Antennæ long, the second segment twice as long as the first. Pronotum comparatively long and broad, about length of the vertex, tricarinate, the lateral carinæ curved out behind the eyes and not reaching the hind margin. Elytra short, well-rounded on outer side; apex truncate and rounded. Legs long and slender; calcar typical, margin very finely dentate.

General color pale testaceous; eyes dark; dorsum of abdomen orange yellow, with a dark area at base and the last three or four segments whitish; just before this there is a black transverse band, variable in width and distinctness. These show through the translucent elytra, giving the latter the appearance of being banded. Elytra translucent, yellowish-testaceous with the tips piceous. Male pygofer dark piceous. Legs pale, immaculate.

Male pygofer small and rather short, ventral margin rather deeply and roundly emarginate, produced dorsally caudad on each side of anal tube; genital styles long and acuminate, rather stout at base, widely divergent, flexed out, sparsely hirsute, and acute at tip; anal tube with two very long, slender, needle-like ventral processes; anal style small, white.

Length of body, 0.8–1.5 mm.

Described from a series of four males swept at edge of salt marsh bayou, Feb. 18, and ten males sweeping grass in pine woods, Feb. 21, 1922, all brachypterous, Ocean Springs, Miss., by Prof. H. Osborn.

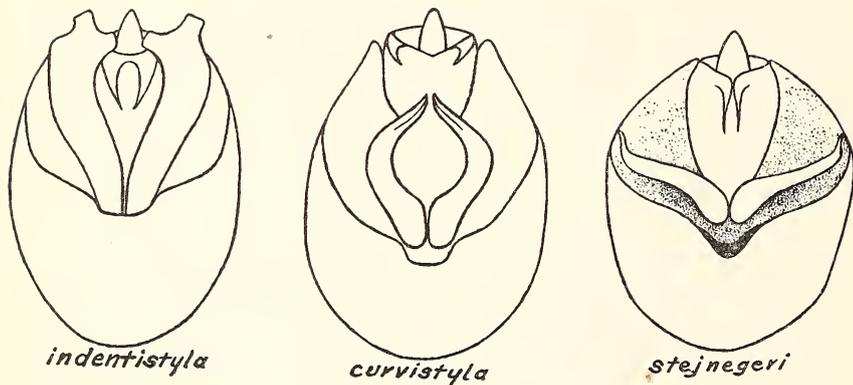


FIG. 2. Male genitalia of *Delphacodes indentistyla*, *curvistyla* and *stejneri*

***Delphacodes curvistyla* new species.**

General color soiled testaceous or dirty yellowish-brown.

Macropterous form. Head narrower than pronotum, the carinæ of vertex very distinct. Frons long, tricarinate, narrower at apex of vertex but

widening below the eyes. Last antennal joint slightly shorter than the basal one, tuberculate. Pronotum about as long as the vertex, tricarinate, the lateral carinæ strongly curved outwards and not attaining the hind margin. Scutellum over twice as long as the pronotum, tricarinate. Elytra long, hyaline, the veins distinctly fuscous.

Male pygofer fuscous, ventral margin of aperture sinuately rounded; genital styles dark fuscous, very prominent, rather thick, divergent and distinctly and characteristically recurved; anal style medium sized.

Length to tip of wings, 3.10 mm.

Described from a macropterous male collected by the writer at Ocean Springs, Miss., Aug. 3, 1921, sweeping swampy area, and a macropterous male taken by Prof. Hines at Cameron, La., July 11, 1905.

Delphacodes indentistyla new species.

A medium sized species difficult to distinguish from a number of species such as the above described *curvistyla*, *weedi*, etc., except by the male genitalia.

Head narrower than the pronotum, the vertex longer than wide and not prominently carinated. Frons long, widened below the eyes, narrowing towards apex. Last joint of antenna shorter and more robust than the basal one, somewhat tuberculate. Pronotum about as long as the vertex, tricarinate, lateral carinæ not quite reaching the hind margin. Scutellum twice as long as the pronotum, tricarinate. Macropterous wings long, venation darker.

Male pygofer with the ventral aperture sinuately rounded; genital styles prominent, long and broad with indentions at apices as in figure.

Length to tip of macropterous wing, 3.00 mm.

Described from one female and three males taken by the writer sweeping low grass along road through deep, dark swamp near Merrill, Miss., Aug. 9, 1921.

Delphacodes stejneri (Ash.)

1898 Fur Seals and Fur Seal Isles of the No. Pacific Ocean, Pt. IV.

Very closely allied in structure of male genitalia to *pellucida* Fabr. but is stouter and pale yellowish testaceous in color.

Head broad but narrower than the prothorax. Vertex nearly square, produced a little beyond the eyes, carinate, distinctly foveate. Frons twice as long as wide, broad at base, narrowed at anterior margin of the eyes and then gradually broadened to posterior margin of the same, then slightly narrowed to clypeus; tricarinate, the median carina forked just below apex of the head. Antennæ comparatively short, the second segment tuberculate, twice as long as the first segment; seta long and fuscous. Pronotum nearly as long as the vertex, posterior margin rather deeply and angularly

emarginate, tricarinate, lateral carinae curved out behind the eyes and not reaching the hind margin. Mesonotum about twice as long as the pronotum, tricarinate. Brachypterous elytra very short, truncate with apices well rounded, with delicate punctures along the nervures. Abdomen large and stout. Calcar typical, tectiform.

In the macropterous form the elytra are also very short, reaching to or just extending beyond the tip of abdomen.

General color of female pale yellowish testaceous, abdominal segments margined with fuscous and ovipositor fuscous. In the male the scutellum, frons and clypeus, except the pale carinae, are fuscous and almost the entire underside including the genital segment, is black. Legs pale, faintly lined with brown.

Female segment subcylindrical, roundly emarginate at base, ovipositor not reaching to tip of ovipositor sheath.

Male genital segment terminal; ventral margin of pygofer deeply notched; genital styles long, stout at base and narrowed to an acuminate tip; flexed outward, lying closely against the ventral margin of pygofer; anal tube with two needle-like ventral processes.

Length of body, 2.50-3 mm.

Redescribed from four brachypterous females, Anchorage, June 6, 1917, six females and eight males taken June 20-Aug. 10 at Katmai, and a rather large female from Kashirk Bay, Aug. 2. All were taken by Prof. J. S. Hine in Alaska during the summer of 1917.

Megamelanus terminalis Metcalf. This species is found in the *Spartina patens* association. The writer swept a single specimen at edge of inland bayou near Mobile, Alabama, in August, 1923, and has examined a single male taken by Prof. Herbert Osborn sweeping in salt marsh at Ocean Springs, Miss. It was originally described from material collected at Cape Charles, Va., and Caroline Beach, No. Car., and the distribution of this and the two following species probably follows the distribution of their food plant, *Spartina patens*, around the entire Atlantic and Gulf Coasts.

Megamelanus lautus Metcalf. The writer collected a male of this species at Ocean Springs, Miss., Aug. 3, 1921, sweeping *Spartina patens*, and Prof. Osborn took a male at the same locality Feb. 11, 1922. Originally described from material collected on the Texas Coast.

Megamelanus dorsalis Metcalf. Two males were collected by the writer at Ocean Springs, Miss., Aug. 6, 1921, a male from same marsh habitat at Pascagoula, Miss., August 6, 1921, and Prof. Osborn took a male at the former locality Feb. 11, 1922. A male specimen of this species, collected by Prof. J. S. Hine at Cameron, La., June 30, 1905, in the Ohio State University collection has also been examined.

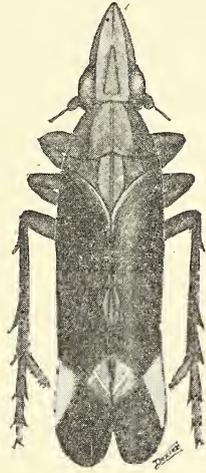


FIG. 3. Adult *Megamelanus lautus* Metcalf, greatly enlarged.

The three above mentioned species all seem to be extremely rare as so few were taken although extensive and hard sweeping was done.

A REVIEW OF DELONG'S MONOGRAPH OF THE GENUS DELTOCEPHALUS*

CHRIS. E. OLSEN

WEST NYACK, N. Y.

DeLong's monographic study of the North American species of *Deltocephalus* is off the press. It is indeed an achievement that Dr. DeLong can well be proud of. Although I should not attempt to criticise or pass on this work, I cannot refrain from giving a review of it in a general way. The high standard of DeLong's previous work in Cicadellid studies is enough to assure us that this volume of 129 pages with 30 plates, printed by the Ohio State University, in Vol. II, No. 13, January 15, 1926, the third contribution in Zoology and Entomology of this series, is a piece of work of the highest type and character. It will be exceedingly valuable and absolutely indispensable to workers in this Cicadellid genus. First of all, as a guidance in determination of species, then for future work in this group be it whatever character it may, morphologic, taxonomic, systematic, biologic, faunistic, ecologic, economic. It is a great stride forward in the progress of Cicadellid knowledge.

After giving due credit to all those who assisted in this accomplishment, DeLong gives a hint at the worthlessness of poorly mounted, broken, and badly preserved specimens, indeed a good hint which we all may take to heart. The illustrations accompanying this paper consist of nineteen plates of excellent line-cuts, drawn with the aid of an ocular micrometer which insures accurateness. They are executed neatly and are what we may call perfect in every respect. The remaining eleven plates are microphotographic reproductions exceedingly well produced. They show careful and clever photo-retouching which is so often neglected in a publication of this kind, and which is so necessary in microphotography.

DeLong has omitted the bibliography that sometimes accompanies descriptions of species in a monograph of this kind.

* Read at April 6, 1926, meeting of the New York Entomological Society.

This eliminates an item which takes considerable space in print, time and preparation and which is generally a repetition throughout. Of course, it must be admitted that it is handy to have the list of publications compiled for each species separately, at least such references as have appeared in print since Van Duzee's catalogue, 1918, but then to compensate for this, DeLong has given a complete bibliography at the end of his volume.

The introduction is continued with a short résumé of the genus explaining important and unimportant structural characters, showing relationship to other genera in the family. He devotes some time to showing the probable phylogeny of the genus, clearly illustrated with a figure of the family tree showing *Scaphoideus*, *Platymetopius*, *Deltocephalus*, *Aconura*, *Lonatura* and *Thamnotettix*, all apparently branching off together from one stem with *Euscelis* springing from the *Thamnotettix* branch and showing the *Deltocephalus* branch dividing into subgenera. (Two of the subgenera are, however, not accounted for.)

He gives quite a clear view of the effect of evolution in this animal group, explaining in other groups that where certain intermediate forms have disappeared or become extinct, it is not so difficult to form well defined descriptions of a group or genera, but *Deltocephalus* does not belong to this category and consequently it is sometimes very difficult to determine whether certain species should be placed here or in other closely allied genera. To quote him exactly, he says, "It is useless and absurd to look for hard and fast lines in all cases to separate animals into groups as man has tried to classify them."

In concluding his introduction, he laments the fact that unfortunately a species has been made type of the genus which is really not typical of it. He shows here the effect of man-made laws and rules. This species is not type by virtue, but by rule, because it happened to be first on the list of described species assigned to this genus. The second species would have conformed more closely with the description of the genus, but according to the rules and regulations cannot bear the title to which it is more fit. However, this is not of so much consequence as one may imagine, for as DeLong explains (quoting him again)

“The original characters given mean nothing as the group now stands.”

One thing that DeLong ought to be blessed for is that he has found a way to subdivide this, as it now stands, tremendous genus into comparatively small groups or subgenera; that he has not attempted to give a key for the whole ninety odd species. I am speaking now from the standpoint of one who has ambition enough to try to identify his own collection and perhaps specimens collected by his friends, and to whom the time is exceedingly limited, and the compensation for his labors is only the satisfaction obtained by the results of his studies.

After this introduction he devotes the first twenty pages to external morphologic character study, using Uhler's *Deltocephalus configuratus* as the illustration for the genus.

Fortunately Dr. DeLong has been able to separate the various species without necessarily having to depend on internal structures or characters which can only be seen after dissection. He found the male genital character very useful in this, in fact he mentions it as being “very important” and strengthens this contention by asserting “some species can only be, or can more easily be, separated by the male genital character.” It appears that he has found his strongest separating characters here, for in his concluding paragraph of the chapter on this subject he says, “In the genus under discussion, then, the male characters, both external and internal,* are important in classification and they are far better for specific determination than any other characters with the possible exception of the female characters which are used in some cases.”

The next section is devoted to the systematic arrangement. There is a key which separates the genus into seven subgenera. Each subgenera is in its proper place briefly described. DeLong describes fully and systematically the species and illustrates each by figures of the dorsal head, male and female genitalia, many of them by elytra and wing venation, and in addition, a photo-

* The internal genital characters, DeLong explains, are really not internal, but are the structures enclosed by the projecting dorsal pygofer and the ventral genital plates, which form the genital chamber.

graphic halftone of each of the ninety-six species listed and discussed. He then continues discussing various other phases of the subject, such as, biology, ecology, fauna, economy, finally winding up with a bibliography and index. Altogether it is a commendable piece of work which I am sure will be much appreciated and extensively used by all who have a working interest in the Cicadellid family.

NOTES ON SOME HESPERIIDAE FROM ALABAMA (LEPIDOPTERA, RHOPALOCERA)

BY E. L. BELL

FLUSHING, N. Y.

Atrytone dukesi Lindsey.

Dr. Lindsey described *Atrytone dukesi* in *Entomological News*, XXXIV, No. 7, pages 209-210, 1923, from four male specimens, collected in Mobile County, Alabama, during the month of August.

The writer collected eleven specimens of this species, eight males and three females, at Mobile, Alabama, from August 24 to September 2, 1925, and saw several other specimens, which he was unable to capture; most of the specimens captured, and observed, were found in the vicinity of, and visiting the flowers of, a species of *Hibiscus* growing in the marsh about a mile from the Union Station; some individuals were, however, found visiting other flowering plants growing in this marsh, but none was found in any of the other localities where the writer collected; they were usually quite shy and difficult of approach; their flight somewhat resembled that of *Phycanassa viator*, through or just over the tops of the rank vegetation, which grew from waist to shoulder high, so that they would readily disappear from view among it; when frightened, they flew with considerable speed and for a long distance; they were more readily captured when visiting the flowers of the *Hibiscus*, into which they crawled and could be approached within collecting range, as they were nearly hidden from view within the flower; Dr. van Aller and Mr. Lodging, of Mobile, who have collected specimens of *dukesi*, say that they have more often found them resting on the leaves of *Pontederia*, but none of the writer's specimens was so found. The specimens collected were in variable condition, some quite fresh, others much worn.

Since the writer's visit to Mobile, Dr. van Aller and Mr. Lodging have collected and sent to him several specimens of both sexes, taken during September and up to October 11.

In the fresher male specimens, the narrow, fulvous spots, bordering the lower side of the stigma, are usually bright and prominent, but in worn specimens they are so greatly reduced as to be barely noticeable; there is also some variation in the brightness of the color of the secondaries beneath and the distinctness of the rays; many of the specimens taken in late September and October are noticeably smaller in size than those taken on the earlier dates; one taken on October 11 is somewhat aberrant in having a slightly curved row of three, small, ill-defined, pale spots below the cell, on the primaries beneath.

The females are larger than the males; above, of approximately the same color, and with the fulvous area of the secondaries; beneath, though variable, generally of a more brownish color than the males and the pale rays less contrasting. The upperside of the primaries may be immaculate or have from one to three discal spots in a transverse band; these spots, when all are present, are in the interspaces between veins 1-2, 2-3, 3-4, the uppermost being just below the end of the cell; the spot in the interspace between veins 2-3 is the largest and brightest, somewhat crescentic in well-marked specimens; when only one spot occurs, it is this second or median spot of the band; on the underside of the primaries, this second spot is the only one distinctly repeated; in one specimen there is a very faint indication of the upper spot. There is no trace of sub-apical spots in any specimen before the writer.

Atrytone dion race *alabamæ* Lindsey.

A single female specimen taken at Chickasaw, on September 1, has the spots of the transverse band of the primaries and the sub-apical spots more reduced than those usually found in the typical females of *dion*; and, as noted in the description, the pale ray of the secondaries beneath is less contrasting; they differ from the females of *dukesi* in the more pointed apex of the primaries, in the presence of the sub-apical spots, the darker, reddish undersurface of the secondaries and in that all of the spots of the transverse band of the upper surface of the primaries are present on the under surface.

This race of *dion* was described by Dr. Lindsey in the same issue of *Entomological News* mentioned at the beginning of this

paper, following the description of *dukesei*, from one male collected in Mobile County, Alabama, in June.

Atrytonopsis verna Edwards.

A single, worn female was taken at Chickasaw, on September 1; this is the southernmost record for *verna*, known to the writer.

Copæodes minima Edwards.

This bright little species was very common at Mobile and Springhill, and in lesser numbers in some of the other localities in the vicinity.

Atrytone byssus Edwards.

One male and several females, all more or less worn, were taken at Chickasaw, in the pine woods, in grassy places, none were observed to visit the flowers, and their habit of settling low in the grass made them rather easily overlooked.

Amblyscirtes alternata Grote and Robinson.

Several specimens of this little species were taken at Dog River, near Mobile, in the pine woods, their swift, low flight and their dark color, amid the shadows in the woods, made it difficult to follow them with the eye, once they were disturbed, and their habit of alighting low in the grass or on the ground among it, made them hard to find.

Amblyscirtes textor Hubner.

Two specimens of this rather scarce species were taken at Chickasaw, on September 1 and 2, one each day.

NOTES ON THE SYNONYMY OF SOME NEW YORK STATE CHIRONOMIDÆ

BY O. A. JOHANNSEN

Changes in the synonymy of several species of Chironomidæ will be made in the forthcoming Catalogue of Insects of New York which may call for an explanation. On a recent visit to the Natural History Museums of Europe I have had the privilege of comparing some of the types of American forms with specimens which I brought with me from America and have thus been able to establish the identity of some species.

In the Natural History Museum of Vienna there are many specimens from the Von Winthem Collection which are said to have been identified by Meigen and in some cases to be the cotypes, hence I have included notes upon such of Meigen's species as are of interest to American entomologists. In Vienna also I saw some of the Say-Wiedemann species. The Staeger and Lundbeck types as well as a few of Fabricius are in the University Museum of Copenhagen. Zetterstedt's types are in the University Museum of Lund, those of Walker in the British Museum. To the museum authorities, Dr. Zerny, Mr. Wm. Lundbeck, Dr. Bengtson, Major Austen and Mr. Edwards, I am under great obligations for courtesies extended.

The figures following authors' names in the notes below refer to volume or page, or both. For bibliographical references see N. Y. State Museum Bul. 86, 1905.

Ceratopogon basalis Walker, List, I: 27. This species and my *J. flaviceps* (Johannsen, N. Y. State Mus., Bul., 124: 268) should be placed as synonyms of *Heteromyia flavipes* Meigen.

Tanypus tricolor Loew, Cent., 1: 3. This species belongs to the genus *Coelotanypus* Kieffer as I have determined by an examination of the type in Cambridge, Mass. A specimen of this species from New York is conspecific with the Loew type.

Tanypus melanops Wiedemann, Meigen, 1: 65. The Von Winthem specimens in Vienna are like the North American speci-

mens in our collection under this name. *Chironomus unicolor* Walker (1: 19), is a synonym.

Tanypus nigropunctatus Staeger, 2: 589. This species is distinctly smaller and more delicate than the American species bearing this name. The fore tarsi of the male are not bearded.

Chironomus atomarius Zett. 9: 3522. *Orthocladius atomarius*. This is an *Orthocladius* in the strict sense. In the male specimen from Areskutan the fore basitarsus is $\frac{2}{3}$ as long as the tibia. The other two specimens in the collection are in poor condition.

Chironomus sordidellus Zett. 9: 3521. This species belongs to the genus *Psectrocladius* Keiffer. In the single male specimen from Wilhelmina, Lapland, the wing is milky, the costa is produced beyond the tip of R_s only about twice the thickness of the costa; the empodium and pulvilli are large and the eyes are bare. The fore basitarsus is broken off. In female specimens of *C. variabilis*, which is regarded as the same species, the fore basitarsus measures .685 the length of the tibia. Of this form there are no males in Zetterstedt's collection. My North American records refer to another species as yet undescribed.

Chironomus atratulus Zett. 9: 3590. This species belongs to the genus *Metriocnemus*. There are three males in the collection. The legs are brown; fore basitarsus .57 as long as the tibia; the wings are more or less milky, tips of R_s and Cu_1 , equidistant from the apex of the wings, cubitus forks slightly distad of the base of the radial sector.

Metriocnemus lundbecki Joh. 86: 302. This name was proposed for *M. nana* Lundbeck not Meigen. The N. Y. specimens agree well with the type in Copenhagen.

Chironomus gmundensis Egger, Schiner, 2: 597. This is a *Tanytarsus*. The Egger types in Schiner's collection in Vienna agree with my New York specimens. *T. polita* Malloch differs in the form of the dorsal plate of the hypopygium. The fore tarsi of the male are not bearded, the hairs are rather short.

Chironomus flavellus Zett. 9: 3584. *Tanytarsus flavellus*. Only the thorax and wings of the type, apparently a male, remain. The cubitus forks slightly distad of the base of the radial sector.

Chironomus pellucidus Walker, List, 1: 21. Belongs to the genus *Tanytarsus*. *T. exiguus* Joh. (86: 294) is a synonym.

Chironomus trichomerus Walker, List, 1: 21. This is a *Tanytarsus*. It will find a place in my key near *flavellus* but it differs in having the cubitus fork very distinctly distad of the base of the radial sector. The type is a female. The fore basitarsus measures 2.12 times the tibia in length.

Chironomus albimanus Meigen. The Von Winthem specimens in the Vienna collection agree with the North American forms.

Chironomus albistria Walker, List, 1:17. This species goes to *neomodestus* Malloch in Malloch's key (Bul. Ill. State Lab. of N. H. 10: 424, 1915) but differs in being much larger. The thoracic stripes are reddish brown. The posterior part of the abdomen and the tarsal segments 2 to 5 are missing in the type. The fore basitarsus measures 1.7 times the tibia in length. The N. Y. species mentioned under this name is *quadripunctatus* Malloch.

Chironomus annularis DeG. Mr. F. W. Edwards, who has seen the type, considers this species identical with *C. plumosus* L.

Chironomus attenuatus Walker, List 1: 20. The specimen in the British Museum labelled type is a female with yellow thorax marked with three brown stripes. This does not agree with Walker's description. The fore legs are broken. The species recorded from New York state under this name is undescribed.

Chironomus brevitibialis Zett. 9: 3537. There are several specimens in the collection at Lund. A male labelled Hoburg 6 Jul, has the proportions of the fore leg segments, femur, tibia, and basitarsus as 8: 9.5: 12.5. Some other specimens measured gave approximately the same ratios. This is not in agreement with Van der Wulp's description reproduced by me in the New York State Museum bulletin 86, page 226. In the types the forceps are rather elongate, the inferior pair measuring about two-thirds the length of the superior, resembling those of *modestus* Say. The species may not occur in America. It most closely resembles *abortivus* Malloch and *dux* Joh., but differs from them in tarsal proportions and other details.

Chironomus brunnipes Zett. 9: 3518. A male specimen from Areskutan and a pair from Faxelfven are in the collection at

Lund. The fore basitarsus measures 1.4 times the tibia in length in the first mentioned specimen.

Chironomus dorsalis Meigen. Among the Von Winthem specimens in the collection in Vienna are three males. In these the fore basitarsi are sparsely but distinctly long haired. The specimen in the collection in Paris is said to be in fragments. The species in Vienna most closely resembles *C. maturus* Joh., but differs in size and coloring. My North American records of *C. dorsalis* should be referred to *C. cayuga* Joh.

Chironomus flavicingula Walker. List I: 20. My New York specimens agree perfectly with the type in the British Museum.

Chironomus festivus Say. Wiedemann's specimen of this species is in the museum in Vienna. Only a fragment of what appears to be a male specimen remains. There is no black line on the thorax. It resembles *glaucurus* Wied. (*stigmaterus* Say) in coloring.

Chironomus ferrugineo-vittatus Zett. 9: 3492. There are male and female specimens in the collection in Lund. The hairs on the fore tarsi of the female are much shorter than the diameter of the tarsi in all three cotypes, agreeing in this particular with my New York specimens. The distinction which Kieffer gives for separating this species from *C. plumosus* does not hold. I agree with Mr. Edwards in considering it a pale variety of *plumosus*.

Chironomus hilaris Walker. List 1: 17. *C. nephoterus* Mitchell is the same species.

Chironomus lobiferus Say. Only a fragment of head and thorax remains of Wiedemann's specimen of this species in Vienna. In coloring, it agrees with my specimens from New York.

Chironomus meridionalis Joh. N. Y. State Mus. Bul. 124: 277. This is correctly placed as a variety of *hyperborealis* Staeger. It is perhaps scarcely entitled to varietal rank. I compared my specimen with the type in Copenhagen.

Chironomus modestus Say. Only a fragment remains of Wiedemann's specimen of this species in the collection in Vienna. In coloring, and in the proportion of fore basitarsus to tibia, it agrees with my specimen determined as *modestus*.

Chironomus nubeculosus Meigen. In the collection in Vienna the Von Winthem and Von Frauenfeld specimens have hairy fore tarsi in the male and the wing spots are exceedingly faint. Schiner's specimens in Vienna, Staeger's in Copenhagen, and those recorded by me in N. Y. State Bulletin (124: 278) agree in having nearly bare fore tarsi and in having distinct wing spots. Which one is identical with Meigen's specimen remains to be determined.

Chironomus prasinus Meigen. *Chironomus intermedius* Staeger is considered a synonym of this species. The Staeger type in the museum in Copenhagen resembles *plumosus* except for size, hence probably identical, as Edwards and others have already assumed.

Chironomus riparius Meigen. There are several specimens in the collection in Vienna, but only one, and that one a female, from Von Winthem. My specimens from New York do not differ.

Chironomus stigmaterus Say. This is *C. glaucurus* Wiedemann (1: 15) of which there is one male from Pennsylvania in the Vienna collection obtained by Wiedemann from Say. The fore tarsi are hairy and the basitarsus is about $\frac{1}{3}$ longer than the tibia. It agrees with Malloch's characterization of the species.

Chironomus tenellus Zett. 9: 3517. The types, from Jemtland-Mulfjellet, are in the museum in Lund. The fore tarsi are not bearded, the basitarsus is $\frac{1}{3}$ longer than the tibia. The species is correctly placed in my key (Bul. 86: 193).

Chironomus tentans Fabr. The types in the collection in Copenhagen consist of two female specimens which do not differ from my specimens from the United States in coloring. In the collection are several male specimens named by Staeger. These resemble our own in having enlarged claspers as figured by Goetghebuer (Chir. de Belgique, 1921, page 145). The species from Europe and America are no doubt identical. The male specimens in the Zetterstedt collection in Lund likewise have enlarged claspers of similar structure. The Frauenfeld and Brauer specimens in Vienna have small claspers and differ in other particulars.

NEW MEMBRACIDAE, II

BY FREDERIC W. GODING

Subfamily Smiliidae

MENDICEA new genus

Head triangular, twice broader between eyes than long, flat, strongly reclined towards apex which is obtusely angulate, base straight; eyes rather small; ocelli slightly nearer eyes; base of vertex briefly trisulcate, median sulcus the longer.

Pronotum convex, depressed anteriorly; base of metopidium strongly depressed and almost horizontal, then suddenly sloping upward and backward to summit, its base with a short horizontal carina each side in front of a short sulcus; median carina percurrent, strong especially posteriorly, and several (six in type) smooth lateral carinae extending from near base to apex, between them strongly and distinctly punctured; humerals barely evident, but acute; posterior process convex, a transverse depression at base which extends to lateral margins, thereafter arcuate and very lightly elevated at middle, posterior half tectiform, seen from above strongly sinuate at base, then lightly dilated and gradually acuminate to the acute apex which is long as tegmina.

Tegmina almost completely covered by sides of pronotum, colorless vitreous; corium emitting two longitudinal veins from base, contiguous but not united for half their length, distant from costa the space between coriaceous, opaque and punctured, radial vein forked at middle enclosing the small only discoidal cell, ulnar vein simple not forked, fourth apical cell and interior basal cell with clavus occupying three-fourths of width of tegmina; one discoidal and four apical cells, free apical margin rather broad; wings with three apical cells, second cell sessile base truncate.

Legs slender, with three or four spines in exterior angle, tarsi equal. Type, *M. scaphoidea* n. sp.

Mendicea scaphoidea new species.

Naviculate, multicarinate, green clouded anteriorly with ferruginous; head yellow, base laterally impressed, with numerous small irregular ferruginous marks. Pronotum pea-green, lateral carinae yellowish, apical third of median carina ferruginous. Tegmina colorless vitreous, costal cell rich brown, base of clavus green, coriaceous, opaque, punctured. Below, chest piceous, abdomen sordid pale yellow; femora black, tibiae sordid yellow, basal third and tips, and tarsi tips, piceous.

Type: ♀, long. 4 mm.; lat. 1.5 mm.; alt. 1 mm.; cotype: ♂, testaceous between carinae, lateral margins posterior process and base of clavus yellow; also 4 ♂♂, ferruginous, and 1 ♀, color of type; size equal. Tena, Napo River, Ecuador (Williams).

INCOLEA new genus.

Naviculate, with indistinct longitudinal elevated lines. Head triangular, about as long as wide between eyes, punctulate, base sinuate; eyes small; ocelli inconspicuous, slightly nearer eyes and above a line passing through their center; genæ sinuate, clypeus narrow, apex acute, strongly recurved.

Pronotum punctured, strongly depressed anteriorly, metopidium sloping; median carina distinct; humerals slightly prominent; posterior process compressed, tectiform, lateral margins deeply sinuate behind humerals, then broadened and gradually acuminate to acute apex which reaches tips tegmina; dorsum lightly elevated at middle, sides with indistinct elevated longitudinal lines.

Tegmina with two longitudinal veins contiguous to and forked at middle, distant from costa and claval suture, interior basal cell with clavus vitreous occupying three-fourths width of tegmina, space between longitudinal veins and costa coriaceous, opaque, punctate; one discoidal cell between forks of ulnar vein, five apical cells, the vein between first and second apical cells rarely deficient; wings with three apical cells, second sessile base truncate. Legs simple. The tegmina are largely covered by pronotum.

Genotype, *I. variegata* n. sp.

Incolea variegata new species.

Pale yellow, variegated with ferruginous, median carina darker, the coriaceous costal part of tegmina, chest, and legs, concolorous.

Type: ♂, long. 4 mm.; lat. 1.5 mm.; alt. 1.5 mm.; paratype, ♂, similar to type. Tena, Napo River, Ecuador (Williams).

Incolea viridis new species.

Greenish-yellow, base of metopidium broadly and sometimes extending to middle of dorsum, and several small dots on median carina, piceous, coriaceous costal part of tegmina mottled with ferruginous; legs yellow; abdomen yellow.

Type: ♀, long. 3.5 mm.; lat. 1 1/3 mm.; alt. 1 mm. Tena, Napo River, Ecuador (Williams).

Aphetea bicolor new species.

Small, naviform, piceous and yellow. Head black, double wider than long, base straight, apical margin rounded from eyes, apex obtuse strongly recurved, densely punctate; eyes small; ocelli inconspicuous, very difficult to see, equidistant. Pronotum convex anteriorly, metopidium perpendicular on basal half, then rounded to dorsum; humerals acute, rather prominent; median carina distinctly percurrent; posterior process convex at base, deeply sinuate behind humerals, slightly amplified and gradually acuminate to apex which equals tips tegmina; seen from side the dorsum sinuate near base; densely punctate, piceous black, lateral margins in front of humerals very narrowly, small spot on base tegmina, broad transverse band across middle of posterior process, and spot in front of apex, yellow. Tegmina

with venation of the genus, base of clavus and space between the longitudinal veins and costa for two-thirds its length, black, punctate, otherwise colorless hyaline, free apical margin smoky at apex; no discoidal cell; tegmina two-thirds covered by pronotum; wings with three apical cells, bases of first and second cells truncate, of third cell stylate; legs simple, piceous and yellow irrorate; abdomen brown.

Type: ♂, long. 3 mm.; lat. 1 mm.; alt. 1 mm.; cotype, ♂, similar.

var. *a*. In three females the yellow transverse band extends anteriorly each side of median carina to base of metopidium.

var. *b*. One male has a yellow arcuate stripe around each humeral, as well as markings of the type; measurements of the varieties same as those of the type. All from Tena, Napo River, Ecuador (Williams).

Bicolor differs from *A. inconspicua* Fowl., and *A. affinis* Havig., in the straight basal margin of the head as well as in the distinct color markings, and from the latter in the position of the ocelli.

BOOK REVIEW

Ueber Chinas Pyraliden, Tortriciden, Tineiden . . ., by Aristide Caradja. (Academia Româna: Memoriile Sectiunii Stiintifice, Seria iii, Tomul iii, Mem. 7; Bucuresti, România, 1925).

At last we have a list of the Microlepidoptera of the boundary between the Palearctic and Oriental regions, with a clear indication of where that boundary lies. This memoir is in two parts, a discussion of biogeographical matters and a detailed list of species with their localities, including previously known material, as well as a larger amount which has not been previously published. The Pyralids are entirely adequately represented, with 602 species against 347 in the northeastern United States; the Tortricidæ, with eighty species listed, must be considered as a fair sample rather than a representative list, while the Tineid list of 22 species is really incredibly small—a good day should have netted more.

The most interesting thing that appears, perhaps, in the geographical discussion is a rather accurate tracing of the boundary between the Palearctic and Oriental regions. Starting from Hoang Chow, south of Shanghai, the line crosses the Yang Tse Kiang a little west of Nanking, then along the edge of the mountains of northern Ngan Hwei, south of the Hupei plain and along the Tapashan and Lanshan mountains to the borders of Thibet, where it turns south and runs into the main crest of the Himalayas. In the east the boundary is very sharp, the mountains belonging rather definitely to the oriental, and the plains to the Palearctic, but in the west, and especially in the province of Sze Chuan, the two faunæ intergrade. Caradja explains this plausibly as a result of the recent colonization of the plains, which have been formed by the loess and alluvium of the great rivers in relatively modern times, and were most accessible to the Palearctic species already colonized in their upper reaches before the lower (Shanghai) areas became land.

Another interesting item is his statement that the main part of China was colonized from three centers (with possibly another or two in regions yet unknown to us), namely the truly Pale-

arctic mountain district west and south-west of Peking, the mixed and largely mountainous district of western China, mainly Sze Chuan, and the more Oriental mountains south of the Yang Tse toward the Ocean. Such a statement based on records of over 600 species is certainly significant, though the author prefers not to support it with specific lists.

The following comparison of his species-list with the corresponding fauna of the northeastern United States may be of interest.

| | China | N-E. U.S. |
|-----------------------------------|-------|-----------|
| Galleriinae | 8 | 7 |
| Crambinae | 47 | 55 |
| Schœnobiinae (Siginæ)..... | 14 | 7 |
| Anerastiinae (Hypsotropinae)..... | 7 | 8 |
| Phycitinae (Anerastiinae)..... | 28 | 105 |
| Epipaschiinae | 31 | 10 |
| Chrysauginae | 1? | 7 |
| Endotrichinae | 22 | 0 |
| Pyralinae | 56 | 11 |
| Nymphulinae (Hydrocampinae) | 66 | 17 |
| Scopariinae | 7 | 7 |
| Pyraustinae | 317 | 109 |
| Macrothecinae | 0 | 1 |

The differences speak for themselves. The outstanding number of Pyraustinae and dearth of Phycitinae speaks plainly for the tropical affinity, while the large number of Pyralinae and Endotrichinae is obviously Palearctic.

I note a few misprints, mostly those to be expected when the compositor is unfamiliar with the language. A more confusing slip is the reference of the name "Nymphulinae" to the Scopariinae, Nymphula is, of course, the same as Hydrocampa, and has priority.—W. T. M. Forbes.

ORTHOPERUS SCUTELLARIS

This species of Coleoptera, less than a millimeter long, was described by Dr. John L. Leconte in 1878 (Proc. Am. Phil. Soc. XVII, 599). Rev. A. Matthews in 1899 (Mon. Corylophidæ and Sphæriidæ, p. 11) says it "proved on dissection to belong to *Sphærius*." On p. 212 of the same work he gives a careful description of *Sphærius scutellaris*. In my catalogue of 1920 I followed Matthews as no contradiction of his statement had appeared.

I have since learned by a communication from Mr. H. C. Fall, confirmed by an examination of Dr. Leconte's type made by Mr. P. J. Darlington, Jr., and by examination of Matthews' specimens, kindly loaned for the purpose by Mr. Gilbert J. Arrow, of the British Museum, that *Orthoperus scutellaris* Lec. was correctly described as an *Orthoperus* and that Matthews' statement was erroneous. Three specimens, received from Dr. George H. Horn, are in the Matthews collection, two of which were sent to me by Mr. Arrow. They have been dissected so that neither the antennæ nor the abdomen, displaying the diagnostic characters, can now be seen; but the acute apex of the elytra is characteristic of *Sphærius*, not *Orthoperus*, and coupled with the description published by Matthews, shows that Matthews' statement was based upon specimens of *Sphærius* sent to him by Dr. Horn as representatives of Leconte's *Orthoperus scutellaris*.

These specimens have been examined by Mr. Wm. T. Davis, of Staten Island, and by Mr. A. J. Mutchler, of the American Museum of Natural History, and compared with specimens of *Orthoperus* and *Sphærius*. Both of them agree that the remains of Matthews' type represent some species of *Sphærius*, but which species the mutilated types do not clearly disclose.

It is proper to add to the above that Col. Casey in 1900 (JOUR. N. Y. ENT. SOC. VIII, pp. 51-172) reviewing the family Corylophidæ did not accept Matthews' conclusions, though his text shows that he was aware of them. He described two varieties of *Orthoperus scutellaris* and retained that species correctly in Corylophidæ. He did not, however, discuss Matthews' treatment

of *Sphærius* beyond pointing out that *Sphærius politus* had been described by Dr. Horn and this statement, "There are many minor errors throughout this important monograph, which would doubtless have been avoided had the author lived to conduct it through the press" (p. 75).

CHARLES W. LENG.

THE RESTING PLACE OF SOME COLLECTIONS

Dr. Walther Horn has published in "Supplementa Entomologica" No. 12, March 15, 1926, a list of the entomological collections of the world, which have passed out of the possession of the original collector. Beginning this monumental task in 1910 as a card catalogue for personal use, industrious correspondence has produced a list of over 3,000 collections at the end of sixteen years. The information assembled in the case of such historic collections as those of Castlenau, Chevrolat, Dejean, etc., now divided and in many different museums is invaluable for students who may have occasion to study the types they contain; and the list is interesting now to those who remember deceased entomologists and will become more so as time goes on. In a preface of fourteen pages Dr. Horn mentions some of the more interesting facts connected with the earlier collections and expresses his admiration for the ardor which, in spite of all difficulties, their owners displayed. The work done by Louis Bedel in studying the fauna of Algeria has prompted him to adorn the work with a portrait of Bedel in Algerian costume.

For American coleopterists it may be of interest to recite the present location of some of our more famous collections as shown by Dr. Horn's labors:

John L. Leconte in Museum at Cambridge, Mass.

C. Zimmermann in Museum at Cambridge, Mass. (American sp.)

Frederick Blanchard in Museum at Cambridge, Mass.

Roland Hayward in Museum at Cambridge, Mass.

Edward D. Harris in Museum at Cambridge, Mass.

William G. Dietz in Museum at Cambridge, Mass.

Geo. R. Crotch in Museum at Cambridge, Mass. (Coccinellidæ.)

George H. Horn in the Museum at Philadelphia (except Baja Calif.).

Charles Wiit in Museum at Philadelphia, Pa.

Thomas L. Casey in U. S. Nat. Mus., Washington, D. C.

Hugo Soltau in U. S. Nat. Mus., Washington, D. C.

John B. Smith in U. S. Nat. Mus., Washington, D. C.

E. A. Schwarz in U. S. Nat. Mus., Washington, D. C.

Charles V. Riley in U. S. Nat. Mus., Washington, D. C.

H. K. Morrison in U. S. Nat. Mus., Washington, D. C. (part).

Martin L. Linell in U. S. Nat. Mus., Washington, D. C.

Fred Knab in U. S. Nat. Mus., Washington, D. C.

Geo. W. Belfrage in U. S. Nat. Mus., Washington, D. C.

Henry Ulke in Carnegie Museum, Pittsburgh, Pa.

John Hamilton in Carnegie Museum, Pittsburgh, Pa.

F. H. Snow in University of Kansas, Lawrence, Kans.

E. G. Love in Buffalo Society of Natural History.

Charles Palm in American Museum of Nat. Hist.

Chris H. Roberts in American Museum of Nat. Hist.

Gustav Beyer in Howard Notman Collection.

CHARLES W. LENG.

MIGRATION OF PYRAMEIS CARDUI

The unprecedentedly huge migration of Painted Lady Butterflies *Pyrameis cardui* from Baja California in 1924 was duly noted by me in this JOURNAL. As a rule these insects are comparatively scarce for several years following their extreme abundance.

The season 1925 ran true to form in this respect. I am out in my car, crossing large distances almost daily, I am in a position to note comprehensively. During the entire spring I did not see more than a dozen. At mid-summer I saw a few, invariably ovipositing on nettle. In the fall I saw fewer than 25.

March 7, 1926, I looked from the car window at Barstow, it being about breakfast time. The weather, which had been frosty across New Mexico and cold through Arizona, was balmy and, to my surprise, the air was filled with butterflies. I got off and noted that nearly all were our friends *P. cardui*. A few *P. coenia* and *Pieris* sp. with an occasional skipper made up the rest.

March 8 and 9 in Orange County *P. cardui* were occasional. March 12 they became abundant enough to be recordable as a migration.

In numbers they probably were not a third of the 1924 swarms. They followed a distinct path northward. Using a square acre just in front of my door as a unit for calculation, I estimate that all day from 1,000 to 1,500 individuals were present. The wild onion bloom was very abundant and each blossom carried a visitor. I estimate that each set moved onward and was entirely replaced each ten minutes (on an average). Moreover, they kept in flight and were attracted in numbers to the lighted windows, as late as 10:00 P. M. This would work out that 65,000 to 125,000 individuals passed a 200 feet wide space in the day. The whole path of migration (ocean to Colorado River) is a minimum of 125 miles. Certainly over 300,000,000 individuals a day moved northward from Baja California. March 13 they were about as abundant at Laguna Beach as the day before. It was a sultry day, very hot in the interior. A great many automobiles arrived at Laguna from considerable distances. The radiator of each one was decorated or entirely covered with *P. cardui*, caught and desiccated by the indrawing fan.

The individual specimens were seldom worn or looked old. This is rather different from 1924, when for the first ten days almost all were much battered. Weather conditions were more favorable in 1926, there being no high winds. I observed no ovipositing but this is presumably due to absence of food plant, even wild sunflower being locally absent.

March 14. *P. cardui* still abundant but not enough to indicate anything but the tail end of the movement.

R. P. Dow.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF APRIL 7, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on April 7, 1925, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty-seven members and six visitors present.

The Program Committee reported Dr. W. D. Leonard as the speaker on April 21.

Mr. Nicolay announced an outing to Orangeburg on Sunday, April 19.

Dr. Eugene K. Schwarz, 42 West 69th St., New York City, was elected a member.

A letter from H. S. Barber, of Washington, commending the obituary of Col. Casey in *Entomological News*, was read. It was also announced that the Casey collection had been moved to the U. S. National Museum.

Dr. Lutz told of Mr. Woodruff being ill with fever in the West Indian Island Tortola, where only five white men reside.

Dr. Felt spoke on "Winds and Insect Distribution with special reference to the Gypsy Moth in New York State." Believing that small caterpillars might be spread by air currents, he had, during 1923 and 1924, caused 709 balloons to be liberated; of these about 6 per cent. were recovered demonstrating easterly air currents, with an average velocity of about seventeen miles an hour. In extreme cases a velocity of 100 miles an hour was recorded and several balloons reached Nova Scotia, one even South Londonderry, Newfoundland, 775 miles away. The recorded cases of distant distribution, Monarch butterfly, Cotton Moth, Corn Ear Worm, Mexican Bean Beetle, Vanessa butterflies, Dragon flies, etc., were next considered and shown to be consistent with a theory of distribution by air currents. Further corroborative evidence was found in insects taken at sea, on the great lakes, in the altitude of 1,000 feet reached by spores, etc., of his general conclusion that air currents constitute an important factor in insect distribution.

Dr. Lutz spoke of his finding a Euglossid bee, a native of the American tropics, in his garden at Ramsey, N. J., and of the distribution of volcanic ash from Krakatau as additional evidence. In reference, however, to the migrations of the Monarch butterfly he considered further study advisable and told of the plans made at the museum for that purpose.

Mr. Davis spoke of his and other repeated observations of the Monarch butterfly going in a southerly direction every fall irrespective of wind; of the Cicadas that really like to stay at home, though they are good fliers; and of the Geometrid moth *Catenaria* plastered all over the fences. Such diverse examples showed in his opinion the need of considering the "inclination of the critter."

Messrs. Angell, Olsen, Weiss, Bird, Lawler and Lemmer joined in the discussion which recalled other instances of distribution by air and ocean currents.

Mr. Watson exhibited a second donation by Mr. Frank Johnson of rare and remarkably handsome tropical butterflies, including: *Papilio priamus* Lydius Felder, from Halmahera; *Papilio b. Brookiana* Wallace, from Borneo; *Prepona omphale omphale* Hubner, from Amazon; *Agrias amydon* Hewitson, from Colombia; *Morpho aurora aureola* Fruhstorfer, from Peru; *Morpho hecuba phanodemus* Hewitson, from Upper Amazon; *Tropea truncatipennis* Sonthonnax, from Mexico.

Mr. Nicolay read a newspaper article on *Scaphinotus viduus* found by Miss Anita A. Neu at Hemlock Falls.

Mr. Mutchler read a letter from Dr. Walther Horn, Berlin, telling of the reduction of his staff to one girl, and of his forthcoming list of entomological collections.

Mr. Bird exhibited four species of *Papaïema* moths collected by Mr. Lemmer.

MEETING OF APRIL 21, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. in the American Museum of Natural History on April 21, 1925, Dr. Frank E. Lutz, the president, in the chair, with twenty-four members and six visitors present.

Mr. Nicolay for the Outing Committee reported that rain had prevented the Orangeburg trip; that it would be repeated in two weeks and be followed by trips to Greenwood Lake and Wyandanch.

Mr. Weiss for the Program Committee reported papers by Messrs. Bell, Watson and Janson for May 5 and by Messrs. Brown and Davis for May 19.

Mr. Albert Hartzell, Yonkers, N. Y., was elected a member.

Dr. Leonard spoke of "The Spanish Grape Embargo on Account of the Mediterranean Fruit Fly" with illustrations by lantern slides. He said that the embargo resulted from the discovery of a slight infestation, about 2 per cent., in so-called "Malaga" grapes shipped in cork dust from Almeria in Spain, usually between November 1 and January 1. As it was a hardship to growers and importers he had gone to Spain to study the situation and plan, in conjunction with Spanish agricultural authorities, an amelioration of the conditions that might justify lifting the embargo. He found the grapes themselves practically free of infestation but the figs, which were commonly grown on the edge of the vineyards, the actual cause of the trouble. An effort was made to have the growers clean up, which in a few cases was quite successful but as a general rule was not. The embargo was therefore continued in force, leading to complications in renewing the trade treaty with Spain. Prohibition affected Spanish exports to the United States of wine and cork; embargo affected their exports of grapes; little was left for them but a feeling of severe treatment.

Dr. Leonard showed many views of the region he had visited, its mountains and terraced vineyards. The varieties grown and methods of cross fertilization, spraying and marketing were also shown with a few views of the Spanish onion industry. The pictures ended with several devoted to the bull fights and Dr. Leonard finally in bull fighter's costume photographed by Dr. W. M. Mann.

Dr. Leonard's remarks were discussed by Dr. Shaw of the Federal Horticultural Board, Mr. Seymour of the Florists' Exchange, Dr. Lutz, and other members.

MEETING OF MAY 5, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 5, 1925, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty-four members and three visitors present.

Mr. Nicolay announced for the Outing Committee a trip to Greenwood Lake for May 17, and the results in capturing ground beetles including *Elaphrus cicatricosus* on the trip to Montvale.

Dr. Lutz announced the establishment of a Field Station in a tract of 40 acres at Wild Cat Brook in the Ramapo Mts. about one mile south of Southfields and invited the members to camp there May 30-31, conditioned upon their restraining from turning stone, detaching bark or otherwise destroying the natural conditions. Several members signified their intention of accepting the invitation.

Upon a statement of the Second Annual Luncheon of the Riverdale Entomological Club on May 2, which club is composed of boys about 15 years of age, the following resolution was adopted:—

The New York Entomological Society, thirty-three years old, congratulates the Entomological Club of Riverdale upon its second birthday and sends its best wishes for a long and successful life, with instructions to the secretary to send a copy thereof to the club.

A letter from Dr. Leonard requesting the endorsement of the society of his request for a grant of \$300 from the New York Academy of Sciences was read. The money was needed for completion of the New York State List and could not be furnished by Cornell University.

Dr. Lutz explained the situation in the Academy Executive Committee, which would make prompt action advisable and a subscription of part of the amount by the Society more effective than a simple endorsement; provided the Society desired to make the endorsement.

The treasurer stated that in view of the loss liable to result in the C. M. & St. Paul matter \$100 would be all that the Society could afford.

After discussion in which Messrs. Sherman, Weiss, Woodruff and Engelhardt took part, on motion by Mr. Leng the society appropriated \$100 provided the balance could be obtained.

Mr. Frank Johnson offered to add \$50, which offer was accepted with thanks.

On motion by Mr. Engelhardt, the Society's delegate to the Academy, Mr. Davis, was instructed to present Dr. Leonard's letter to the Academy Executive Committee informing them that the Society would be prepared to contribute \$150.

Mr. Barber called attention to a proposed Biographical Entomological Dictionary as explained in *Science*, *Entomological News*, etc. C. L. Metcalf, Urbana, Ill., will receive and forward to Prof. Embrik Strand, the publisher, American autobiographies.

Mr. Bell under the title "Remarks on Some Hesperidæ" exhibited *Achalarus casica* from Arizona and pointed out the difference between it and *epigona* and the history of the literature. He also exhibited *Myscelus phoronis*, *amystis* and *orbis* from South America with comments thereon.

Mr. Watson exhibited the following rare and beautiful butterflies from tropical America, given to the American Museum by Mr. Frank Johnson, and all new to that collection, viz.: *Metosamia montezuma*, *Morpho sulkowskii*, *Dynastor napoleon*, *Morpho anaxibia*, *Morpho rhetenor helena* and *eusebes*, *Morpho cypris cyanites*. *Telea polyphemus* from New York was added to the exhibit to show the differences exhibited by *montezuma*.

Mr. Janson spoke on "Adventures of an artist with Tingididæ and certain Coleoptera" in which he dwelt upon the resemblances the artist saw between insects and other objects, the lace bug suggesting Elizabethian costume, the roughly sculptured Scolytid the wild scenery of the Garden of the Gods in Colorado, etc. He exhibited several of the drawings he had made for Dr. Blackman at Syracuse University and for other authors in confirmation of this. He also described some interesting habits of the insects he had observed while making such drawings, particularly the Scolytid male response to any suggestions of danger by partial opening of elytra to better conceal the burrow entrance and the dancing upon arrival at the hive of the field bee laden with a rich store of nectar. In this connection he referred to Hart's paper in the *Journal of Economic Entomology*. Mr. Janson closed his remarks with quotations from Walt Whitman on the aesthetic view of natural objects.

Mr. Engelhardt commented on the way primitive art seemed to draw its inspiration from natural objects and suggested that designers might profit by a closer study of our native insects.

GEO. J. KELLER

The entomological fraternity has lost in the death of Geo. J. Keller one of its most enthusiastic collectors of Lepidoptera.

He was born Dec. 24, 1873, in Darmstadt, Germany, where he studied pharmacy and served his apprenticeship in his father's apothecary. He came to this country in 1892 and owned and operated in succession and simultaneously a number of drug stores and the one he left at the time of his death is by far the finest in Newark, N. J.

Being a lepidopterist all his life he devoted his efforts the last fifteen years to the genus *Catocala*, of which he accumulated by successful breeding and purchase one of the most complete and largest collections in the country.

Always of a social and agreeable disposition, his death will be keenly felt by all who were fortunate enough to enjoy his acquaintance.—OTTO BUCHHOLZ.

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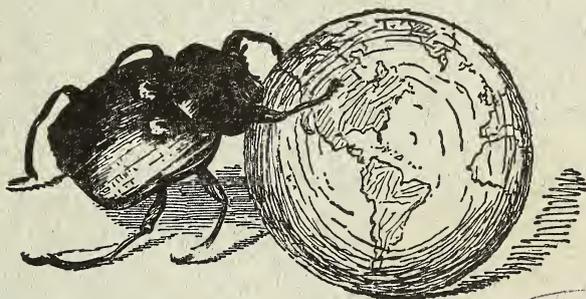
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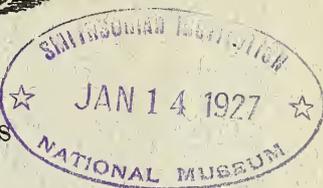
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VOL. XXXIV

DECEMBER, 1926

No. 4

CLASSIFICATION OF THE MEMBRACIDÆ OF AMERICA

BY FREDERIC W. GODING

LIVERMORE FALLS, MAINE

Key to Subfamilies

- 1(10). Third apical cell of corium elongate, sessile, base truncate.
- 2 (5). Scutellum more or less visible; exceptionally when covered by sides of pronotum the apical cells of corium are arranged obliquely on apical margin which is then destitute of a limbus; tibiæ rarely dilated.
- 3 (5). Pronotum destitute of a posterior process, more or less sexangulate or quadrangulate; base of head frequently elevated in a transverse carina; clavus gradually acuminate from base to apex (one exception)Subf. *ÆTHALIONINÆ*.
- 4 (3). Pronotum produced posteriorly in a process, dorsum convex, armed or unarmedSubf. *CENTROTINÆ*.
- 5 (2). Scutellum completely covered by sides of pronotum, or abortive.
- 6 (7). Posterior tarsi much shorter than the front and middle tarsi.....Subf. *HOPLOPHORIONINÆ*.
- 7 (6). Posterior tarsi equal in length to or longer than front and middle tarsi.
- 8 (9). One or more pairs of tibiæ dilated and flattened; apical margins of head foliaceous.....Subf. *MEMBRACINÆ*.
- 9 (8). Tibiæ simple, not dilated; margins of head not foliaceous.....Subf. *DARNINÆ*.
- 10 (1). Third apical cell of corium stylate, triangular or transversely elliptical, its base never sessile and truncated.
- 11(12). Tegmina membranous, bases and costal area sometimes coriaceous and opaque, venation distinct, limbus not broad.....Subf. *SMILIINÆ*

- 12(11). Tegmina mostly coriaceous and opaque, venation very indistinct, apices often folded transversely, limbus very broad.....
.....Subf. TRAGOPINÆ.

Subfamily *ÆTHALIONINÆ*

Key to Genera

- 1(26). Clavus gradually acuminate from base to apex.
2 (5). Base of head not elevated in a transverse carina and destitute of horns and tubercles, ocelli near eyes and base; pronotum and scutellum with a median carina, unarmed; margins of tegmina parallel, tips not passing apex of abdomen; wings with 4 apical cells; scutellum triangular.
3 (4). Head triangularly produced, base longitudinally sulcate, front lightly reclined; scutellum much longer than broad; tegmina coriaceous, venation obsolete.....STICTODEPSA Stal.
4 (3). Head truncate, base perpendicular then suddenly reclined horizontally; scutellum slightly longer than broad, acutely carinate; venation obscure, 5 apical and no discoidal cells in corium.....
.....SCYTODEPSA Stal.
5 (2). Base of head elevated in a transverse carina frequently sulcate at middle and tuberculate each side, or bicorniculate.
6 (9). Wings with 2 apical cells; pronotum and scutellum unarmed.
7 (8). Venation of corium irregular forming numerous cellules, tegmina opaque or semiopaque; pronotum slightly broader than long, depressed, with a median carina; scutellum triangular, destitute of a median carina or tip lightly carinate, apex acuminate; ocelli distant from each other and base of head.....ÆTHALION Latr.
8 (7). Venation of corium normal, 5 apical and no discoidal cells; pronotum twice longer than broad; scutellum nearly long as abdomen, dorsum lightly sinuate, convex towards base, tectiform towards apex.....TROPIDASPIS Stal.
9 (6). Wings with 4 apical cells.
10(19). Pronotum convex, unarmed.
11(12). Corium with 7 apical cells and 2 discoidal cells; scutellum elongate, base gibbous, apex obtuse.....NICOMIA Stal.
12(11). Corium with 4 or 5 apical cells.
13(14). Corium with 4 apical cells, no discoidal cell; pronotum long as broad with median carina; scutellum nearly flat, equally long and broad, with median carina; apices of tegmina not passing tip of abdomen; carinate basal margin of head porrect, sulcate at middle and bilobed, ocelli near eyes, distant from base.....
.....ENDOASTUS Fowl.
14(13). Corium with 5 apical cells.

- 15(16). Base of head armed each side with a long slender horizontal horn; scutellum with an erect slender compressed horn its altitude three times its width; tegmina with 1 discoidal cell.....MINA Walk.
- 16(15). Base of head arcuate, unarmed; scutellum cornute, or crested, or carinate; tegmina hyaline, corium with 2 discoidal cells.
- 17(18). Scutellum with a median carina or small crest longer than high; pronotum with a median carina; head perpendicular, ocelli very distant; tarsi medium.....LOPHYRASPIIS Stal.
- 18(17). Scutellum with an erect compressed slender horn three times higher than wide; head strongly reclined, ocelli nearly equidistant; pronotum destitute of a median carina; tarsi nearly as long as tibiæGERRIDIUS Fowl.
- 19(10). Dorsum of pronotum elevated in an erect or porrect horn or process, or cornute above each humeral.
- 20(23). Pronotum destitute of a horn above each humeral.
- 21(22). Dorsal elevation of pronotum rounded from posterior margin anteriorly above head, compressed; dorsum of scutellum sinuate; corium destitute of discoidal cells; basal margin of head sulcate at middleEUSTOLLIA Godg.
- 22(21). Dorsum of pronotum and of scutellum each elevated in a nearly erect acuminate compressed horn equal in altitude; corium with 1 discoidal cell; base of head bicorniculate, horns erect, acuteLAMPROPTERA Germ.
- 23(20). Pronotum cornute above each humeral.
- 24(25). Scutellum oblong, longitudinally sulcate or impressed, apex obtuse; suprahumeral small acute, compressed; vertex of head perpendicular, flat, ocelli equidistant; tegmina hyaline, corium with 7 apical cells and 1 discoidal cell.....TOLANIA Stal.
- 25(24). Scutellum large, triangular, transversely sulcate, apex a slender spine; suprahumeral short, thick, conical, directed obliquely outward and upward; vertex of head, horizontal, bituberculate, front suddenly turned downwards and backwards, ocelli near eyes and base; tegmina coriaceous, opaque, reticulate forming numerous cellules; wings long as tegmina and some broader.....WILLIAMSIANA Godg.

Subfamily *CENTROTINÆ*

Key to Tribes and Genera

- 1(38). Clavus gradually acuminate from base to apex.

Tribe *Acuminatini*

- 2(15). Venation of tegmina irregular, reticulate forming numerous cellules; posterior pronotal process close to scutellum.
- 3(10). Pronotum convex, unarmed above humerals.

- 4 (5). Dorsum of pronotum seen from side straight, posterior process broad at base almost covering scutellum, gradually acuminate; tibiæ slightly dilatedETONEUS Kirk.
- 5 (4). Dorsum of pronotum seen from side strongly sinuate.
- 6 (9). Pronotum gibbous anteriorly between humerals, dorsum bisinuate, posterior process shorter than abdomen; apex scutellum emarginate or truncate; ocelli near eyes; tibiæ simple.
- 7 (8). Summit of gibbosity convex, humerals produced in tubercles, posterior process narrow, sides parallel, apex acute between apical denticles of scutellum.....CENTRODONTUS Godg.
- 8 (7). Summit of pronotal gibbosity truncate, humerals not produced, sides in front of humerals with a tubercle in a depression each side, posterior process broad at base, constricted at middle then acuminate to lightly elevated apex.....TUBERCULOCENTRUS Godg.
- 9 (6). Pronotum depressed, convex anteriorly, posterior process narrow at base, sides parallel, apex reaching middle of abdomen acute and unituberculate; ocelli nearly equidistant.....♂ TYLOCENTRUS V. D.
- 10 (3). Dorsum of pronotum cornute, or bilobed, or tuberculate.
- 11(14). Dorsum of pronotum bilobed or bicornute.
- 12(13). Dorsum of pronotum elevated between humerals its summit bilobed, posterior process broad at base almost covering scutellum, long as abdomen, gradually acuminate, seen from side bituberculate, basal margin of pronotum produced in a transverse carina; ocelli slightly nearer eyes, tibiæ slightly dilated.....MULTAREIS Godg.
- 13(12). Dorsum of pronotum convex, depressed, with a short acute horn above each humeral; otherwise as in '9(6)'......♀ TYLOCENTRUS V. D.
- 14(11). Dorsum of pronotum quadricornute or distinctly quadrituberculate or quadrinodose, humerals strongly prominent, large, posterior process at least long as scutellum its apex crested; basal margin of head very sinuous, sides of clypeus parallel its apex extended below inferior margins of genæ; ocelli about equidistant, even with center of eyes; tibiæ slightly dilated.....EUWALKERIA Godg.
- 15 (2). Venation of tegmina normal.
- 16(37). Posterior pronotal process close to scutellum, apex acuminate; dorsum of scutellum depressed, unarmed.
- 17(34). Corium with 5 apical cells; wings with 4 apical cells.
- 18(27). Corium with 1 discoidal cell, apical cells placed obliquely on apical margin which is destitute of a limbus; tibiæ flattened and dilated.
- 19(22). Pronotum convex and gibbous anteriorly, not compressed.

- 20(21). Pronotum unarmed above humerals, posterior process slender apex reaching middle of abdomen; base of head bituberculate.....
LIRANIA Stal.
- 21(20). Pronotum armed above each humeral with a short tricarinate horn, posterior process long, undulate, triquetrous, apex reaching tip of abdomen; base of head unarmed.....FLEXOCENTRUS Godg.
- 22(19). Pronotum strongly elevated at least anteriorly, more or less compressed; some of apical cells of corium placed obliquely on apical margins which are destitute of a limbus.
- 23(24). Pronotum formed as a large reticulated inflated vesicle long as tegmina, completely covering body and scutellum; ocelli near eyes and base of head.....CEDA A. S.
- 24(23). Dorsum of pronotum acute, or summit bilobed or slightly dilated.
- 25(26). Pronotum strongly elevated in front, lightly compressed, its summit bilobed or slightly dilated, sometimes emitting a process behind its tip.....LYCODERES Germ.
- 26(25). Dorsum of pronotum strongly elevated, compressed, acute, posterior process long as abdomen its base slightly emarginate almost covering scutellum.....STEGASPIS Germ.
- 27(18). Corium with 2 or 3 discoidal cells; legs simple.
- 28(29). Corium with 2 discoidal cells; pronotum moderately elevated and gibbous anteriorly, unarmed above humerals, posterior process shorter than abdomen, slender; apex scutellum acute; ocelli near eyesMELIZODERES Blanch.
- 29(28). Corium with 3 discoidal cells, tegmina opaque; apex scutellum emarginate; ocelli equidistant, far from base of head.
- 30(31). Radial vein of corium forked near middle, ulnar vein simple not forked; pronotum convex anteriorly, unarmed or with lateral crests, posterior process very slender and short.....
MICROCENTRUS Stal.
- 31(30). Radial vein of corium simple not forked, ulnar vein forked near base; pronotum with a short truncate horn or elevated ruga above each humeral, posterior process long as abdomen.....
CENTRUCHOIDES Fowl.
- 32(17). Corium with 4 apical cells two cells occupying apical margin obliquely, 1 true discoidal cell, radial vein forked far behind middle enclosing discoidal cell, ulnar vein simple; wings with 4 apical cells; pronotum elevated anteriorly in a high erect slender stilus, its summit emitting slender rami; ocelli distant; legs simple.
- 33(34). Basal margin of pronotum lightly reflexed, unarmed, front and lateral rami with inflated globules; base of head unarmed, apical margin lightly produced between eyes and front.....
BOCYDIUM Latr.

- 34(33). Basal margin of pronotum reflexed, bidenticulate, rami of front process destitute of globules; base of head bituberculate, apical margin lobate each side front of eyes.....*STYLOCENTRUS* Stal.
- 35(16). Posterior pronotal process distant from scutellum, long, compressed at middle, apex trispinose, dorsum with a large antlered horn above each humeral; scutellum long, base and apex elevated, apex touching swelling on posterior pronotal process; corium with 1 discoidal cell and 5 apical cells, radial vein forked far behind middle, ulnar vein simple; wings with 4 apical cells.
.....*SMERDALEA* Fowl.
- 36 (1). Margins of clavus nearly parallel, clavus not or very slightly narrowed towards apex which is obtusely rounded; corium with 5 apical cells.

Tribe *Hebesini*

- 37(40). Basal margin of pronotum produced anteriorly in a prominent angle or long porrect process, cornute above each humeral, posterior process long, straight to middle then lightly curved, base almost completely covering scutellum, gradually narrowed behind, with an erect process at base; ocelli near eyes and base of head; corium with 3 discoidal cells, and some cellules; wings with 4 apical cells.
- 38(39). Basal margin of pronotum produced in a long porrect process sulcate above representing the union of the two sides
.....*NESSORHINUS* A. & S.
- 39(38). Basal margin of pronotum produced in a prominent angle, destitute of a porrect process *GONIOLOMUS* Stal.
- 40(37). Basal margin of pronotum straight or broadly sinuate, not produced anteriorly.
- 41(52). Posterior pronotal process distant from scutellum; corium with 2 discoidal cells, exterior vein of clavus not percurrent; wings with 4 apical cells.
- 42(43). Exterior discoidal cell of corium stylate, base angulate not truncate; pronotum cornute above each humeral, posterior process slender, long as abdomen, slightly amplified at middle below where it touches scutellum *BOOCERUS* Stal.
- 43(42). Exterior discoidal cell sessile, base truncate.
- 44(47). Posterior pronotal process short, extended about to middle of abdomen.
- 45(46). Pronotum with a short horizontal horn above each humeral, apex posterior process dilated, spatulate.....*SPATHOCENTRUS* Fowl.
- 46(45). Pronotum unarmed above humerals, posterior process very slender, apex acute.....*ISCHNOCENTRUS* Stal.
- 47(44). Posterior pronotal process extended to apex of abdomen.

- 48(49). Posterior pronotal process lobed inferiorly at middle which touches scutellum; pronotum cornute or tuberculate above each humeral.
.....CAMPYLOCENTRUS Stal.
- 49(48). Posterior pronotal process slender, sinuate, curving downwards and touching scutellum at middle; pronotum unarmed.
- 50(51). Pronotum unicarinate; exterior discoidal cell of corium small nearly circular, interior discoidal cell much larger and subtriangular, exterior apical cell minute.....OPHICENTRUS Fowl.
- 51(50). Pronotum tricarinate, with a median carina and short carina each side above humerals; discoidal cells of corium subequal, exterior apical cell large.....PSILOCENTRUS Fowl.
- 52(41). Posterior pronotal process close to scutellum.
- 53(60). Corium with 2 discoidal cells; pronotum convex, unarmed.
- 54(57). Wings with 4 apical cells; exterior discoidal cell of corium sessile, base truncate; posterior pronotal process short, slender.
- 55(56). Posterior pronotal process long as scutellum, apex acute, humerals prominent, destitute of a furrow each side above humerals.....
.....CENTRICULUS Fowl.
- 56(55). Posterior pronotal process seen from side gradually dilated posteriorly, slightly longer than scutellum; pronotum with a deep furrow above each auriculate humeral.....AMBLYCENTRUS Fowl.
- 57(54). Wings with 3 apical cells.
- 58(59). Exterior discoidal cell of corium stylate; posterior pronotal process broad at base largely covering scutellum, extended beyond middle and sometimes beyond apex of abdomen.....GARGARA, A. & S.
- 59(58). Exterior discoidal cell of corium sessile; posterior pronotal process short, slender, apex slightly passing middle of abdomen.....
.....BRACHYBELUS Stal.
- 60(53). Corium with 3 discoidal cells; wings with 4 apical cells.
- 61(64). Exterior discoidal cell of corium sessile; pronotum cornute above each humeral, base of posterior process broad nearly covering scutellum.
- 62(63). Exterior vein of clavus percurrent, corium destitute of transverse venule between rami of ulnar vein; posterior pronotal process short, extended just behind middle of abdomen, gradually narrowed behind middle.....PLATYCENTRUS Stal.
- 63(62). Exterior vein of clavus not percurrent, corium with 2 or 3 transverse venules in front of middle between rami of ulnar vein; posterior pronotal process long as abdomen.....
.....ORTHOBELUS Stal.
- 64(61). Exterior discoidal cell of corium stylate, base angulate; pronotum unarmed above humerals, posterior process broad at base covering most of scutellum.
- 65(66). Posterior pronotal process extended just beyond middle of abdomen; head with eyes narrower than width between humerals.....
.....BRACHYCENTROTUS M. & B.

- 66(65). Posterior pronotal process long as abdomen; head with eyes broad as width between humerals.....MONOBELUS Stal.

Subfamily *MEMBRACINÆ*

Key to Tribes and Genera

- 1 (6). Pronotum more or less strongly compressed and elevated.

Tribe *Membracini*

- 2 (3). Pronotum very strongly elevated and compressed, front rounded destitute of a process or lateral carinæ anteriorly, pronotum forming a large foliole.....MEMBRACIS Fabr.
- 3 (2). Pronotum moderately compresso-elevated and foliaceous, front produced in a process or obtuse angle with lateral carinæ in superior part, front rarely rounded.
- 4 (5). Lateral carinæ not extended behind humerals.....
.....ENCHOPHYLLUM A. & S.
Dorsum of pronotum produced anteriorly in a compressed foliaceous process or angle, median carina from base to summit foliaceous.....Subgenus *Enchophyllum* A. & S.
Dorsum of pronotum rounded anteriorly and foliaceous, destitute of a front process or angle, median carina foliaceous from summit to below and in front of head.....
.....Subgenus *Phyllotropis* Stal.
- 5 (4). Lateral carinæ of pronotum extended behind the humerals, usually to the middle of lateral margins.....ENCHENOPA A. S.
Front pronotal process with a carina each side extended from its apex to lateral margins behind humerals, and one or more abbreviated carinæ toward apex.
Lateral carinæ of front process equally distant from its superior and inferior margins, both margins foliaceous; head longer than broad between eyes.....Subg. *Enchenopa* A. S.
Lateral carinæ of front process close to superior margin, median carina not foliaceous below the process; head lightly transverse.....Subg. *Campylenchia* Stal.
Front pronotal process short, nearly erect, with one carina each side extended from apex to lateral margins of pronotum behind humerals, destitute of abbreviated carinæ; superior margin of dorsum distinctly impressed, foliaceous; head narrowed towards apex.....Subg. *Tritropidia* Stal.
- 6 (1). Pronotum not compressed or foliaceous.
- 7(25). Apex of head rounded or obtusely angulate, not trilobed.
- 8(18). Pronotum destitute of front or suprahumeral processes, sometimes produced anteriorly in an obtuse angle.

Tribe BOLBONOTINI

- 9(12). Form subglobular, very short, stout, rugose and carinate.
- 10(11). Corium with 2 discoidal cells; wings with 4 apical cells.....
BOLBONOTA A. S.
 Posterior pronotal process with a transverse tubercle compressed
 antero-posteriorly; dorsum gradually rounded to base of the
 tubercle.....Subg. *Tubercunota* Godg.
 Posterior pronotal process suddenly depressed in front of apex;
 dorsum straight or lightly sinuate in front of depression.....
Subg. *Bolbonota* A. & S.
- 11(10). Corium with 4 discoidal cells; wings with 5 apical cells.....
BOLBONOTODES Fowl.
- 12 (9). Form oblong, elongate or triangular.
- 13(17). Corium with 3 discoidal cells; metopidium with one or more abbrevi-
 ated carinæ over each eye.
- 15(16). Dorsum seen from the side nearly straight, two short carinæ over
 each eye.....ERECTIA Walk.
- 16(15). Dorsum of pronotum seen from the side strongly bisinuate, one
 short carina over each eye.....TYLOPELTA Fowl.
- 17(13). Corium with 2 discoidal cells; dorsum of pronotum substraight, no
 short carinæ over eyes.....LEIOSCYTA Fowl.
- 18 (8). Pronotum elongate, armed with horns or protuberances.

Tribe PTERYGIINI

- 19(24). Front of pronotum produced in a more or less porrect process or
 tubercle.
- 20(21). Pronotum destitute of lateral carinæ, rugæ or tubercles, surface
 smoothGUAYAQUILA Godg.
- 21(20). Pronotum furnished with carinæ and tubercles.
- 22(23). Pronotal front process long, porrect, destitute of a tubercle at
 base, apex slightly dilated.....PHILYA Walk.
 Venation normal, corium with 3 discoidal cells.....
Subg. *Philya* Walk.
 Venation irregular, with numerous cellules, toward apex.....
Subg. *Scalmophorus* Fowl.
- 23(22). Pronotal front process high, erect, carinate, or reduced to a tuber-
 cle; dorsum tuberculate and spinose.....HYSOPRORA Stal.
- 24(19). Front of pronotum unarmed, dorsum with two robust erect or
 divaricate processes, one above each humeral, apices truncate,
 and one or more elevated tubercles between and behind them,
 with numerous small spines.....PTERYGIA Lap.
- 25 (7). Apex of head trilobed; pronotum with clavate or fungiform pro-
 cesses on dorsum, variable in form.....
SPHONGOPHORUS Fairm.

Posterior pronotal process armed near middle of dorsum with a process; front pronotal process with or without a lobe or denticle on the posterior margin.

Front pronotal process destitute of a lobe or denticle on the posterior margin.....Subg. *Cladonota* Stal.

Front pronotal process armed with a lobe or denticle near middle of the posterior margin.....Subg. *Lobocladisca* Stal.

Posterior pronotal process unarmed near middle of dorsum, front pronotal process unarmed.....Subg. *Sphongophorus* Fairm.

Subfamily HOPLOPHORIONINÆ

Key to Tribes and Genera

- 1 (6). Wings with 3 apical cells.

Tribe HOPLOPHORIONINI

- 2 (5). Anal cell of wings distinct, sublobate, 1-veined; apex of posterior pronotal process not or slightly passing tip of abdomen.

- 3 (4). Head broad, obtuse, equal in width to base of posterior pronotal process, that process narrowed from base to apex.....
.....PLATYCOTIS Stal.

Metopidium strongly declivous, basal margin broadly sinuate between eyes.

Pronotum convex and unarmed in front, or with a more or less porrect process on dorsum in front of humerals.....
.....Subg. *Platycotis* Stal.

Pronotum convex anteriorly, with a process on dorsum behind humerals.....Subg. *Lophopelta* Stal.

Metopidium slightly convex, not perpendicularly declivous, basal margin straight between eyes; pronotum with or without dorsal elevations, with a median and two or three lateral carinae above each humeral, lateral margins of posterior process sinuate.....Subg. *Microschema* Stal.

- 4 (3). Head narrower than base of posterior pronotal process; pronotum shield-shaped, lateral margins sinuate behind humerals, apex obtuse.....
.....HOPLOPHORION Kirk.

Pronotum destitute of front or dorsal process, lateral margins of posterior process parallel toward base.....
.....Subg. *Hoplophorion* Kirk.

Pronotum with a compressed, oblique porrect process, lateral margins of posterior process narrowed from base.....
.....Subg. *Enchotype* Stal.

- 5 (2). Anal cell of wings very small, barely evident, not lobate; dorsum of pronotum with an erect or reclined process, apex of posterior process passing tip of abdomen.....UMBONIA Burm.

- 6 (1). Wings with 4 apical cells.

Tribe POTNIINI

- 7 (8). Dorsum of pronotum compresso-elevated, humerals produced in strong sharp spines.....ALCHISME Kirk.
- 8 (7). Humerals not produced, not prominent.
- 9(10). Metopidium convex, declivous, pronotum destitute of dorsal processesOCHROPEPLA Stal.
 Corium with 2 discoidal cells.....Subg. *Ochropepla* Stal.
 Corium with 3 discoidal cells; type, *O. carinata* Funkh.....
Subg. *Trinarea* Godg.
- 10 (9). Front of pronotum produced in a horn or process.
- 11(12). Apex of front pronotal process obtuse, sides of pronotum not carinate, posterior process short, hardly passing tip of abdomen.....
POTNIA Stal.
- 12(11). Apex of front pronotal process long, acute, sides of pronotum carinate, apex of posterior process nearly long as tegmina.....
ACONOPHOROIDES Fowl.

Subfamily DARNINÆ

Key to Tribes and Genera

- 1(46). Pronotum convex or gibbous, unarmed, humerals rarely auricularly produced; corium with 4 or 5 apical cells.

Tribe DARNINI

- 2(21). Pronotum covering a large part of tegmina; corium with 2 discoidal cells; head short, apex rounded or truncate, obtuse.
- 3(16). Pronotum convex, not gibbous, humerals not produced.
- 4(13). Pronotum destitute of a median longitudinal carina.
- 5(10). Corium emitting 2 longitudinal veins from base, contiguous or united toward origin.
- 6 (9). Sides of pronotum produced downward in a lobe behind each eye; ocelli nearer each other than to eyes, distance variable.
- 7 (8). Ulnar vein of corium forked in front of middle, radial vein forked at or behind middle, exterior discoidal cell small, interior cell large, elongate; tegmina largely covered by sides of pronotum.....
HEBETICA Stal.
- 8 (7). Ulnar and radial veins of corium forked equally far behind middle; tegmina some prominent below sides of pronotum.....
STICTOPELTA Stal.
- 9 (6). Sides of pronotum destitute of postocular lobes; ulnar vein forked towards base, radial vein forked behind middle, discoidal cells elongate, subequal; ocelli almost equidistant; pronotum alutaceous, not punctulate.....ALOBIA Stal.
- 10 (5). Corium emitting 3 longitudinal veins from base, radial vein forked near middle, the two ulnar veins contiguous or united toward

- origin and simple, not forked, 2 elongate equal discoidal cells; pronotum lightly punctulate, basal margin not calloused, humerals distinct.
- 11(12). Ocelli equidistant; lateral margins of pronotum yellow or black from eyes almost to apex, not interrupted; tegmina nearly covered by sides of pronotum.....DARNIS Fabr.
- 12(11). Ocelli distinctly nearer to eyes, lateral margins of pronotum yellow from behind humerals almost to apex; tegmina about one-half covered by sides of pronotum.....OCHROLOMIA Stal.
- 13 (4). Pronotum furnished with a median longitudinal carina more or less distinct.
- 14(15). Corium emitting 3 longitudinal veins from base, simple not forked, a transverse venule between ulnar veins near middle; humerals rather prominent.....TROPIDARNIS Fowl.
 Apex posterior pronotal process acute.....
Subg. *Tropidarnis* Fowl.
 Apex posterior pronotal process tridentate.....
Subg. *Dectoneura* Butl.
- 15(14). Corium emitting 2 longitudinal veins from base, radial vein forked at middle, ulnar vein forked just behind middle.....
PARALOBIA Godg.
- 16 (3). Dorsum of posterior pronotal process gibbous, rugose, depressed, with a median carina, humerals produced in large auricular processes, lateral margins produced each side anteriorly in postocular lobe; longitudinal veins of corium (3) approaching costa, the two ulnar veins coalesce briefly to form an oval basal cell, interior basal cell occupying more than half the width of corium, 2 discoidal cells the interior cell large; clavus broadened towards apex.
- 17(18). Head produced obliquely forward, porrect, large; basal margin of pronotum carinate, dorsum of posterior process trinodose and deeply sulcate longitudinally also bisulcate transversely, not tectiform.....CYPHOTES Burm.
- 18(17). Head produced downward, broad as long, not porrect; basal margin of pronotum not carinate, dorsum of posterior process rugose, tectiform at least towards apex, not nodose or sulcate.
- 19(20). Posterior pronotal process broadened and gibbous at middle, strongly convex each side, lateral margins gradually inflexed.....
ASPONA Stal.
- 20(19). Posterior pronotal process gibbous anteriorly, lightly convex each side, lateral margins not inflexed.....HYPHEUS Stal.
- 21(22). Tegmina almost or entirely uncovered by pronotum, corium emitting 3 longitudinal veins from base, ulnar veins contiguous or united toward origin.
- 22(31). Corium with more than one discoidal cell.

- 23(26). Corium with 3 discoidal cells, elongate, subequal.
- 24(25). Pronotum strongly elevated, produced above humerals in a large inflated flattened lobe followed by a less elevated part with a broad shallow sulcus between, dorsum abruptly descending to the short obtuse apex which is much shorter than tegmina; size large.....ATYPA Lap.
- 25(24). Pronotum convex, not elevated, posterior process long, sides strongly and broadly impressed from margins, apex nearly long as tegmina; ocelli distinctly nearer eyes; size medium.....PARADARNOIDES Fowl.
- 26(23). Corium with 2 discoidal cells, interior cell much larger than interior cell.
- 27(28). Pronotum convex anteriorly, compresso-elevated behind humerals, superior margin of compressed part longitudinally canaliculateCYMBOMORPHA Stal.
- 28(27). Pronotum entirely convex, tectiform towards posterior apex, superior margin not canaliculate.
- 29(30). Posterior pronotal process curved obliquely upward and backward and compressed from middle, gradually elevated above abdomen; ocelli near eyes; size very small.....PARAGARGARA Godg.
- 30(29). Posterior pronotal process straight; ocelli equidistant; size moderately large.....EUMELA Stal.
- 31(22). Corium with 1 discoidal cell situate far behind middle, ulnar vein forked in front of middle, radial vein forked far behind middle.
- 32(45). Corium destitute of a transverse venule between ulnar veins near middle, base of discoidal cell stylate.
- 33(34). Dorsum of pronotum distinctly tricarinate, punctured, tectiform posteriorly, apex acute.....IRIA Stal.
- 34(33). Dorsum of pronotum unicarinate.
- 35(38). Sides of posterior pronotal process slightly narrowed from base, not slender, apex rounded, obtuse; body short and broad.
- 36(37). Discoidal cell of corium situate between rami of radial vein; pronotum distinctly but not closely punctulate.....TRISTRAN Kirk.
- 37(36). Discoidal cell of corium situate between rami of first ulnar vein; pronotum very lightly punctulate.....RHEXIA Stal.
- 38(35). Posterior pronotal process elongate, slender, gradually acuminate, apex acute.
- 39(42). Discoidal cell of corium situate between rami of first ulnar vein.
- 40(41). Tegmina almost hyaline, apical veins suboblique; pronotum densely and distinctly punctured, not shining; head triangular, ocelli nearer each other than to eyes.....SMILIORACHIS Fairm.
- 41(40). Tegmina semiopaque, apical veins straight; pronotum smooth shining; head broad, short, ocelli equidistant, near base.....BRACHYTALIS Met. & Brun.
- 42(39). Discoidal cell of corium situate between rami of radial vein.

- 43(44). Pronotum smooth, shining, dorsum arcuate; veins of corium straight, sometimes one or two extra discoidal cells; ocelli slightly nearer each other.....DARNOIDES Fairm.
- 44(43). Pronotum dull, not shining, dorsum more or less sinuate; veins of corium curved; ocelli slightly nearer eyes.....DYSYNCRITUS Fowl.
- 45(32). Corium furnished with a transverse venule near middle between the two ulnar veins, base of discoidal cell on transverse venule, sessile, truncate; pronotum punctulate, hardly shining, dorsum broadly sinuate the apex elevated; ocelli slightly nearer eyes.....PROCYRTA Stal.
- 46 (1). Pronotum armed with horns or spines.
- 47(50). Pronotum produced anteriorly in a porrect horn or prominent angle, posterior process very rarely lightly carinate on sides; tegmina entirely uncovered, corium with 2 elongate subequal discoidal cells.

Tribe ACONOPHORINI

- 48(49). Front horn or angle of pronotum compressed, substraight, directed obliquely forward and upward, destitute of lateral carinae; body pubescent; head triangular, ocelli approaching each other.....ACONOPHORA Fairm.
- 49(48). Front horn of pronotum curved forward and downward, a carina each side extending from summit to at least middle of dorsum; body not pubescent; head quadrangular, apical margin rounded, apical angles lightly produced, ocelli approaching eyes.....KRONIDES Kirk.
- 50(47). Pronotum armed each side above humerals with one or two horns or spines.
- 51(70). Pronotum destitute of lateral spines near posterior apex, not produced posteriorly in a long spine, apex acute not inflated or nodose.

Tribe HEMIPTYCHINI

- 52(55). Tegmina partly covered by sides of pronotum, corium with 2 discoidal cells.
- 53(54). Head short, apical margin rounded, front obtuse, ocelli approaching each other; suprahumeral directed upward and lightly forward, posterior process convex anteriorly, tectiform posteriorly, apex strongly compressed.....PROTERPIA Stal.
- 54(53). Head triangular, obtusely angulate, ocelli equidistant; suprahumeral directed outward, short in ♂, longer in ♀, posterior process entirely tectiform; body pilose.....EUALTHE Stal.
- 55(52). Tegmina entirely uncovered by sides of pronotum, very rarely the apex of clavus is covered.

- 56(57). Corium with 1 discoidal cell situate between rami of radial vein, destitute of a transverse venule between ulnar veins; pronotum moderately elevated, convex anteriorly, tectiform posteriorly, suprahumeral produced well above humerals, short, slender, horizontal, acute.....NASSUNIA Stal.
- 57(56). Corium with 2 discoidal cells, usually elongate and subequal.
- 58(61). Pronotum moderately elevated, convexly declivous in front, not or slightly impressed above humerals as seen from the front and sides parallel, suprahumeral moderate in size, not robust, tips acute (one exception), posterior process gradually acuminate subequal to tip of abdomen; ulnar vein forked near base; head subtriangular.
- 59(60). Pronotum finely punctulate, shining, suprahumeral short, slender, horizontal, not rising above dorsal line; corium with a transverse venule between rami of ulnar vein, base of exterior discoidal cell stylate; ocelli near each other.....TOMOGONIA Stal.
- 60(59). Pronotum coarsely punctured, suprahumeral strong, directed outward and upward rising above dorsal line, tips acute or obtuse; corium destitute of a transverse venule between rami of ulnar vein, base of exterior discoidal cell sessile, truncate; ocelli slightly nearer eyes and toward base.....CALLICENTRUS Stal.
- 61(58). Pronotum strongly elevated anteriorly, produced far above humerals each side in a strong horn or angle, usually convex between.
- 62(69). Sides of posterior pronotal process not covering apex of clavus.
- 63(68). Ocelli almost equidistant; pronotum strongly declivous anteriorly, seen from front broadened upward.
- 64(67). Posterior pronotal process seen from above sinuate behind middle, slender behind sinus; sexes differ slightly in form.
- 65(66). Pronotum deeply impressed above humerals.....ALCMEONE Stal.
- 66(65). Pronotum not, or very slightly impressed above humerals.....
.....HYPHINOE Stal.
- 67(64). Posterior pronotal process seen from above gradually acuminate to apex, sides not sinuate, impressed above humerals; head and pronotum pilose.....BUBALOPA Stal.
- 68(63). Ocelli distinctly, sometimes much nearer to each other than to eyes; suprahumeral directed outward and moderately upward, length variable, altitude of posterior process gradually decreasing to apexSANDARION Kirk.
- 69(62). Sides of posterior pronotal process covering apex of clavus, tip reaching or passing apices of tegmina, dorsum entirely tectiform, suprahumeral long, curved strongly upward, backward and moderately outward, not impressed above humerals; ocelli closely approaching each other.....HEMIPTYCHA Germ.
- 70(51). Apex of pronotum armed each side with a spine and ending in a longer spine (sometimes deficient in ♂); pronotum convex an-

teriorly, strongly inflated posteriorly, or posterior process furnished with inflated nodes; tegmina uncovered by pronotum, entirely free, corium destitute of a transverse venule between rami of ulnar vein near middle.

Tribe HETERONOTINI

- 71(76). Corium with 1 discoidal cell situate between rami of radial vein which is forked far behind middle, ulnar vein forked toward base; wings more than half as long as tegmina; pronotum strongly inflated especially posteriorly, posterior process not nodose; ocelli nearly equidistant.
- 72(73). Pronotum furnished with a carina each side extended from near eyes to behind middle of dorsum.....HELIODORE Stal.
- 73(72). Pronotum destitute of lateral carinæ.
- 74(75). Head transverse; pronotum moderately compressed anteriorly, moderately inflated posteriorly.....OMOLON Walk.
- 75(74). Head triangular; pronotum very strongly inflated, especially posteriorlyCOMBOPHORA Germ.
- 76(71). Corium with 2 discoidal cells, radial vein forked at or behind middle enclosing exterior discoidal cell, ulnar vein forked at or in front of middle enclosing interior discoidal cell which is double the length of exterior cell; tegmina double the length of wings; pronotum depressed, convex, suprahumeral when present are slender spines, posterior process with one or more inflated nodes constricted between, the distal node with a spine each side (often deficient in ♂), ending in a longer spine at or below the tip (also sometimes deficient in ♂); ocelli very near to each other.
- 77(78). Front tibiæ slightly dilated at middle; pronotum densely punctured, suprahumeral frequently present as slender spines, posterior process rugosely reticulate towards apex.....HETERONOTUS, Lap.
- 78(77). Front tibiæ simple, not dilated; pronotum smooth, shining, or very obsoletely and remotely punctulate, suprahumeral as in "77(78)"HENICONOTUS Stal.

Subfamily SMILIINÆ

Key to Tribes and Genera

- 1(82). Wings with three or four apical cells, second cell stylate.
- 2(51). Corium with two longitudinal veins emitted from base, contiguous or united sometimes appearing as one vein toward base; apex of pronotum gradually acuminate or ending in a spine.
- 3(44). Longitudinal veins of corium diverging from or near base, one or both veins forked in front of middle, one to four discoidal cells, four or five apical cells; pronotum destitute of longitudinal rugæ or smooth elevated lines.
- 4(27). Tegmina free, not covered by sides of pronotum.

Tribe CERASINI

- 5 (6). Corium with four apical cells and one discoidal cell, ulnar vein forked near base, radial vein forked behind middle; pronotum strongly punctate with median carina, dorsum slightly sinuate, apex reaching tips tegmina.....TRACHYTALIS Fowl.
- 6 (5). Corium with five apical cells, two to four discoidal cells, longitudinal veins forked in front of middle.
- 7(12). Pronotum trispinose posteriorly and more or less inflated or globose.
- 8 (9). Posterior pronotal process with two slender spines anteriorly, usually a slender spine above each humeral.....CYPHONIA Lap.
- 9 (8). Posterior pronotal process destitute of spines anteriorly, dorsum tumid.
- 10(11). Pronotum with a suprahumeral spine each side.....POPPEA Stal.
- 11(10). Pronotum unarmed above humerals, inflated posteriorly.....CLEPSYDRIUS Fowl.
- 12 (7). Pronotum not trispinose posteriorly.
- 13(18). Posterior pronotal process convex, not compressed, strongly swollen or globose at basal or apical part, apex a slender spine, a curved impression on sides.
- 14(17). Corium with three discoidal cells.
- 15(16). Base of posterior pronotal process swollen, apical part slender, dorsum of tumid part sinuate.....ANTONÆ Stal.
- 16(15). Posterior pronotal process strongly constricted at base then suddenly strongly inflated; pronotum unarmed anteriorly.....PARANTONÆ Fowl.
- 17(14). Corium with four discoidal cells; basal part posterior pronotal process tumid, dorsum not sinuate, with suprahumeral horns.....ILITHUCA Stal.
- 18(13). Posterior pronotal process more or less compressed, dorsum frequently acute or carinate, apex gradually acuminate.
- 19(22). Pronotum very convex each side in front, a distinct callous each side near base, often impressed within basal margin; dorsum of posterior pronotal process frequently convex, rarely tectiform.
- 20(21). Dorsum of pronotum convex anteriorly, unarmed each side above humerals, seen from front gradually narrowed upwards.....MELUSINA Stal.
- 21(20). Pronotum with a slender acuminate horn above each humeral directed outward.....CENTROGONIA Stal.
- 22(19). Pronotum obtuse in front, flat or slightly convex, not impressed within basal margin, a slightly impressed mark each side near base; dorsum of posterior process usually compresso-acute, sometimes convex, with large semicircular impression each side, apex frequently subulate.

- 23(24). Pronotum highly elevated anteriorly, with suprahumeral horn or angle, each side directed outward; dorsum posterior process very acute, moderately subulate.....CERESA A. & S.
- 24(23). Pronotum moderately elevated and convex anteriorly, unarmed or very slightly angulate above humerals, lengthily subulate posteriorly.
- 25(26). Lateral vertical margins of metopidium distinctly angulate, pronotum highest front of middle.....STICTOCEPHALA Stal.
- 26(25). Lateral vertical margins of metopidium rounded, not angulate, pronotum highest at middle.....STICTOLOBUS Metc.
- 27 (4). Tegmina partly covered by sides of pronotum, radial vein forked front of middle, two rarely three discoidal cells; posterior pronotal process gradually acuminate, not subulate.

Tribe AMASTRISINI

- 28(36). Corium with three discoidal cells, bases exterior and interior cells about equally distant from base, longitudinal veins briefly united near middle forming an intermediate oval basal cell, supernumerary transverse venules sometimes present forming extra cellules in that case the longitudinal veins slightly curved toward tips; * third apical cell usually transverse, its base truncate but stylate.
- 29(43). Dorsum of pronotum destitute of tumid elevations.
- 30(31). Pronotum compresso-elevated, acute, seen from side rounded highest front of middle.....AMASTRIS Stal.
- 31(30). Pronotum convex, depressed, dorsum seen from side nearly straight.
- 32(35). Third apical cell of corium irregularly triangular its base angulate; corium with supernumerary transverse venules forming extra cellules and veins slightly curved; fourth apical cell twice longer than broad; tegmina often with coriaceous patches where venation is indistinct.
- 33(34). Head produced downward, lightly reflexed; apex interior basal cell of corium narrow, straight.....BOETHOOS Kirk.
- 34(33). Head produced obliquely forward and downward; apex interior basal cell corium occupying one-fourth width of corium, lightly curved.....TYNELIA Stal.
- 35(32). Third apical cell of corium broadly transverse, elliptical, base truncate but stylate; venation normal, mostly hyaline, veins distinct; fourth apical cell of corium irregularly quadrangular; body often pubescent.....VANDUZEA Godg.
- 36(28). Corium with two discoidal cells, base of exterior cell extended some nearer toward base than interior cell; third apical cell small, transverse, base angulate and lengthily stylate, second and fourth cells elongate, fifth and apex interior basal cell broad; venation normal.
- 37(40). Pronotum convex, not compresso-elevated.

- 38(39). Radial vein of corium forked in front of middle, second apical cell elongate, third very small its base slightly angulate; large part of tegmina covered by pronotum, space between longitudinal veins and costa pellucid; altitude of dorsum gradually decreasing toward apex.....HYGRIS Stal.
- 39(38). Radial vein of corium forked at middle, second apical cell short, subtriangular, third cell short nearly triangular its base angulate, fourth and fifth apical cells nearly equal; tegmina about one-half covered by pronotum, hyaline excepting coriaceous base of costa; dorsum pronotum nearly straight.....IDIODERMA V. D.
- 40(37). Pronotum highly compresso-elevated, dorsal carina acute; radial vein forked far in front of middle, all apical cells elongate excepting third which is small, base slightly angulate, fifth apical and interior basal cells broad.
- 41(42). Pronotum produced anteriorly in a compressed oblique horn.....GELASTOPHARA Kirk.
- 42(41). Pronotum unarmed anteriorly, seen from side dorsum strongly rounded, highest front of middle.....EROSNE Stal.
- 43(29). Dorsum of posterior pronotal process with two large rounded elevations each side of median carina; third apical cell of corium triangular, base angulate.....LALLEMANDIA Funkh.
- 44 (3). Longitudinal veins of corium parallel, close to each other and to costa, not diverging from base, large part of tegmina covered by pronotum; interior basal cell very broad; normally one discoidal cell; wings with four apical cells; posterior pronotal process with elevated longitudinal lines.

Tribe POLYGLYPTINI

- 45(48). Pronotum destitute of a porrect horn anteriorly (one exception).
- 46(47). Dorsum of pronotum compresso-elevated, acute, deeply sulcate near middle; longitudinal veins corium forked behind middle.....ENTYLIA Germ.
- 47(46). Dorsum of pronotum convex, depressed, slightly sinuate near middle; radial vein not forked, ulnar vein forked behind middle enclosing discoidal cell (one Mexican species with a short broad horn).....PUBLILIA Stal.
- 48(45). Pronotum produced anteriorly in a long porrect horn.
- 49(50). Corium with three apical cells.....BILIMEKIA Fowl.
- 50(49). Corium with five apical cells.....POLYGLYPTA Burm.
- 51 (2). Corium with three longitudinal veins emitted from base, all or two contiguous or united at base; tegmina partly covered by sides of pronotum.

Tribe SMILIINI

- 52(65). Sides of pronotum destitute of longitudinal carinae or elevated lines, pronotum punctured; longitudinal veins of corium diverging from near base.

- 53(58). Corium destitute of a transverse venule between ulnar veins front of middle, with one discoidal cell or none.
- 54(57). Pronotum compresso-elevated, dorsum acute.
- 55(56). Dorsum of pronotum seen from side highest in front; corium with one discoidal cell.....SMILIA Germ.
- 56(55). Dorsum of pronotum seen from side arcuate, highest at middle, corium destitute of discoidal cells.....ADIPPE Stal.
- 57(54). Pronotum convex, not compressed, highest and sides strongly and broadly impressed behind humerals; dorsum posterior pronotal process lightly sinuate at base, suddenly strongly depressed in front of short apex; corium with one discoidal cell.....GODINGIA Fowl.
- 58(33). Corium with a transverse venule between ulnar veins in front of middle, two discoidal cells.
- 59(64). Dorsum more or less compresso-elevated.
- 60(63). Pronotum strongly elevated, humerals produced in oblique triangular lobes passing into front angles.
- 61(62). Radial vein of corium distant from costa, close to first ulnar vein leaving a broad costal cell, space between second ulnar vein and costa coriaceous and punctate excepting apical cells; dorsal elevation rounded in front, rather deeply impressed.....TELAMONANTHE Baker.
- 62(61). Radial vein of corium equally distant from first ulnar vein and costa; tegmina vitreous excepting toward base; dorsal elevation highest front of middle, straight posteriorly.....ANTIANTHE Fowl.
- 63(60). Pronotum moderately elevated and compressed; humerals obtuse, front angles not produced.....CYTOLOBUS Godg.
Pronotum strongly inflated posteriorly, constricted at middle.....Subgenus *Xantholobus* V. D.
Pronotum not inflated, usually compressed at middle.
Dorsum low, sinuate at middle; form elongate, much depressed.....Subgenus *Evashmeadia* Godg.
Dorsum not distinctly sinuate above.
Dorsum highest anteriorly, altitude gradually decreasing straight to apex.....Subgenus *Atymna* Stal.
Dorsum regularly arcuate above, highest near middle.....Subgenus *Cytolobus* Godg.
- 64(59). Pronotum convex, not compressed, with an obsolete median line; ocelli near eyes.....OPHIDERMA Fairm.
- 65(52). Sides of pronotum with longitudinal rugæ or elevated lines.
- 66(71). Corium with two discoidal cells; wings with four apical cells.
- 67(70). Corium with four apical cells; pronotum normally produced anteriorly in a porrect horn.

- 68(69). Radial vein of corium forked towards base, dorsum pronotum strongly compresso-elevated, acute, arcuate.....
.....POLYRHYSSA Stal.
- 69(68). Radial vein of corium forked far behind middle; pronotum depressed, dorsum sinuate, front rarely convex or angulate.....
.....METHEISA Fowl.
- 70(67). Corium with five apical cells, radial vein forked far behind middle; pronotum lightly arcuate, unarmed.....HERANICE Stal.
- 71(66). Corium with one discoidal cell or none.
- 72(79). Dorsum of pronotum elevated in a horn or process in front of or behind humerals; longitudinal veins of corium forked behind middle.
- 73(76). Pronotal horn or process placed in front of humerals.
- 74(75). Corium with three apical cells and one discoidal cell, longitudinal veins parallel approaching costa; dorsal horn porrect.....
.....POLYGLYPTODES Fowl.
- 75(74). Corium with five apical cells, with or without a discoidal cell; front horn or angle erect or lightly inclined forward.....
.....GELASTOGONIA Kirk.
- 76(73). Pronotal horn or process placed behind humerals.
- 77(78). Dorsum of pronotum with two large rounded elevations tandem, summits rounded, deeply sulcate between.....ECUADORIA Godg.
- 78(77). Dorsal elevation conical or convex, summit acute or obtuse with or without a posterior angle.....HILLE Stal.
- 79(72). Dorsum of pronotum more or less compresso-elevated, destitute of a horn or angle, seen from side lightly sinuate and elevated behind humerals, summit very obtuse.
- 80(81). Posterior pronotal process tectiform, sides flat.....MATURNA Stal.
- 81(80). Posterior pronotal process subdepressed, sides convex.....
.....DIOCLOPHARA Kirk.
- 82 (1). Wings with three or four apical cells, second cell sessile, base truncate; corium with one to three discoidal cells or none, and four or five apical cells.

Tribe TELAMONINI

- 83(98). Tegmina more or less covered by sides of pronotum.
- 84(91). Wings with four apical cells.
- 85(88). Dorsum of pronotum elevated in a horn or process, sides with longitudinal rugæ or elevated lines, humerals strongly produced, auriculate; head broad, ocelli distant from eyes.
- 86(87). Pronotum produced anteriorly in a long oblique horn.....
.....THELIA A. & S.
- 87(86). Pronotum elevated between or behind humerals in a horn or process directed upward, summit rounded, truncate or sinuate.....
.....TELAMONA Fitch.

- Dorsal pronotal process at least as long as high.
 Summit of dorsal process rounded.....Subgenus *Telamona* Fitch.
 Summit of dorsal process sinuate.....Subgenus *Heliria* Stal.
 Dorsal pronotal process long, narrow, tongue-shaped, summit rounded.....Subgenus *Glossonotus* Butl.
- 88(85). Pronotum destitute of dorsal horn and of longitudinal rugæ.
 89(90). Pronotum strongly elevated, compressed, seen from side rounded and highest anteriorly, humerals not prominent.....
ARCHASIA Stal.
- 90(89). Pronotum convex, not compressed, lightly impressed each side behind the not prominent humerals, median carina obsolete.....
CARYNOTA Fitch.
- 91(84). Wings with three apical cells; pronotum unarmed, convex.
 92(95). Dorsum of pronotum with more or less distinct longitudinal elevated lines; corium with one discoidal cell and five apical cells (transverse venule between first and second cells sometimes deficient).
- 93(94). Discoidal cell of corium situate in fork of ulnar vein where longitudinal veins coalesce; elevated lines on dorsum rather indistinct.....INCOLEA Godg.
- 94(93). Discoidal cell of corium situate in fork of radial vein, longitudinal veins not coalescing; elevated lines on dorsum distinct, strongly punctured between.....MENDICEA Godg.
- 95(92). Dorsum of pronotum strongly punctate, destitute of longitudinal rugæ or lines.
 96(97). Corium with three discoidal cells (posterior cell rarely deficient); all apical cells wings sessile.....PHORMOPHORA Stal.
- 97(96). Corium destitute of discoidal cells; first and second apical cells of wings sessile, third stylate.....APHETEIA Fowl.
- 98(83). Tegmina free, not covered by sides of pronotum; posterior pronotal process much shorter than tegmina, lateral margins usually longitudinally impressed.
 99 (104). Corium with five apical cells.
 100(103). Corium with discoidal cells.
 101(102). Corium with one discoidal cell.....THRASYMEDES Kirk.
 102(101). Corium with two discoidal cells.....EURITEA Stal.
 103(100). Corium destitute of discoidal cells.....ACUTALIS Fairm.
 104 (99). Corium with four apical cells, one discoidal cell rarely deficient; pronotum destitute of median carina.....MICRUTALIS Fowl.

Subfamily TRAGOPINÆ

Key to Genera and Subgenera

- 1(2). Corium destitute of discoidal cells, apical cells arranged normally, limbus moderately broad; wings with 4 apical cells; tegmina about one-half covered by sides pronotum, venation indistinctly evident.....
HORIOLA Fairm.

- 2(1). Corium with 1 discoidal cell, apical cells arranged in a more or less circular or quadrangular form distant from the margins, limbus occupying about one-third of the surface; tegmina largely covered by sides pronotum; venation very indistinct, more evident towards tips; wings with 4 apical cells.....TRAGOPA Latr.
- 3(8). Base of head unarmed, destitute of horns or tubercles.
- 4(7). Sides of prostethium not produced in a lamina produced outward, furnished with a small lobe directed downward sometimes simulating a carina; lateral margins pronotum with a rather distinct elevated carina anteriorly from behind eyes to humerals.
- 5(6). Pronotum destitute of a median longitudinal carina or smooth line; head obtuse, apical margin obtusely rounded, not reflexed, front strongly reflexed; free part tegmina very lightly and remotely punctulate.....Subg. *Stilbophora* Stal.
- 6(5). Pronotum furnished with a more or less distinct median longitudinal carina or smooth line, punctate; head not narrowed towards apex; free part tegmina punctate.....Subg. *Tropidolomia* Stal.
- 7(4). Sides of prostethium produced in a large lamina behind eyes produced outward, lobate behind; pronotum distinctly or lightly punctate, lateral margins destitute of a carina anteriorly, front strongly inflexed, narrowed from base.....Subg. *Tragopa* Latr.
- 8(3). Base of head furnished with two horns or tubercles, strongly produced in front of pronotum; head subelliptical; pronotum strongly produced horizontally forward from humerals, basal margin rounded over the head between eyes, lateral margins anteriorly with a flattened carina from eyes to below humerals; posterior process gradually acuminate, apex acute; dorsum bi-impressed each side.....
.....Subg. *Ceratopola* Stal.

ATRYTONOPSIS VIERECKI SKINNER FROM TEXAS

A single male specimen of this species has been received by the writer, from Mr. O. C. Poling, who captured it at the Sunny Glen Ranch, Brewster County, Texas, in April, 1926. The locality is in the vicinity of Alpine, Texas, and the capture of this specimen at that point extends the recorded range of the species, all previous records known to the writer having been from New Mexico. The specimen has been compared with a co-type in the collection of the National Museum in Washington.—E. L. BELL.

STUDIES ON CHEMICAL CHANGES DURING THE
LIFE CYCLE OF THE TENT CATERPILLAR
(MALACOSOMA AMERICANA FAB.). II. NI-
TROGEN AND ITS RELATION TO
MOISTURE AND FAT¹

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If fats and salts are removed from living matter a mass of insoluble organic material is left behind. Upon analyzing this material we find roughly 50 per cent. carbon, 22 per cent. oxygen, 7 per cent. hydrogen, 0.3 to 1 per cent. sulfur, some phosphorus and traces of other elements, and about 16 per cent. nitrogen. This nitrogenous material (proteins) plays a predominant role in vital phenomena. The proteins are decomposed into amino-acids and distributed into the blood. Some of the amino-acids present in the digestive tract are attacked by bacteria and changed into ammonia and carbon residues. In metabolic processes amino-acids can be changed to sugars. Nitrogen determinations can be regarded as important since it is assumed that the insect uses nitrogen to form protein material in the tissues.

It is well known in physiological chemistry that proteins laid down in a cell for storage checks the metabolism of such a cell. Off hand, therefore, one would expect to find no storage of protein material in active cells. In the case of insects one might suppose that nitrogenous material would be stored in the larvæ, possibly in special non-active cells, to be used in metamorphic processes. This is not conceivable in a rapidly growing larva, where all cells would seem to be needed for activities. Aside from the energy necessary to sustain life, the larvæ are rapidly gaining in length and weight and have also to produce a new skin several times. In the mammalian body fats are more avail-

¹ Paper No. 284 of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

able for energy than proteins and only when insufficient amounts of fats and carbohydrates are present proteins are used. However, this does not necessarily mean that the same is true for insects.

Methods and Material

The same material previously described (8) has been used. Total nitrogen was determined by the Kjeldahl method.

Results

Analysis of the egg masses shows that shortly after deposition, when larvæ are formed, from 50 to 53 per cent. of the total dry weight is due to the nitrogenous cover and egg cases. This percentage changes with the age of the egg masses. The cover contains 8.0 to 8.4 per cent. moisture, and about 16 per cent. nitrogen and no fat. The moisture of the egg shells with as much of the gelatinous cover removed as possible appeared to be about 15.7 per cent., while the moisture of the larvæ taken out of the egg cases averaged about 60 per cent. The average nitrogen content

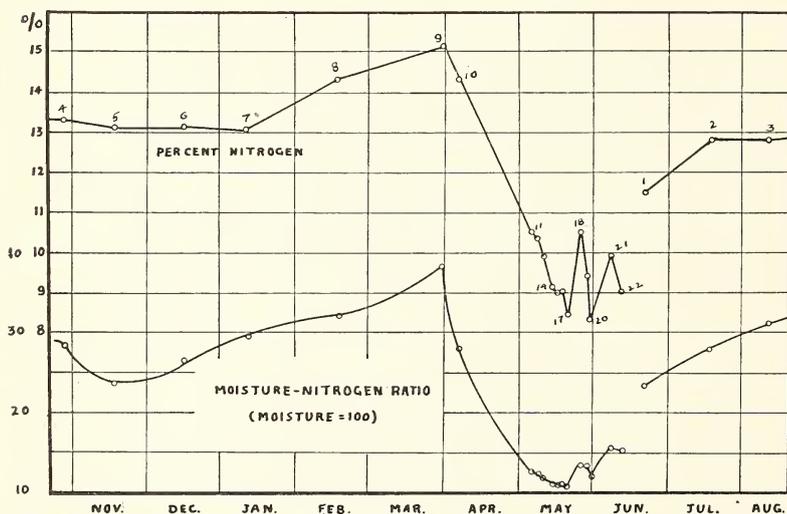


FIG. 1. Total nitrogen content of egg masses, larvæ, pupa and adults and nitrogen-moisture ratios. Nos. 1-8, egg masses; no. 9, newly hatched larvæ; nos. 10-17, growing larvæ; no. 18, full grown; no. 19, prepupal; no. 20, just pupated; no. 21, pupæ ready to hatch; no. 22, adults.

of the total egg masses from the time they were deposited to the hatching of the larvæ was about 13 per cent. Figure 1 shows the fluctuation in total nitrogen content during the entire life cycle of the insect. It can be seen that total nitrogen seemed to increase rapidly during the period when the larvæ were forming inside the egg cases. It has been found (8) that during this time fats decreased rapidly. From July until January the nitrogen content decreased slightly, coinciding with the slight decrease in fatty substances. There seems to be a rise of nitrogen again just before hatching, which again corresponds with a rapid decrease of the remaining fat (reduction of nearly 50 per cent. of the total fat present). At the time of hatching the nitrogen content of the young larvæ was 15.1 per cent. As soon as active feeding began the total nitrogen dropped apparently considerably. As has been pointed out before (8) at least one fourth of the total wet weight of the caterpillar was due to gut contents. The droppings contained on an average 2.5 per cent. nitrogen and 70 per cent. moisture, so that the actual nitrogen content of the caterpillar bodies was greater than indicated by the figures in the graph. For example a batch of full grown, but actively feeding caterpillars, contained 9.0 per cent. N, including gut contents, while the droppings analyzed about 2.5 per cent. N on a dry basis. Caterpillars starved for 40 hours contained 8.45 per cent. nitrogen. Calculations, on the basis of no droppings present, show that the bodies should contain about 10.6 per cent. nitrogen. This amount practically corresponds to the amount of nitrogen found when the insects stopped feeding (10.55 per cent. N) and it seems fair to conclude that from 1.5 per cent. to 2.0 per cent. of nitrogen should be added to the figures of the growing caterpillars in order to derive at the proper nitrogen contents for their bodies. As stated above the newly hatched caterpillar contained 15.1 per cent. N (dry weight) while the growing larvæ decreased rapidly to 12.5 and finally to 10.5 per cent. (adding 2 per cent. N for the difference of gut contents); this leaves a difference from 2.5 to 4.5 per cent. N on the basis of dry weight or a decrease of from 18 to 30 per cent. nitrogen of the original amount present. These figures show thus that the body weight of the growing caterpillars increased at a greater rate than its nitrogen

content. This is partly accounted for by the fact that large quantities of fats were stored during this period. However, if we examine the curve, we see that during the last instar nitrogen increased again and it might be assumed that a part of the nitrogen intake went into the makeup of the skins of the growing caterpillar which were shed at intervals. Only one analysis of discarded skins is available but this shows that they contained 12.2 per cent. nitrogen. Since no actual weights of all discarded skins are available it is impossible to calculate the total amounts of nitrogen used for their construction. From the time the larvæ made ready for pupation (becoming flabby) until they had just pupated insects lost actually 2.29 per cent. nitrogen or 22.6 per cent. of the total nitrogen present at the first stage. The cocoons contained 16.2 per cent. nitrogen, with a moisture content of 10.0 per cent. It is interesting to note that from the time no food was taken until the prepupal stage 1.2 per cent. N was lost, corresponding to 11.2 per cent. of the total present or exactly half the loss sustained until they had just pupated. Since the actual loss was 22.6 per cent. and 16.2 per cent. was recovered in the cocoons we might assume that part of the difference was lost during this reconstruction period. From the fact that during this period nitrogen decreased and fatty materials actually increased the conclusion might be drawn that nitrogenous materials only were used during this part of the metamorphosis. However, this does not complete the story. During the period of "just pupated" to "ready to hatch" the nitrogen content increased with 1.63 per cent. of the total dry weight or 19.7 per cent. of the total nitrogen at the first stage. At the same time the fatty substances decreased with 2.81 per cent. or nearly 10 per cent. of the total amount present. It would seem therefore that during this second period metabolic processes necessary for the maintenance of life were continued at the cost of fatty substances. Alderhalden (1) found that nitrogen increases considerably with pupation.²

The relation of the percentage of nitrogen to the percentage of fats present during the life cycle is presented in figure 2. The apparent increase of nitrogen during the first and last stages of

² See also note 3.

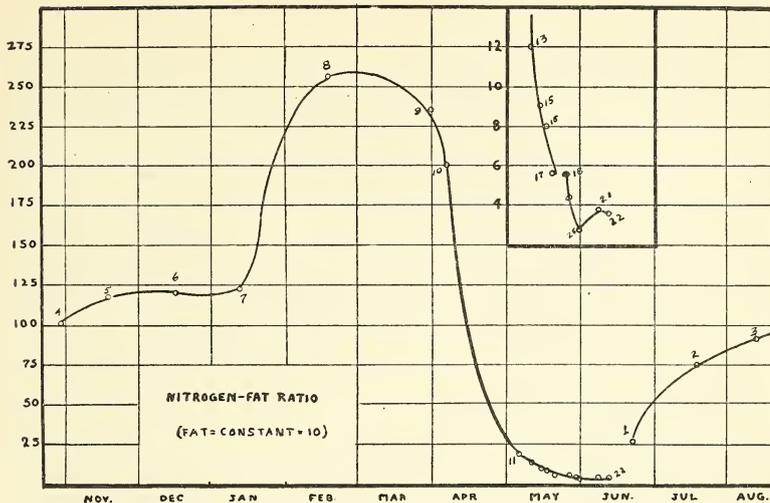


FIG. 2. Relation of nitrogen to fat present in tent caterpillar during entire life cycle. Nos. 1-8, egg masses; nos. 9-18, larvæ; no. 19, prepupæ; nos. 20-21, pupæ; no. 22, adults. Nitrogen calculated to a constant fat basis of 10.

the larvæ in the egg masses is here accentuated since fat decreased rapidly. There is no doubt that vital activities were carried on during this period through the oxidation of the fatty substances. Fat being the most prolific source of energy accounts for this. Since fat increased rapidly during the growing period of the caterpillars, the decrease in nitrogen was here also accentuated. The rate of decrease and increase of nitrogen during pupation is by no means the same as during the two other stages. In the last part of the curve the rate appears to be nearly equal, but the inset (showing a part of the life cycle) indicates that there were differences.

Kellner (3) found that the larvæ of the silk worm contained 12.0 per cent. nitrogen upon hatching which was reduced to 9.75 per cent. in the last instar. One analysis made on the pupa showed 9.16 per cent N and one on the adult 9.49 per cent. N. It can be seen that these figures correspond in a general way with my results. There was only one analysis made during each instar, and one each of pupæ and adults. This might explain

why variations during certain stages escaped unnoticed by this investigator.³

Nitrogen fluctuations in relation to moisture content (figure 1) and to fat (figure 2) seem to make a chemical division of the life cycle in at least 6 parts permissible, namely (1) formation of larvæ in egg cases, (2) rest period of larvæ in egg cases, (3) growing larvæ, (4) reconstruction stage of larvæ into pupæ, (5) rest period of pupæ, (6) adult stage. Two of these periods would be unsuitable for the application of control measures and the best would appear to be when metabolic processes are most active, or during the period shortly after hatching.

The growing caterpillars decreased in total nitrogen in spite of the fact that they were continuously eating material containing a certain amount of nitrogen. Analysis of leaves on which the caterpillars were feeding showed that they contained from 3.0 to 3.9 per cent. N (dry basis) and from 65 to 72 per cent. moisture. Their droppings contained about 2.5 per cent. nitrogen. How much nitrogenous material, or how much actual nitrogen was consumed is unknown to me since no measurements of the amount of food consumed were taken. A good deal of the nitrogenous materials present in the leaves are not available but it is clear that the digestive juices extracted from 0.5 to 1.5 per cent. of the nitrogen present. In this process the carbohydrates in the

³ After this paper was prepared for publication a reprint of an article "On the Biochemistry of the Wild Silk Worm," published in the Memoirs of the Coll. of Sci., Kyoto Imp. Univ., v. 9, 1925, by O. Shinoda, came to hand. This investigator found a nitrogen content of the larvæ varying between 1.3 to 1.0 per cent. (apparently on a wet basis). From the fourth molting until after cocooning he found to his "astonishment the nitrogen content increased from 1.2 per cent. to 2.6 per cent., *i.e.*, 9.2 per cent. to 10.4 per cent., when calculated in dry materials." His figures show a further increase during pupation. If nos. 19 and 21 are compared it may be seen that this corresponds to my findings. However, I found that nitrogen increased rapidly after the insect stopped feeding with an increase in the prepupal stage, then a decrease and again followed by an increase, with the result that actually more nitrogen was present in the insects when they were ready to emerge than when they were still feeding during the last instar. Apparently Shinoda missed the period when nitrogen decreased during metamorphosis. Otherwise his figures agree remarkably well with my results.

leaves, which are used especially for oxidation and the formation of fatty substances, are taken in at the same time.

The egg masses increased apparently in total nitrogen in spite of the fact that through handling a small part of the cover, high in nitrogen, was lost. There are three reasons for this apparent increase in nitrogen percentage: (1) Fat decrease at greater rate than nitrogen, (2) Carbohydrate material decrease at greater rate than nitrogen, (3) Synthesis of protein decomposition products into simple proteins thereby preventing loss of nitrogen. In order to gain some insight into the activities and decomposition processes, qualitative analyses were made of the nitrogenous cover, larvæ taken out of the egg cases and whole egg masses for ammonia nitrogen, albuminoid nitrogen, total amino-nitrogen, amino-acids, glycogen and sugars. These determinations were repeated at intervals throughout the life cycle and will be presented more in detail later. Table 1 shows some of the results obtained on the nitrogenous cover and egg masses.

In the animal body simple proteins are distributed into the blood largely in the form of amino-acids. The circulation of blood is so rapid that the amino-acids are removed almost as rapidly as they enter, so that there is no accumulation of amino-acids in the blood, but non-protein nitrogen (amino-acids, urea, ammonia, etc.) always occurs. The question whether or not similar products are present in the insect body is of interest. Muttowski (6) reports finding in insects' blood ammonia, gelatin, a nuclea protein and at feeding possibly various hydrolyzed proteins, aside from a number of metallic bases and pigments. He also tested a number of insects (5) for copper and the finding was "interpreted as forming the nucleus of another respiratory pigment, hemocyanin," not as yet demonstrated. The results presented in table 1 are on egg masses and there was thus no active feeding. The determinations were made on egg masses from which the nitrogenous cover was removed as much as possible. The total nitrogen in the case of the cover indicates that it consisted practically all of nitrogenous matter, a trace of sulfates, some carbonates and insoluble ash being present. Amino-nitrogen, determined by the Van Slyke method, includes urea. In considering first the analyses of the cover a certain amount of

TABLE 1.
ANALYSES OF EGG MASS AND NITROGENOUS COVER*
(NOVEMBER 17, 1924).

| | Egg mass | Cover |
|---|-----------------|-----------------|
| Total nitrogen | 10.04 per cent. | 16.15 per cent. |
| Amino-nitrogen | 1.426 per cent. | 0.835 per cent. |
| Ammonia-nitrogen | 13.4 ppm | 35.4 ppm |
| Albuminoid-nitrogen | 669 ppm | 1062 ppm |
| Urea | +++ | ++ |
| Amino-acid reaction: | | |
| Tryptophane | ++ | ++ |
| Xanthoproteic (Tyrosine, Phenylalanine and tryptophane)..... | ++ | - |
| Ehrlich's diazo: (Histidine, tryosine) | - | - |
| Millon's: (organic compounds containing a monohydroxybenzene nucleus) | - | - |
| Cholesterol | - | - |
| Reduced sulfur (cystine, cysteine) | + | + |
| Carbohydrates (Molisch reaction) | ++++ | + |
| Sugars | ++ | - |
| Glycogen | 3.2 per cent. | + |
| Ether soluble (fats) | 1.20 per cent. | 0.0 per cent. |
| Phosphorus (P_2O_5) | ++ | + |

* ppm = parts per million; - = negative; + = positive.

amino-nitrogen is recorded. The weight of amino-acids from a given weight of protein is greater than that of the protein from which they are derived. Decomposition of the proteins is hydrolytic or in other words water has been taken up. No great energy transformations accompanies the decomposition. During the process of digestion and absorption of proteins in the animal

body amounts of ammonia are set free. Tissues can also decompose their protein and amino-acids, namely when not sufficient amounts of carbohydrates are present to supply energy. In the latter case organic acids are formed plus urea. In the third place protein decomposition takes place readily outside the animal body, through the agency of bacteria. We note that ammonia was present in the cover. The presence of both amino-acids and ammonia seems to indicate therefore that the cover was slowly decomposing. Turning to the analyses of the egg masses we note a considerable amount of amino-acids being present. It is likely that a good deal of it was in reality urea. Probably three amino-acids were present, namely: Tryptophane, phenylalanine and cystine or (and) cysteine. The xanthoproteic reaction gives the presence of tyrosine, phenylalanine and tryptophane. Tryptophane was found with its special reagent, tyrosin was absent with Ehrlich's diazo reagent, while the cover did not show positive results with the xanthoproteic reagent, it can be deduced that phenylalanine was present in addition to tryptophane. However, the presence of phenylalanine was not demonstrated at that time. Roose (7) demonstrated the presence of this amino-acid in the cocoon. Tryptophane is a necessary constituent of food. If it is remembered that not protein but amino-acids are required by the body, it seems significant that tryptophane was present in the resting larvæ. Since tryptophane is formed in tryptic digestion it might have been formed from simple protein-matter and this would explain the reduction of the total nitrogen. During the stage that nitrogen content remained stationary the life of the insect in the egg case is one of existence rather than living. Since nitrogen was reduced rapidly in the growing caterpillar the difference in activities between the two stages is obvious. During the third stage in the life of the encased caterpillar an apparent increase in nitrogen was noticed together with a rapid decrease of fats. It is clear that fats were used for energy, but from where did the increase in nitrogen come? It is a bold hypothesis to assume that the decomposing cover of the egg mass furnished the caterpillar with ammonia and amino-acids for resynthesis of protein matter. In a next article this whole question will be discussed more in detail in relation to the data on ash and its constituents.

As has been pointed out above tyrosine was not present in the encased larvæ. Tyrosine, one of the first discovered end products of protein decomposition, is present in plants and animal tissues. It is needed by mammals but they are unable to make sufficient to supply their needs. It is formed in tryptic digestion (from zein, found in maiz for instance) and when decomposed by bacteria it gives organic acids plus phenol. Since these tiny larvæ could not take any plant protein but had to subsist on the amount of protein laid down in the egg mass it is possible that as soon as traces were formed in the digestive tract it was further decomposed. In dead insects this amino-acid is found (Muttowski). Cholesterol was also absent, this is found in all animal cells and especially in brain cells and nervous tissue. Egg oil, prepared from the yolk of eggs, contains always a certain percentage. I was able to demonstrate a trace in freshly laid eggs, but it disappeared rapidly. Cystine is necessary in food. It readily oxidizes itself and resembles the respiration processes. Nearly all proteins contain sulfur in small amounts in an unoxidized form (as sulfide sulfur). It occurs in the protein molecule either as cystine or cysteine and possibly in other amino-acids. This protein sulfur is oxidized in the body to sulfates and excreted as such. (Adult humans excrete about 2.5 grams sulfuric acid a day.) The larvæ in the egg cases must deposit these sulfates in the egg cases. Analytical figures on total sulfates will be given in the next paper of this series, suffice it to say that remarkable fluctuations occurred.

Albuminoid, simple proteins like collagen, according to Hawk (2) "include the principal organic constituents of the skeletal structure of animals as well as their external covering and its appendages." A glance at the table shows that almost twice as much albuminoid-nitrogen was present in the cover than in the total egg mass. The cover in this case constituted 48 per cent. of the total dry matter. Muttowski (5) demonstrated the presence of gelatine in insect blood. Although gelatine is a transformation product of collagen we will assume that all the albuminoid-nitrogen found was derived from gelatine. Gelatine contains 17.9 per cent. N and on the above assumption we found about 0.5 per cent. gelatine present in the cover. Gelatine upon hydrolysis

yields amino-acids and it is possible that some amino-acids came from this source. However, cystine and tryptophane are not mentioned among the decomposition products of gelatine but these amino-acids were found to be present in the cover. We can say then that the cover is possibly for a small part made up of gelatine, mostly of simple proteins and another small part of carbohydrates (glycogen). Carbohydrates were present in comparatively considerable quantities in the larvæ confined to the egg cases and also some in the cover. Carbohydrates have the same tendency as fats, namely they have a "protein sparing function" in metabolism. That the carbohydrates were used is shown by the fact that sugars were present in the larvæ and not in the covers. The presence of carbohydrates in the cover might be explained on the basis that acetic acid is formed by hydrolysis of certain materials (mucin, chitin, etc.), aside from the presence of glycogen. Glycogen, animal starch, is an important constituent of muscle. The amount of this polysaccharide in muscle varies with muscular activity. Embryonic structures do not contain large amounts of glycogen. Vaney and Maignon (9) found a rapid increase in glycogen in the growing larvæ, reaching its maximum when the larvæ were full grown and decreasing continuously during pupation. This question will be dealt with in a later paper. From the table it can be seen that it was present in the larvæ and in the cover. The presence of phosphorus indicates that certain lipoids were present. This could be expected since one of the two great groups of tissue colloids is constituted of these substances, the other being proteins. It has been pointed out above that no cholesterol was present and it seems likely that the phosphorus present came mainly from phosphorized fats. The most important of the phosphorized fat group is lecithin which yield upon decomposition fatty acids, glyceric-phosphoric acid and choline.

Summary

Analyses of egg masses, larvæ, pupæ and adults of the tent caterpillar show that total nitrogen content of the egg masses from the time they were deposited to the hatching of the young larvæ was on an average of 13 per cent. There was an initial increase,

followed by a decrease and again followed by an increase. The average nitrogen content of the growing larvæ was about 10.2 per cent., decreasing from the time of hatching to the last instar. Nitrogen decreased considerably from the time the larvæ was full grown until the larvæ had "just pupated" (propupal stage) while it increased during the chrysalis stage. Adults again contained less nitrogen than the pupa in the last stage.

The relation between nitrogen and moisture and nitrogen and fatty substances is shown.

Analyses (total nitrogen, fats, ammonia-nitrogen, albuminoid nitrogen, amino-acids, glycogen and sugars) of the egg masses and nitrogenous cover of the egg cases are made a basis of discussion regarding the vital phenomena and decomposition processes of the larvæ confined to the egg cases.

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THE RELATIONSHIPS OF SOME ABERRANT PYRALIDS (LEP.)

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In every classification there are a certain number of aberrant types which do not immediately fall into any main category, but which must stand by themselves, or be somewhat loosely attached to the forms from which they show the least dissimilarity. This paper is a discussion of several of these forms, on which some previously unemphasized characters seem to throw a new light. The chief characters concerned are three:

1. The development of the first anal vein, both in fore and hind wings. The normal condition for the Pyralids, as for many other Microlepidoptera, is for 1st A to be absent in the fore wing but present in the hind wing. In the Schœnobiinæ, as already noted (Cornell Memoir 68, p. 525), 1st A is fully formed in the fore wing as well; and in another, the Chrysauginæ, it is absent⁷ in both wings.

2. The development of the loop formed by 3d A in the fore wing. The primitive condition, as shown by the Galleriinæ, Chrysauginæ, and the genus Hypsopygia, as well as many Tineids, and other primitive forms, is a small loop on the posterior side of 2d A, with a spur at its outer end, representing the free part of 3d A₂ (fig. 4). In the majority of Pyralids the outer part of this structure has atrophied, leaving the remnant of 3d A as a free vein (fig. 1). It is not so well known that in another group (all Pyraustinæ), the loop has enormously enlarged without breaking (fig. 3), and frequently reaches half the length of the wing. In the genus figured the free part of 3d A₂ has disappeared, but a number of the larger South American forms show more or less obvious remnants.

3. The loss of the frenulum hook. In the ordinary run of Lepidoptera, and as a primitive condition in the Pyralids, the frenulum of the male runs through a membranous hook attached

to the neighborhood of Sc or R, and may also be more or less supported by a fan-like tuft of hair-scales rising from the neighborhood of Cu. The entire structure is frequently called the retinaculum. I should restrict that name to the scale-masses (fig. 7, retin) and use frenulum-hook for the more specialized membranous structure (fig. 7, f.h.).

In a large proportion of Pyralids the frenulum-hook of the male is lost, and the two sexes alike have a highly developed retinaculum of hooked scales attached below Cu. In *Myelobia* (and no doubt many other forms where the hook appears to be lost) there is a minute rudiment covered by scales and wholly non-functional. I have not followed this character through the whole series of Pyralids, but in the Pyraustinae, at least, it makes a very striking cleavage of the group, and I suspect along mainly if not wholly natural lines.

Schœnobiinae

Hampson's revision of this subfamily (Proc. Zool. Soc. London '95, 897) conceived it somewhat rigidly to include all forms with the fringe of bristles on the base of Cu of the hind wing reduced to a few scattered hairs, or absent, and the tongue weak and non-functional, to which may be added Sc and R of the hind wing actually fused for a distance, to separate such Pyralinae as *Aglossa*. My own limitation to forms with 1st A preserved in the fore wing would restrict this somewhat from the exotic point of view, though making no difference in the list from Eastern North America, nor, I think, in Europe.

This raises the question what are the remaining members of Hampson's *Schœnobiinae*. My personal belief is that the two I have examined (*Siga* and *Cirrhochrsta*) are aberrant *Pyraustinae*.

Siga liris (fig. 3) has in fact the obsolescent tongue of the *Schœnobiinae*, and also has R_5 fused for a distance with R_{3+4} , a character out of place in the *Pyraustinae*. But an examination of the base of R_{3-5} shows it is far thicker than the other veins of the vicinity, and I believe that the fusion is merely a recent development from the close parallelism found in many *Pyraustids*.

A much more striking fact is that *Siga* shows plainly the large loop of 3d A, which is found only in the Pyraustinae, and is very common among them. The general build and pattern are Pyraustid, and derivable from something like Polygrammodes, and I venture that when the early stages are discovered they will prove to be Pyraustid. I have little doubt that *Midila*, and very probably *Gonothyris* and *Cacographis*, will go with *Siga*.

Cirrhochrista brizoalis (fig. 5). In this form also there is not a rudiment of 1st A, and the wing-form is not at all Schænobiid. I feel much less confidence where this genus will go, but the abnormal thickening of the base of R_{3-5} again shows that the stalking of R_5 is a very recent affair. The appearance is rather suggestive of the Nymphulinae, but I suspect that a closer home can be found for the genus in the neighborhood of Evergestis. As to many of the forms listed by Hampson as Schænobiinae (such as *Niphopyralis*), I would not venture a guess; unfortunately his figures are pure diagrams where the anals are concerned, 1st A not being figured in a single case (nor the loop of 3d A), and on the other hand being uniformly supplied in the Chrysauginae where it is absent. The following genera are true Schænobiinae: *Patissa*, *Scirpophaga*, *Rupela* (distinguished from *Scirpophaga* by the short upturned palpi), *Schænobius*, *Donacaula*, *Acentropus*.

Myelobia

Hampson in Ragonot's revision of the Galleriinae (Roman. Memoirs viii) puts this genus in the Galleriinae. I can see no reason whatever. The venation, save for the closed cell of the hind wing, is wholly Crambine (fig. 2) and agrees in even that detail with *Doratoperas*, from the same district (fig. 1).

I have seen the larva in the National Museum and it is a borer in bamboo, and also Crambine so far as a superficial examination would show. These two genera, then, will make an early Crambine tribe with the cell still closed (as in the *Ancylolomia* group), and with R_5 still free, as it is in the *Chilo* group. I believe the true Galleriinae will all have R_5 stalked.

Bradypodicola

Bradypodicola hahneli is the famous sloth-moth, which feeds among the hair of the living sloth. It has been taken for a Tineid, probably on account of its peculiar habits, as there is nothing abnormal for a pyralid in its structure. As to the subfamily position the possibilities lie between the Chrysauginæ, Galleriinae and Macothesinae, as there is a small anal loop with a strong spur (fig. 4), R_5 stalked in ♀, united with R_{3+4} in ♂, cell of hind wing small with a deeply angled closing vein, and Sc and R strongly fused. The absence of maxillary palpi and highly specialized sexually dimorphic venation would appear to point to the Chrysauginæ, but the first anal vein, which though weak is distinctly present, would be abnormal. Perhaps it will attach best to this subfamily, but presumably from its foot, and in a sense representing the common ancestor of Galleriinae and Chrysauginæ.

In Hampson's key to the Chrysaugine genera it will run to *Acutia*, which I should judge by the figure may be really related; the different wing-form easily separates them as well as the stalking of R_1 in the male of *Bradypodicola*.

Loxostegopsis

This is an extraordinarily synthetic genus (fig. 6). In Hampson's subfamily key it would run to the Schænobiinae, but is not only more specialized in lacking 1st A, but more generalized in the lack of fusion of Sc and R of the hind wing. The weak tongue would fit in almost any group, though commoner in some than others. In *L. merricki* it is not obviously weakened, though in all other ways *merricki* is a normal *Loxostegopsis*; so I should pass the tongue over as an indicator. The venation of the fore wing agrees with the Pyraustinae, or perhaps more with *Scoparia* (which is hardly different), the palpi are *Scopariine* and the appearance is perhaps of a *Scoparia* of the typical (*penumbralis*) group. The separation of Sc and R would be abnormal in either case, but is said to occur in a few primitive Pyraustinae. The frenulum-hook is absent. On the whole I believe the genus is a relict, representing the ancestral Pyraustinae.

Pyraustinae

The *Pyraustinae* show two striking and clean-cut characters that seem never to have been used. In about half the species (most often the forms with beak-like palpi), the frenulum hook is preserved (fig. 7); in the other half, including the great mass of tropical forms centering around *Sylepta*, the hook is wanting and the frenulum is held by a highly developed retinaculum attached just below Cu. Two genera are heterogeneous on this character (*Pyrausta* and *Phlyctænia*), and I am convinced should be divided. The other character is the large loop in 3d A. This is characteristic of a decided majority of the subfamily but fails somewhat erratically in the smaller forms, and so should probably be used with caution.

The following list indicates the distribution of these characters:

FRENULUM HOOK ABSENT, ANAL LOOP PRESENT

| | |
|--|---|
| <i>Entephria receptalis</i> | <i>Agathodes designalis</i> |
| <i>Hymenia</i> spp. | <i>Diaphania</i> spp. |
| <i>Eurrhyparodes</i> spp. | <i>Leucinodes</i> spp. (loop very weak in most species) |
| <i>Desmia</i> spp. | <i>Sameodes</i> spp. |
| <i>Pagyda traducalis</i> | <i>Terastia meticulosalis</i> |
| <i>Ercta ornatalis</i> (loop broken) | <i>Megastes pusialis</i> (? , ♂ not seen) |
| <i>Marasmia</i> spp. | <i>Crocidophora</i> spp. |
| <i>Hyalea pallidalis</i> | <i>Stenophyes huronalis</i> |
| <i>Leucochroma corope</i> | <i>Lineodes integra</i> |
| <i>Anania</i> (<i>Syngamia</i>) spp. | <i>Polygrammodes</i> spp. (<i>Siga liris</i>) |
| <i>Samea</i> spp. (loop incomplete at tip in <i>S. multiplicalis</i>) | <i>Nomophila noctuella</i> |
| <i>Trithyris sunialis</i> | <i>Pachyzancla ægrotalis</i> |
| <i>Diastichtis argyralis, talis</i> | <i>Liopasia</i> spp. |
| <i>Pilocrocis</i> spp. | <i>Sparagmia gigantalis</i> |
| <i>Mesocondyla dardusalis</i> | <i>Anarmodia majoralis</i> |
| <i>Spilomela</i> spp. | <i>Condylorrhiza vestigialis</i> |
| <i>Conchylodes</i> spp. | <i>Noorda esmeralda</i> |
| <i>Nevrina procopia</i> (? , ♂ not seen) | <i>Phlyctænia ferrugalis</i> and <i>rubigalis</i> only |
| <i>Phostria</i> (<i>Omiodes</i>) spp. | |
| <i>Lamprosema</i> spp. | |

Nacoleia and *Blepharomastix* *Psara phæopteralis*
 spp. (loop very weak in *B. Pyrausta* (group *pertextalis*)
stenialis)

FRENULUM HOOK ABSENT, ANAL LOOP ALSO ABSENT, THE TIP
 OF 3D A BEING DISTANT FROM 2D A AND FADING OUT

| | |
|-------------------------------------|--------------------------------|
| (<i>Samea multiplicalis</i>) | <i>Diasemia</i> spp. |
| (<i>Blepharomastix stenialis</i>) | <i>Stenoptycha cælodactyla</i> |
| <i>Leucinodes</i> spp. | <i>Loxostegopsis</i> spp. |
| <i>Maruca testulalis</i> | |

FRENULUM HOOK PRESENT, ANAL LOOP WELL DEVELOPED

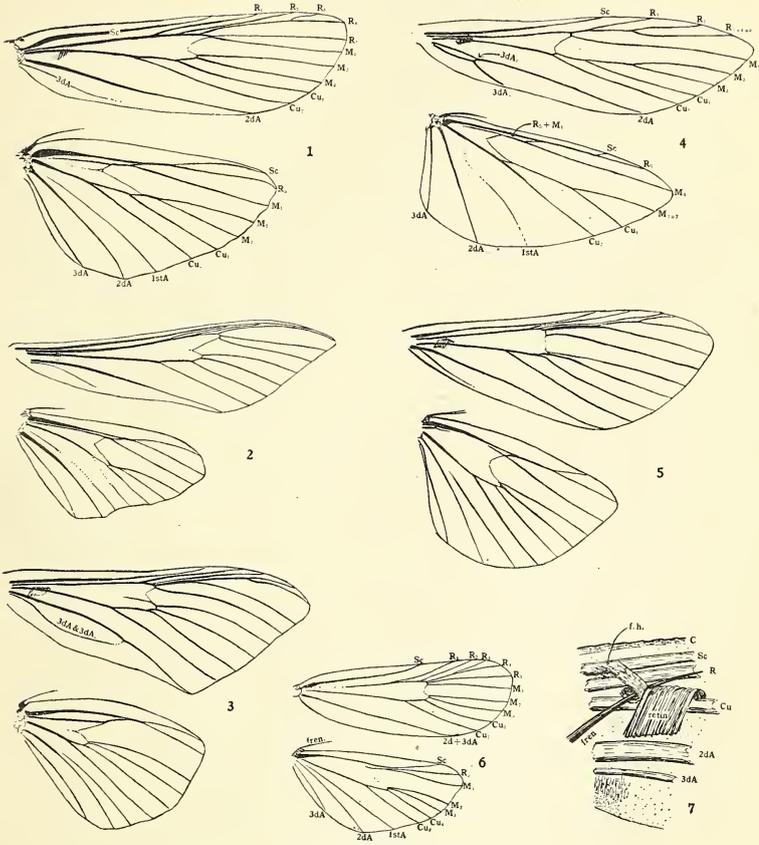
| | |
|--|---------------------------------|
| <i>Dichogama redtenbacheri</i> (loop narrowly broken) | <i>Pyrausta fumiferalis</i> |
| | <i>Pyrausta f. subolivialis</i> |
| <i>Cliniodes</i> spp. | <i>Pyrausta penitalis</i> |
| <i>Loxostege</i> spp. | <i>Pyrausta nubilalis</i> |
| <i>Tholeria reversalis</i> | <i>Pyrausta insignatalis</i> |
| <i>Maroa</i> spp. | <i>Pyrausta phænicialis</i> |
| <i>Phlyctænia</i> (all but <i>ferrugalis</i> group) | <i>Pyrausta generosa</i> |
| | <i>Pyrausta funebris</i> |
| <i>Pyrausta futilalis</i> | <i>Pyrausta niveicilialis</i> |

FRENULUM HOOK PRESENT, ANAL LOOP ABSENT

| | |
|---|------------------------------|
| <i>Glaphyriinæ</i> , with <i>Neurophy-</i> <i>seta</i> spp. and <i>Sufetula</i> spp. | <i>Perispasta cæculalis</i> |
| | <i>Pyrausta fumalis</i> |
| <i>Scybalista restionalis</i> | <i>Pyrausta unifascialis</i> |
| <i>Syllepsis marialis</i> (? , ♂ not seen) | <i>Pyrausta fodinalis</i> |
| | <i>Pyrausta semirubralis</i> |
| <i>Crocidolomia participialis</i> | <i>Pyrausta falcatalis</i> |
| <i>Hellula</i> spp. | <i>Pyrausta acronialis</i> |
| <i>Evergestis straminialis</i> | <i>Pyrausta rubricalis</i> |
| <i>Bæotarcha demantrialis</i> | <i>Pyrausta inæqualis</i> |
| <i>Autocosmia</i> (?) <i>helianthales</i> | <i>Pyrausta ochosalis</i> |
| <i>Titanio pollinalis</i> | <i>Pyrausta laticlavata</i> |
| <i>Cornifrons actualis</i> | <i>Pyrausta tyralis</i> |
| <i>Noctuelia</i> spp. | <i>Pyrausta signatalis</i> |
| <i>Eustixia pupula</i> | |

EXPLANATION OF PLATE XXV

- Figure 1. *Doratoperas atroparsellus* Wlk. ♂.
Figure 2. *Myelobia pustulata* H. S. ♂.
Figure 3. *Siga liris* Cr. ♂.
Figure 4. *Bradypodicola hahneli* Stgr. ♂.
Figure 5. *Cirrhochrista brizoalis* Wlk. ♀.
Figure 6. *Loxostegopsis polle* Dyar. ♂.
Figure 7. Base of forewing (diagrammatic), showing frenulum hook and retinaculum, with frenulum in place.
fren.—frenulum.
f. h.—frenulum hook.
retin.—retinaculum.



PYRALIDÆ

A NEW SPECIES OF LISTRONOTUS FROM NORTH OF MEXICO

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Listronotus leucozonatus new species.

Elongate oval, fully two and a half times as long as wide, cylindrical, dark brown, clothed with dark and light brown and gray scales. Rostrum rather short and stout, nearly as long as the prothorax, very feebly carinate and sulcate. Prothorax nearly as wide as long, sides rather feebly arcuate, narrowed posteriorly; disc coarsely and very closely punctate, punctation much obscured by large round scales, which are light and dark brown at the middle and sides forming a rather wide yellow sinuate band each side and a very narrow one at the middle. Elytra nearly twice as long as wide, much wider at base than the prothorax, humeri obtuse; sides subparallel in basal three-fourths; striæ narrow, moderately and closely punctate in basal half, much finer in the apical half; basal half clothed somewhat sparsely with small variegated light and dark brown round scales; intervals nearly flat except at apex; lateral half with a wide band of very dense yellowish gray scales, bending backward toward the ends, apex coated with variegated yellow and rich brown scales; setæ short, yellow and sparse in apical third. First, second, and fifth ventral segments rather coarsely subreticulately punctate, third and fourth more finely punctate. Femora with a rather broad ring of gray one-third from the apex.

♂.—Apices of elytra conjointly rounded. First and second ventral segments scarcely separated, long, concave; more or less impressed at the sides.

♀.—Apices of elytra produced into very minute, short, acute points; fifth ventral segment transversely concave near the base, moderately but distinctly convex in apical half, otherwise simple.

Length, 4.5–5.2mm; width, 1.7–1.9mm.

Ithaca, New York, N. Y. (Chittenden); Washington, D. C., July 6, 1910 (Chittenden); Ohio.

Type ♂.—Cat. No. 28831, U. S. National Museum.

This species is generally confused in collections with the related *appendiculatus*. It differs as follows: Pronotum shorter, color pattern distinct, in the female the structure of the fifth

abdominal segment as described, and the minute apical points of the elytra. The reticulately punctate fifth ventral segment is in contrast to the finer punctation in the latter. Moreover, the present species is of smaller size. It is one of the most strongly marked and one of the most attractive of the species occurring in our fauna.

INSECTS AND HOMOEOPATHIC MAGIC

Sir James George Frazer in his "Golden Bough," a "study in magic and religion," states that the Arab, to bring back a slave who has run away "will trace a magic circle on the ground, stick a nail in the middle of it, and attach a beetle by a thread to the nail, taking care that the sex of the beetle is that of the fugitive. As the beetle crawls round and round, it will coil the thread about the nail, thus shortening its tether and drawing nearer to the center at every circuit." By reason of this magic the fugitive will be drawn back to his owner. Sometimes homœopathic magic is utilized to invalidate a bad omen by going through it imitatively. For example, in Madagascar, "if fate has decreed that a young girl, still unwed, should see her children, still unborn, descend before her with sorrow to the grave, she can avert the calamity as follows. She kills a grasshopper, wraps it in a rag to represent a shroud, and mourns over it like Rachel weeping for her children and refusing to be comforted. Moreover, she takes a dozen or more other grasshoppers, and having removed some of their superfluous legs and wings she lays them about their dead and shrouded fellow. The buzz of the tortured insects and the agitated motions of their mutilated limbs represent the shrieks and contortions of the mourners at a funeral. After burying the deceased grasshopper she leaves the rest to continue their mourning till death releases them from their pain; and having bound up her dishevelled hair she retires from the grave with the step and carriage of a person plunged in grief. Thenceforth she looks cheerfully forward to seeing her children survive her; for it cannot be that she should mourn and bury them twice over."—ED.

NOTES ON THE MORPHOLOGY OF THE EYES OF COLEOPTERA*

BY MELVILLE H. HATCH

I. OCELLI

Ocelli occur in adult Coleoptera as follows: a pair of ocelli in the Omaliini (Oxytelinæ, Staphylinidæ) ("un Oxytelide american (*Trogophlaeus argus*)" (Houlbert, 1921, *Col. Europe France* I, p. 25) is listed in recent catalogues under Omaliini as *Phloeonomus lapponicus* Zett.) and in certain species of the primitive Silphinæ as *Pteroloma forstræmi* Gyllh., and *Camiroleum loripes* Lew. (Fowler, 1912, *Fn. Br. Ind.*, p. 84); a single median ocellus in the tribes of Dermestidæ (Dermestini) exclusive of Dermestini and in *Phlaeobium clypeatum* Muell., (Proteinini, Oxytelinæ, Staphylinidæ). These structures are located on the vertex of the epicranium between or slightly behind the compound eyes, and, if they are true ocelli, require that the three ocelli of the primitive insect be inserted on the vertex in Stickney's figure of the head of the hypothetical coleopteron (1923, *Ill. Biol. Mon.* VIII, plate I, fig. 1).

II. DIVIDED EYES

There are ten unrelated groups of Coleoptera, representing six families that have the eyes completely divided. The morphological condition is the same throughout. As the eye is constricted the portions of the oculata (ol, figs. 8, 9) in the region of the constriction are brought together, and, in the completely divided eye, meet to form a suture, the exoculata (eo, figs. 1-8) connecting the faceted areas. In the region of the exoculata the oculata is somewhat narrower than about the margins of the faceted areas, but it is still present as an entad extending parademe. The complete division of the compound eye is only the consummation of the emargination of the eye that is of such frequent occurrence in Coleoptera.

* A contribution from the Zoölogical Laboratory of the University of Michigan.

There are about three general types of divided eye.

I. Associated with a caudad movement of the antenna: (1) *Euderces pini* Oliv., (fig. 1) and *E. reichei* Lec., (Cerambycinæ) and (2) *Tetraopes* (fig. 2) and the closely related *Tetrops* (Lamiinæ) among the Cerambycidae.

II. Associated with a caudad extension of a canthus across the eye: (1) *Scarabæus* and other Scarabæinæ and (2) *Geotrupes* (fig. 3) and other Geotrupinæ among the Scarabæidae.

III. Associated with a caudad movement of the frontal ridge, directly underneath which is the antenna, which either may not: (1) *Polygraphus* (fig. 4) (Hylesininæ) and (2) *Xyloterus* and its allied genera, *Xyloterinus* (fig. 5) and *Trypodendron* (Ipinæ) among the Ipidæ, or may be correlated with a caudal emargination of the eye: (3) *Blapstinus* (fig. 6) and other genera among the Pedininæ and (4) the Opatrinæ (Tenebrionidæ), (5) *Amphiops* (fig. 7) (Hydrophilidæ) and (6) Gyrinidæ (fig. 8).

I. The first mentioned condition is the most common. *Chariessa* (Corynetidæ), *Trypitiium* (Cephaloidæ), *Nacerda* (Oedermeridæ), and *Epicauda* (Meloidæ) are more or less unrelated examples of the slightly emarginate condition. *Euderces pini* Oliv. and *E. reichei* Lec. (Leng, 1887, Ent. Am. III, p. 24) among the Cerambycinæ and *Tetraopes* and *Tetrops* among the Lamiinæ stand independently at the end of long cerambycid series exhibiting all degrees of emargination. In these forms the antacava is between the portions of the eye, and the exoculata is homologous in position with the narrowed isthmus of the eye in related types. In *Tillomorpha geminata* (Hald.), closely related to *Euderces*, the dorsal eye is said to have disappeared entirely, leaving only the lower eye (Leconte and Horn, 1883, Class. Col. N. A., p. 305). In *Euderces picipes* Fab. the two lobes of the eye are still connected by such an isthmus, containing facets (not devoid of them as stated by Leconte and Horn, *ibid.*, p. 306) showing the phylogenetically recent occurrence of the division. *Tetropium* (Cerambycinæ) is another unrelated cerambycid in which the eye is not completely divided, but in which the isthmus is devoid of facets, bringing about a physiological condition similar to that in the forms with double eyes.

II. A more or less extensive canthus projecting from the cephalic margin of the eye is found in *Throscus* (Throscidæ) and

is nearly universal among the lamellicorns (absent in *Ceruchus*, a lucanid). At times, as in *Throscus* and many Melolonthinæ, the canthus is devoid of a ridge, but in the other groups there is present on it a prominent ridge that is a portion of the lateral margin of the head. The eye is completely divided in a series of geotrupine (*Odontæus*, *Geotrupes* (fig. 3), *Ceratophyus*, *Lethrus*) and scarabæine (*Phanæus*, *Scarabæus*, *Oniticellus*, *Bubas*, *Onitis*) genera, and the two portions are respectively dorsal and ventral.

III. Closely related to the first condition is the third, with the addition of a frontal ridge dorsad to the antacava. The simplest condition is illustrated by the double-eyed Ipidæ, in which there is no caudal emargination of the eye. *Crypturgus* (Hylesininæ) among the genera related to *Polygraphus* and *Monarthrus* (Ipinæ) among the genera related to *Xyloterus* exhibit an emargination of the cephalic margin of the eye. The males of *Xyloterus* have the frontal ridge strongly developed so that the two portions of the eye are dorsal and ventral; in the others the frontal ridge is feebly developed.

In the double-eyed tenebrionids, in *Amphiops*, and in the Gyrinidæ the exoculata does not connect the caudal margins of the divided eye as in all the groups so far mentioned, but it traverses the middle of the interocular area showing that the eye has become divided as a result of an emargination on both cephalic and caudal margins. The cephalic emargination is correlated with the caudad extension of the frontal ridge, as in the Ipidæ, causing the portions of the eye to be dorsal and ventral respectively. The caudal emargination is correlated with the cephalic encroachment of the anterior angles of the pronotum along the sides of the head.

Among the Tenebrionidæ (fig. 6), numerous genera of Pedininae (all the genera of Blapstini: *Ulus* through *Coniobiosoma* in Leng, 1920, Cat. Col. Amer., pp. 233-234, *Pedinus*, *Colpotus*, *Cabirus*, *Isocerus*, *Heliophorus*, and perhaps others, Reitter, 1904, Best.-Tab. 53, pp. 50, 77, Lacordaire, 1859, Gen. Col. V, p. 244) and numerous genera of Opatrinae (all the genera of the subdivision Phylacina, Reitter, *ibid.*, p. 106-107). Incipient stages of this division are exhibited by Alleculidæ, Tenebrionidæ, La-

gruidæ, and Melandryidæ, all related families. Most of these (*Melandrya*, *Penthe*, *Merinus*, etc.) exhibit only an emargination of the cephalic margin. *Opatrinus* exhibits an emargination of both margins.

The emargination of the caudal margin of the divided eye of *Amphiops* (fig. 7) is well developed in the Hydrophilini, but the cephalic margin is practically entire throughout the family Hydrophilidæ except in the Sphæridiini, where both margins are emarginate.

The Gyrinidæ (fig. 8), all of which have the eye divided, represent the culmination of double-eyed development in Coleoptera and are the only group in which this feature appears to be related to the life habits of the animal. The early stages of this process are, perhaps, exhibited by the Colymbetinae (Dytiscidæ) which exhibit a definite notching of the anterior margin of the eye by the frontal ridge as well as a slight emargination of its caudal edge (fig. 9). All that is necessary to transform such an eye into a gyrid eye is to extend the epicranium (dotted lines "x," fig. 9) over its middle portion. The distinct relationship between the two families makes such an homology possible. The two portions of the gyrid eye are widely separated and, when seen in lateral view, present more or less parallel margins to each other. Extending from the anterior-ventral margin of the dorsal eye to the anterior dorsal corner of the ventral eye is the exoculata.

The males of *Dioptoma* (fig. 10) (Rhagophthalmini, Telophoridae) do not have the eye divided as intimated by Sharp (1899, Camb. Nat. Hist. VI, p. 251) but have it somewhat constricted and traversed by a distinct sulcus, and the dorsal lobe divided by a lesser sulcus into anterior and posterior lobes. The facets vary in size: the smallest are in the sulcus, the next largest are in the posterior dorsal lobe, the next largest in the anterior dorsal lobe, and the largest in the ventral lobe, which covers most of the venter of the head.

In certain may-flies likewise (Comstock, 1920, Intro. Ent., p. 144) where the eye is divided the facets of the lower eye are said to be larger than those of the dorsal eye. This variation is correlated with a difference in the internal structure of the ommatidia

adapting the upper eye for day vision or vision in bright light and the lower eye for night vision or vision in dim light and the same may be suggested for *Dioptoma*, though its habits are unknown. While the lower portion of the eye in the other forms mentioned above is more extensive than the dorsal, no variation in the size of the facets is detected. It does not appear, however, that the distribution of pigment between the ommatidia making for day or night vision is always or even usually correlated with differences in the size of the facets, and in many eyes, as in *Colymbetes*, the pigment cells appear to migrate under the stimulus of light so that the same ommatidia may function as day eyes in strong light and night eyes in weak light (Comstock, *ibid.*, pp. 142-144).

Some of the early authors described and figured a divided eye in *Adelotopus* (Carabidæ, Pseudomorphinæ) (Hope, 1836, Tr. Ent. Soc. London I, plate I, fig. 1b; Lacordaire, Gen. Col. I, 1854, p. 153, and plate V, fig. 4 bis; Sharp, 1868, Ent. Mo. Mag. V, p. 52). Horn (1867, Tr. Am. Ent. Soc. I, p. 152) indicated that this was an erroneous observation, and this is substantiated by Westwood's figure (1853, Rev. et. Mag. Zool. (2), V, plate 15, fig. 2b) and reference to the single specimen in the author's collection (fig. 11). The eye is situated entirely on the dorsal aspect of the head and appears quite homologous with the dorsal eye of *Blapstinus* or a gyrid. Comparison with *Silphomorpha* shows that is probably not the case, but rather that it is the end result of the gradual migration of the eye from the side to the top of the head. The question of the mimicry of Gyridæ by *Adelotopus* (Sharp, *ibid.*), therefore, is not raised.

The author is indebted to Professor Paul S. Welch under whom this study was made, to Mr. Gilbert J. Arrow of the British Museum of Natural History for specimens of *Dioptoma* and *Amphiops*, to Professor M. W. Blackman for the loan of a specimen of *Euderces pini* Oliv., and Mr. Paul G. Jacka and Mr. William Cristanelli for aid in labeling the figures. The specimen of *Adelotopus* was procured from the firm of Staudinger and Bang-Haas.

EXPLANATION OF PLATE XXVI

Figures 1-11: lateral aspect of heads of (1) *Euderces pini* Oliv., (2) *Tetraopes tetrophthalmus* (Forst.), (3) *Geotrupes splendidus* (Fab.), (4) *Polygraphus rufipennis* (Kby.), (5) *Xyloterinus politus* Say, (6) *Blapstinus metallicus* (Fab.), (7) *Amphiops gibbus mater* Sharp, (8) *Porrhorrhynchus landaisi* Rég., (9) *Colymbetes sculptilis* Harr., (10) *Dioptoma greeni* Gahan, (11) *Adelotopus dytiscoides* Newm.

Abbreviations: a, antenna; ac, antacava; adl, anterior dorsal lobe of compound eye; af, antafossa; ag, antennal groove; ar, antacaval ridge; ce, cervacoria; ce, compound eye; dec, dorsal compound eye; e, epieranium; ea, epicranial arm; eo, exoculata; epn, pronotum; fr, frontal ridge; g, groove or sulcus; gu, gula; l, labrum; li, labium; lp, labial palpus; m, mandible; mp, maxillary palpus; mx, maxilla; oc, occiput; ol, oculata; os, occipital suture; pdl, posterior dorsal lobe of compound eye; po, post-clypeus; r, ridge; sc, scape of antenna; sr, supraocular ridge; vee, ventral compound eye; vl, ventral lobe of compound eye; x, lines indicating possible homology between dorsal and ventral lobes of the eye of *Colymbetes* and dorsal and ventral eyes of gyrinid.

COLLECTING AT WILMINGTON, NORTH CAROLINA, AND SUFFOLK, VIRGINIA

By E. L. BELL

FLUSHING, N. Y.

The rediscovery of *Problema bulenta* Boisduval and LeConte at Wilmington, North Carolina, by Mr. F. M. Jones, of Wilmington, Delaware, an account of which he has published in *Entomological News*, XXXVII, no. 7, pages 193-196, July, 1926, led me to make a trip to that city during the first part of July, 1926.

The city of Wilmington, with a population of approximately 42,000, is situated in New Hanover County, well known toward the South Carolina line; it was one of the earliest settlements of the British colonists and, with the surrounding country, was the scene of many historic events during the Revolution and the Civil War. About twenty miles south of the city stood Fort Fisher, which kept the port of Wilmington open for the Confederacy during the Civil War. It was attacked by fifty-five warships during the latter part of December, 1864, and though only a mound of sand, it withstood the greatest bombardment in the history of the world up to that time. On January 13, 1865, it was again attacked by fifty-eight warships and 10,000 men, capitulating two days later.

The excellent beaches make Wilmington a favorite playground for the greater part of the year. It is readily accessible by good motor routes and railways, and is but a few hours ride, by train, from New York. I left New York, via Pennsylvania Railroad, on the 3:50 P. M. train, Eastern Standard Time, changed cars at Washington, D. C., to the Atlantic Coast Line Railroad, and arrived at Wilmington the following morning at 9:45, Eastern Standard Time, where I was joined that evening by my family who made the trip by the Old Dominion steamship line from New York to Norfolk, Va., bringing the motor car with them on the boat. From Norfolk the trip was made in the motor car, crossing the ferry to Portsmouth, Va., thence through Suffolk, Va., to

Sunbury, N. C., and then following North Carolina route 30, through various towns, to Wilmington, a distance of about 260 miles over good roads for most of the way. A few short stretches of poor roads and one long detour where the road was under construction were the only exceptions. *

Upon our arrival at Wilmington, comfortable accommodations were secured at the Cape Fear Hotel, a short distance from the railroad station and but three blocks from the ferry over the Cape Fear River, which had to be used to reach the road on the west side of the river. This road runs for approximately two miles through a swamp and is bordered by a rank growth of water plants, rushes, etc. Back of this, for some distance after leaving the ferry, there is a dense jungle of trees and undergrowth of bushes, tall rushes and water plants, seemingly impenetrable; further along are the old rice fields, extensive open spaces with rank vegetation, into which no attempt was made to go, for if it were possible to find a footing there, the density and height of the vegetation would have prevented collecting. There were many *pontederias* in bloom along the roadside and these flowers, so attractive to insects, afforded the best collecting. A long-handled net was found to be necessary, as often the desired specimens rested on flowers out of reach, with the ordinary length of handle; as it was, wet feet was the rule. *Hesperiidae* were not plentiful, though the locality was seemingly so favorable; perhaps it was a little between seasons and a somewhat off year; the most plentiful species of *Hesperiidae* was *Poanes viator* Edwards, which visited the flowers but more often was found resting on the leaves or slowly flying well down among the plants, where it was difficult to capture, unless one waited for it to cross a comparatively open space; many of them were in poor condition but a reasonable number of quite good specimens were secured. *Poanes yehl* Skinner and *Atrytone dion* Edwards were scarcer and generally in poor condition. Probably about two weeks earlier would have found them at their best. They were taken exclusively on *pontederia* flowers; during several days collecting along this road but fourteen individuals of *Problema bulenta* Boisduval and LeConte were seen; of these several were captured, all on the *pontederias*; the bright yellow undersurface

renders them very conspicuous and easily identified and they are very easily captured when within reach of the net; a few specimens of other common southern species of *Hesperiidæ* were also taken along the road but even these were far from plentiful.

Many of the swamp denizens are killed on the road by the autos; numerous snakes, turtles and frogs were found crushed along its way; dragon-flies are also frequent victims, being struck and killed as they fly about over the roadway; rails clacked in the swamp and were sometimes seen crossing the road, while the wooded sections continuously rang with the songs and cries of other birds.

The collecting in the pine woods was also very poor; one small restricted area yielded several specimens of *Amblyscirtes alternata* Grote and Robinson and a few specimens of other species, the commonest species being *Thorybes daunus* Cramer; however, many seemingly favorable places yielded nothing; there were many and beautiful flowers, most of which did not seem to be attractive to insects; pitcher plants grew in abundance in the somewhat moist places, their yellowish clusters standing out conspicuously; quail were very plentiful in the woods and many were flushed while collecting there.

The marsh back of the beach at Fort Fisher was visited but nothing of interest in *Hesperiidæ* was taken; a few specimens of *Phyciodes phaon* Edwards were collected here, a species not found in any of the other places visited around Wilmington; there were a great many *Cicindelidæ* on the beach, and a small species of *Cicada* in the bushes on the dunes, these latter, however, evaded my efforts to capture them.

The capture of *Amblyscirtes alternata* at Wilmington apparently extends northward the recorded range of that species.

After spending a pleasant week at Wilmington, we motored back to Suffolk, Virginia, and obtained accommodations at the Hotel Elliott, in that city. It was hoped that an opportunity would be afforded to do some collecting in the Great Dismal Swamp, but the weather prevented much being done. It was mostly cloudy with occasional showers and thunder-storms; two visits to the swamp were spoiled by thunder-storms occurring almost simultaneously with the arrival at the collecting-grounds,

however in the few minutes spent there on the last occasion, one specimen of *Poanes yehl* Skinner and one specimen of *Epiphyes carolina* Skinner, were taken; the specimen of *carolina* is apparently the typical form and not the form *reversa* Jones, the type of which was collected at this locality by Mr. Jones. A little collecting was done along the railroad track and at Lake Prince Reservoir; butterflies were scarce, however, though somewhat more plentiful than at Wilmington.

I am greatly indebted to Mr. F. M. Jones for much valuable help in the way of data as to collecting grounds, etc., which enabled me to do a great deal more than would have been possible without it, in the short time at my disposal.

THE ENTOMOLOGY OF HAKLUYT'S "VOYAGES," I

"We were also oftentimes greatly annoyed with a kind of flie, which in the Indian tongue is called Tequani, and the Spaniards called them Muskitos. There are also in the sayd countrey a number of other kinde of flies, but none so noysome as these Tequanies bee: you shall hardly see them they be so small, for they are scarse so big as a gnat; they will sucke ones blood marvellously, and if you kill them while they are sucking, they are so venomous that the place will swell extremely, even as one that is stong with a Waspe or Bee: but if you let them sucke their fill, and to goe away of themselves, then they doe you no other hurt, but leave behinde them a red spot somewhat bigger then a flea-biting. At the first wee were terribly troubled with these kinde of flies, not knowing their qualities, and resistance wee could make none against them, being naked." (From "A Discourse written BY ONE MILES PHILIPS ENGLISHMAN One of the company put on shoare Northward of Panuco, in the West Indies by M. John Hawkins 1568, conteining many special things of that countrey and of the Spanish government, but specially of their cruelties used to our Englishmen, and amongst the rest to him selfe for the space of 15. or 16. yeres together, until by good and happy meanes he was delivered from their bloody hands, and returned into his owne Countrey. An. 1582.")—Ed.

THE ENTOMOLOGY OF PLINY THE ELDER

BY HARRY B. WEISS
NEW BRUNSWICK, N. J.

During the reign of Tiberius, cruel pauciloquent paramount, despiser of Roman nobles, rabble, pomp and popularity, able campaigner and parsimonious public administrator, who was heartily hated and who ruled the Roman empire efficiently before retiring to his twelve villas at Capri where legend has him indulging in vice and framing new styles of satyriasis; during his reign was born Gaius Plinius Secundus, destined to become a bibliophile and plunderer of the past.

Born about 23 A.D., Verona, Como and Rome have all been claimed as birthplaces, but his family lived at Como and here he owned property. For his education he was sent to Rome, where he studied under Appion, and enjoyed the facilities afforded by his affluence and high connections. At the age of twenty-three he entered the army and as commander of a troop of cavalry under Lucius Pomponius, he traveled over the frontier of Germany visiting the Chauci and sources of the Danube. Returning to Rome in 52 he studied law but abandoned it after some unsuccessful cases. Returning then to Como, he superintended the education of his nephew Pliny the Younger and for his guidance wrote the three books entitled "Studiosus," a dissertation on the preparation of youthful orators.

During most of Nero's reign he apparently was without public office but near the end of it he was appointed a procurator in Spain, where, in 71, he was advised of his brother-in-law's death and of his selection as guardian of Pliny the Younger. He remained in Spain during the brief reigns and civil wars of Galba, Otho and Vitellius and returned to Rome some time before 73, where he was favorably received by the Emperor Vespasian. At this time he wrote the history of his own period, completing the work on Roman History which Aufidius Bassus had started and continued the collection of the immense body of material from

which he compiled his "Historia Naturalis," published about 77.

He died in 79, a victim of scientific curiosity. He was stationed at this time off Misenum in command of the Roman fleet protecting part of the Mediterranean when the great eruption of Vesuvius occurred. Anxious to examine the event at closer range, he landed at Stabiæ despite the falling ashes and other signs of danger and was suffocated by the fumes.

Pliny's appetite for knowledge was never appeased. When not attending to his duties he was reading or being read to, taking notes or making extracts. He lived in a world of books at a time when the Roman Empire was being guided by Tiberius, Caligula, Claudius and Nero. During Pliny's youth Caligula squandered in foolish building activities and harebrained carousals the state wealth that Tiberius had saved, Caligula, vertiginous with his own greatness, dressing the part of the gods, one day Apollo, the next Mercury, then Jupiter, at first popular, then unpopular, feeble minded, boldly incestuous, looter of Gaul, torturer of the people for minor offenses and for no offense until the dagger ended his life.

When Pliny was about eighteen, Caligula was succeeded by Claudius, imbecilic husband of Messalina, centre of feminine and official machinations involving banishment and murder, who nevertheless conducted a successful crusade in Britain and built one hundred miles of aqueducts to supply Rome with water before he was poisoned. Although immersed in the writings of the Greeks, Pliny could not have been unaware of the enigmatic antics of Nero, popular and gentle ruler while Seneca was his chief minister, as common as the crowd until he became intoxicated with praise, roving musical composer, poet, singer and chief actor in theatres in which it was treason to leave while he was on the stage, companion of actors, hunters and prize-fighters, awarding himself first prize at the circus and races when he came in last, making the Roman nobles perform for the edification of the proletariat, staging immense spectacles in which panthers, lions, Spanish bulls, leopards, archers, warriors, wild elephants, gladiators, trained geese, charioteers, slaves, criminals and Christians furnished unique and bloody entertainment, slayer of his wife and mother, poisoner of Britannicus, lecherous, bacchanalian

gastronome, collaborator in the fire that destroyed three-fourths of Rome, blaming the Christians and torturing them, undertaking the reconstruction of the city at enormous expense with excessive taxation, and committing suicide by request. Vespasian, whose death occurred a few months before Pliny's, was a plain man, a brave soldier, close fisted, practical, who rebuilt the Capitol, protected the provinces, erected the Colosseum and died naturally.

Of Pliny's works, only his "Historia Naturalis" has come down to us and this is composed of extracts from some 2,000 volumes by physicians, travellers, philosophers, historians, etc. Pliny was a prodigious compiler and as he had little or no first-hand knowledge of the subjects he occupied himself with, he was unable to separate fact from fable, nor did he use rare discrimination in selecting his extracts, the marvelous having the most attraction for him. It is not natural history as we think of that subject now, but includes, without philosophical arrangement, discussions of botany, astronomy, meteorology, anthropology, zoology, etc., interlarded with various digressions. Although Pliny is not dependable as a naturalist, even in the broadest sense, his work has long been valuable as a source of pure Latinity, and as the only fountainhead for certain details on a large number of subjects. From his writings Macgillivray gathers that Pliny had doubts concerning the existence of God, that he disbelieved in the immortality of the soul and that he was opposed to luxury, cruelty, effeminacy and all kinds of vice.

His "Historia Naturalis" is made up of thirty-seven books, the first consisting of a dedication to Titus Vespasian, the emperor, the names of the authors whose books he consulted and a summary of every chapter. The second treats of the world, elements, stars; the seventh of man, his inventions; the eighth of land creatures and their kind; the tenth of flying fowls and birds; the eleventh of insects; the twelfth of drugs and odoriferous plants; the thirteenth of strange and foreign trees; the thirtieth of magic and medicine; the thirty-fifth of painting, color and painters; the thirty-seventh of precious stones. The chapters of each book vary in length, many of them being very short.

The eleventh book deals mainly with insects and the title and some of the chapter headings are as follows, the translation being Holland's.

"In the Eleventh Booke Are Contained the stories and natures of small creatures and such as creepe on the ground."

Chapter 1, "Of Insects in generall"; chapter 2, "The natural industrie of those Insects"; chapter 3, "Whether Insects do breath, whether they have bloud of no?"; chapter 4, "The matter & substance of the Insects bodie"; chapters 5 to 20 are on bees; chapter 21, "Of Wespes and Hornets"; chapter 25, "Of Scorpions"; chapter 27, "In what countries there bee no Grashoppers, and where they sing not"; chapter 29, "Of Locusts"; chapter 30, "Of Ants or Pismires in Italie"; chapter 32, "The diverse sorts of Insects"; chapter 34, "Of a certain creature that hath no passage to void excrements"; chapter 42, "Divers kinds of Cheese"; chapter 44, "The resemblance that Apes have to us"; chapter 45, "Of Nailles"; chapter 46, "Of Houfes"; chapter 50, "Of Tailles"; chapter 54, "How to encrease or diminish the corpulencie of the bodie, and what things with taste onely, will allay hunger and quench thirst."

Many of the chapters in the eleventh book are very short. Chapter 1, for instance, on insects in general consists of only twelve lines. Some, however, are a page or more in length. From the titles of some of the chapters one is led to expect much, but the incompleteness and generality of the text and the peculiar turn given to the subject by Pliny are disappointing. Chapter 27 is quoted in full as follows.

"Places wherein there be no Grashoppers: also where they are mute."

"In countries bare and naked of trees and wood, there breed no Grashoppers: and therefore ye shall have them at Cyrene, about the towne, but not in the plaines and fields thereof. Neither shall a man meet with them in woods that be cold and full of shade. It seemeth also, that they take a liking to some one quarter more than another; for in the region of the Milesians, few places there be that have them; but in Cephalenia, there is a river that doth limit and bound them; for of the one side there be plentie of them; and on the other, few or none. In the terri-

torie of Rhegium they be all mute. Passe the river once and come into the Loerians countrey, yee shall heare them chaunt lustily. Wings they have like to those of Bees, but larger to the proportion of their bodies.”

Pliny's grasshopper, from this description, is apparently the cicada. Some of his accounts deal with egg deposition of insects, feeding habits, etc., and are a little more complete than the above quotation, given as a sample. Another quotation will be sufficient to give one an idea of Pliny's entomology, which is of interest now only because of its quaintness and errors. The following is part of the chapter 35, entitled “Of Moths and Gnats.”

“Wooll and cloth when they be dustie breed moths, especially if a Spider also be gotten within them. For the Spider is very thirstie, and by reason that he drinketh up all the moisture of the cloth or wooll, he increaseth the drinesse much more. In paper also they will engender. A kind of them there is that carie their coats and cases with them, as Cockles and Snails doe; but they have feet to be seen. If they be turned out of their coats or husks, they presently die. If they grow still, they will proove to be Chrysalides.”

Many brief quotations from Pliny's “entomology” are to be found in Cowan's “Curious Facts in the History of Insects,” published in Philadelphia in 1865. Pliny's work was translated into English in 1601 by Philemon Holland, the title of Holland's book being “The Historie Of The World, Commonly called, The Natural Historie Of C. Plinius Secundus.” Until the revival of science, Pliny's work was, next to Aristotle's, the standard authority.

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ANNIE TRUMBULL SLOSSON

BY WM. T. DAVIS

STATEN ISLAND, N. Y.

On October 4, 1926, Mrs. Annie Trumbull Slosson died at her home, 26 Gramercy Park, and the New York Entomological Society lost one of its oldest and most distinguished members. She was elected at its first meeting held June 29, 1892. Later the Society met at her home, 38 East 23rd St.; and still later, through her intercession with the late Morris K. Jessup, in the American Museum of Natural History. A perusal of Mr. Leng's "History of the New York Entomological Society, 1893-1918," to be found in this JOURNAL for 1918, will further show how much the Society is indebted to her.

In the same number of the JOURNAL with the "History," there is a characteristic article by Mrs. Slosson giving her "Reminiscences of the Early Days of the New York Entomological Society," and, as might be expected, it is a most interesting and sprightly production. It should be remembered that it was written when she was over eighty years of age. She might well joke with us in her kindly and appreciative way, and call us her "boys as I love to style you."

Mrs. Slosson wrote the first article for the first number of our JOURNAL, March, 1893, and of course it was followed by many more. She likewise contributed to most of the other American entomological journals of the day, and to some of the botanical ones as well. She once told me that she had commenced her natural history studies with plants. She also told me of her early interest in a very large turtle that had been brought from the Pacific Ocean by a sailor-man to her Connecticut home, when she was a child. She and her brother called it "Terrie," and often rode on its back. Said turtle, possessed of great strength, would pull up the stake to which it was tied, and entering the water of the bay would cause the family some concern and much amusement by being seen off shore with its head protruding like

a stake above the surface of the water. He would be brought home; tied fast once more, and all would be well until the next escape. Alas! the turtle was killed during the winter by rats, while it was hibernating in the cellar.

Mrs. Slosson was forty-eight years of age when she commenced her entomological studies. In the first of her articles on "A Few Memories," contributed to this JOURNAL, June, 1915, she writes: "I had always from childhood been fond of nature and for years devoted myself to botany, being so fortunate as to make some rather interesting discoveries and being a correspondent of Prof. Asa Gray and other old-time plant students. But it was not until the early spring of 1886 that I turned my attention to the study of insects." She progressed very rapidly, and soon had a remarkable collection, that, as years went on, was destined to be visited by many noted entomologists. She was one of the first to collect in the region about Miami, Florida, and naturally secured some rare and new species. In the summer she went to Franconia, New Hampshire, and usually spent some time at the top of Mt. Washington. Her captures were sent to specialists, and many of the new ones later bore the name of *slossonæ*. I believe that about one hundred species have been so named, and she was much amused that the very first one of them, named in her honor by her friend Henry Edwards, should die a little later and sink "into the dread valley of synonymy."

In 1894 she published her first list of the Insects Taken in the Alpine Regions of Mt. Washington, and later many additional lists appeared, about ten in all. Mrs. Slosson's papers are not only useful, and of value as contributions to entomology, but they are good literature as well.

In the *Bulletin of the Brooklyn Entomological Society* for June, 1916, she has an article on "Entomology and Literature," and states that they "work well together in harness, each being a good running mate for the other." She certainly often made them so, and added many literary gems to our entomological literature. Her "Just One Log," in *Entomological News* for March, 1905; "A Hunt for *Saldoidea*," in the same journal for November, 1908, and her papers, "A Few Memories," published in our JOURNAL, reminiscent of Henry Edwards and Dr. Packard,

have, as has been stated, not only much of entomological value, but are very interesting otherwise. This is easily explained, for to an almost entirely different set of people Mrs. Slosson was known as a writer of good literature, and particularly of sketches of New England life. She received many a letter thanking her for her helpful stories, and many a caller came to her door who knew only of her literary achievements, and nothing of her entomological studies. Such callers seeing the many boxes arranged like books on the shelves often made remarks, when shown their contents, that Mrs. Slosson used to relate to us with much amusement—her visitors just did not understand.

In 1878 Mrs. Slosson's book, "The China Hunters Club, by the Youngest Member," was published. There was an introduction by her brother-in-law, Dr. W. C. Prime; it contained a chapter on American History Illustrated in Pottery, and the illustrations were by her brother, Gurdon. The book is now out of print and sells, when found, for \$7.50 or more. Her most appreciated story was Fishing Jimmy (1889), a character who was immediately preached about and quoted on both sides of the Atlantic. She published at least a dozen other stories in book form, some of them first appearing in the great magazines of the day. Many of her essays on the birds she at one time or another had in her aviary, or her observations during her walks in the country, appeared in the *Christian Endeavor World*, even as late as the year 1921. Notwithstanding the age of the writer, these essays are bright and informative. In that year it was written of her: "On May 18 Mrs. Slosson will be eighty-three years old, and those who are privileged to know her find her as cheery and vivacious as any woman of half her years." It was in 1921 also that she wrote thus of her youth: "I was a wonderful dreamer of dreams. Not only those dreams of the daytime common to the young, of a future too bright and fair for fulfillment, but dreams of the night and of sleep. These always interested me and each day with its new morning I would lie and look out of my little east window to the sunrise across the sea, recalling the visions of the night and wondering about them." That was it; she was keenly interested in most things and she once wrote: "I wish I could show you how easily you could make your lives full of beauty, interest and keen

enjoyment. Your quiet farm life may seem to you dull, monotonous. But what a museum of wonders is the piece of woods a stone's throw from your door; what books could tell you what nature's pleasant pictured pages tell?"

Mrs. Slosson was born in Stonington, Connecticut, May 18, 1838, and came of a distinguished family of which she was the ninth child. "An older brother, James Hammond Trumbull, distinguished himself as a philologist. He was appointed lecturer on the Indian languages of North America at Yale in 1873 and subsequently compiled a vocabulary from John Elliot's Indian Bible as he was reputed to be the only living American who could read it. For many years Mr. Trumbull was president of the Connecticut Historical Society. Like his sister he was interested in entomology and during his early life assisted in cataloguing the reptiles, fishes, shells, etc., of this state. A second brother was Henry Clay Trumbull. His career included a few years in the railroad business at Hartford, service as chaplain in the Civil War, and a long period as editor of the Sunday School Times in Philadelphia. A most conspicuous achievement was the discovery, during a trip through Egypt, Syria, etc., in 1881, of the biblical site of Kadesh Barnea on the southern boundary of Palestine, which had been the object of research for many years. The artist, Gurdon Trumbull, was a still younger member of this family."

With such family associates, and herself gifted by nature, it is little wonder that Mrs. Slosson illuminated with much wit and wisdom the things about which she wrote. She well understood, or understood as well as anybody appears to understand, the meaning of human life. With advancing age she used to observe that she ought not and would not complain, and then with a smile would add, that she "had had her day." But to many of us comes the regret that her days were not even longer.



ANNIE TRUMBULL SLOSSON
TAKEN IN 1913

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF MAY 19, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 19, 1925, in the American Museum of Natural History; President Frank E. Lutz in the chair, with 16 members and 11 visitors present.

The treasurer reported the receipt of \$50 from Mr. Frank Johnson in connection with the Society's contribution of \$150 towards the cost of preparing the New York State List of Insects.

On motion by Mr. Woodruff, Mr. Johnson was elected a life member.

Mr. Roland J. Hunter was elected a life member.

Mr. Davis was authorized to complete the arrangement with the New York Academy of Sciences for the joint contribution to the New York State List.

Mr. F. Martin Brown spoke on "*Pyrameis cardui*," a new host for *Bacillus entomotoxicans* of Duggar, with an exhibit of the butterfly, its caterpillar and parasites. From one chrysalis, an exceedingly infectious decoction was obtained which, diluted with 100 parts of water, was found to be fatal to squash bugs. It was suggested that the study of sickening caterpillars might lead to important results.

Mr. Davis made some "Remarks on the Orthoptera from the State of New York," illustrated by eight boxes of specimens in which 138 species were shown. This exhibit resulted from the work that had been done for the State List, started in 1913 by Prof. Bradley and now approaching completion. The work done in the meantime by Morse and by Blatchley was praised and some interesting features, like pink katydids, and unknown males of certain walking stick insects, were especially mentioned.

Mr. Bird spoke of "The Importation of an American species of Lepidoptera into Germany" with illustrations by specimens of *Papaipema horni*.

Mr. Davis exhibited a bound volume of the writing of Prof. Harry H. Knight.

Mr. Barber exhibited a pamphlet case which he had found useful.

MEETING OF OCTOBER 6, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 6, 1925, in the American Museum of Natural History; President Frank E. Lutz in the chair, with 20 members and 8 visitors present.

The librarian reported accessions.

The death of Dr. Kudlich was announced by Mr. Davis. He and the secretary were instructed to prepare a resolution and to send a copy thereof to Dr. Kudlich's family.

A letter from the British Museum, deprecating the use of the wings of certain butterflies for jewelry was read.

Dr. W. J. Holland, present as a guest, spoke of his summer at Watch Hill, R. I., and especially of his success in collecting moths at night by sugaring and at light. At 77 years of age he had the pleasure of finding a moth he had never before seen alive and of being, for a brief time, lost in the woods.

Mr. Stecher, also present as a visitor and but lately arrived from Austria, described his visits to nearby localities and his first experience with the stinging hairs of the Saddleback caterpillar.

Mr. Bell had, besides his local collecting, spent twelve days in Alabama, on which he will report later.

Mr. Shoemaker spent a part of July at Guilford, N. Y., and part of September at Washington, D. C. Energetic collecting had added many Noctuids, Longhorns, and Cychrini to his collection. An interesting variety of *Donacia cincticornis* was found at Guilford.

Mr. Sherman's summer had been spent in the White Mts. The finding of *Carabus chamissonis* above the tree line on Mt. Adams was one result. Other agreeable summer incidents were meetings with Dr. Goding, Mr. Henshaw, Parshley and Morris.

Mr. Watson gave the following butterfly records of the past season which seemed worthy of mention:

Heodes thoe Boisduval, and *Hylephila phylocus* Drury, one fresh male of each at Van Cortlandt Park, New York City, September 6. *Catopsilia eubule* Linnaeus, one specimen at Central Park, New York City, August 31.

The following notes on the last mentioned species were furnished Mr. Watson by Mr. J. T. Nichols. Manasquan and Spring Lake, N. J., September 2, three individuals flying north. Mastie, N. Y., September 5, six individuals flying east.

Mr. Wm. T. Davis stated that he had spent about ten days in Southern New Jersey and would report later on his observations. He showed a very beautiful black male of the geometrid moth, *Nacophora quernaria* Smith and Abbott, found in the Clove Valley, June 19, 1925. This melanistic phase is known as *atrescens* Hulst. Mr. Davis stated that he remembered hearing at one of the early meetings of the New York Entomological Club, Mr. Henry Edwards, editor of *Papilio*, tell Mr. August Grote his surprise at finding *Eudamus lycidus* on Staten Island. Though *lycidus* was rare in 1881 it has since become quite a common species in parts of Staten Island. He further stated that Mr. Louis Ragot had found a considerable colony of *Euptoieta claudia* this past summer near Graniteville, Staten Island.

Mr. Woodruff's summer had been spent in northwestern Connecticut and at Karner, N. Y. Dragonflies and membracids had been his special prey but an interesting beetle, *Ochthebius benefossus*, had also been found.

Mr. Barber visited Nebraska, Ames, Iowa, to meet Prof. Knight, and Vienna, Va. During his western trip he had collected, besides Hemiptera, some new laboratory materials, cellulocin, Pyrex collecting tubes, and calcium cyanide, valuable as less deliquescent than the ordinary cyanide.

Messrs. Mutchler and Silver had been occupied during the past summer with entomology in boys' camps. Mr. Mutchler had also visited the Bruce Park Museum where Curator Howes has some interesting South American material from Kartabo.

Mr. Weiss had devoted some of his little summer leisure to Scarabs on which he will speak later.

Mr. Huntingdon, Mr. Farrelley, Mr. Sheridan, reported local collections, Mr. Angell's trips had extended to Montauk and Cook's Falls, Mr. Hall's to Wyoming, and each will furnish details later.

Mr. Nadler had made a collection of 2,000 Psocids, representing 35 species.

Mr. Swift, present as a visitor, had been in Costa Rica where, besides experiences with wasps, tarantulas, etc., he had enjoyed raising a botfly to maturity in his own leg.

Mr. Davis exhibited larvae of *Eristalis* found in a pool of water among tree roots.

Dr. Holland closed the meeting with an account of the Catalogue of Epipaschiinae on which he is at present engaged.

MEETING OF OCTOBER 20, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 20, 1925, in the American Museum of Natural History; Dr. F. E. Lutz in the chair with 22 members and 7 visitors present.

Mr. Eben H. P. Squire was elected a member of the Society.

The meeting due on Election Day was omitted by consent.

Mr. Davis reported his visit earlier in the day with Mrs. A. T. Slosson and her desire to give her collection to the Museum at once.

Mr. Mutchler spoke of the B. Hamfelt collection of Palaeartic Coleoptera for sale, also of the Zoological Record.

On motion the treasurer was authorized to purchase a copy of all the Insecta portion published since 1919.

Mr. Davis opened the "Symposium on the Field Station for the Study of Insects" by reading from his journal an account of the Decoration Day outing May 30 and 31 in the old barn between Tuxedo and Southfield, later replaced by the station building. He described Mr. Barber's gallinaceous method of collecting by scratching the surface of the rough rocky hillside and the surprising number of insects found among the grass roots; and the beauty of Spruce Pond, well hidden in the wooded mountains. He showed photographs of the locality and two boxes of the insects he had found. He also showed wasps' nests of various sizes and colors, evidently made by the same species in different years under the same stone, as an indication of a sort of homing instinct.

Mr. Barber spoke of his pleasant recollections of the days spent at the station somewhat tempered by memory of cold nights. Among the interesting insects he had found were *Xestocoris nitens*, *Antillocoris pallidus*, *Barce uhleri*, *Geocoris piceus* and *Nabis rufusculus*.

Mr. Woodruff found the season too cold and early for beating and sweeping but in the sorrel which abounded on the barren hillside he had found the leaf hopper *Stictocephala lutea* in extraordinary numbers. He exhibited also *Calophya nigripennis*, found on Sumac, the water bug *Microvelia*, and the dragonflies *Gomphus lividus* and *Tetragoneuria cynosura*.

Dr. Lutz spoke of the outdoor education which the station aimed to supply and particularly of the training trail about one half mile long with labeled trees, insects, etc., along it to the number of nearly 1,000, of which less than 150 were insects. The visitor after studying these labels followed a shorter testing trail where he found fifty numbered tags. His test was based upon the percentage of these he could correctly name and varied greatly. Newsboys scored 72, girl scouts 86, and once 99 was reached. Within the station building, in the garden near it, and elsewhere educational exhibits were made. Many interesting devices were developed during the summer to convey information. Easily remembered verses were used at times on the labels. Caterpillars on trees were surrounded by cylinders of celluloid. Tiger beetle burrows were indicated by boxes of mounted adults. An orchestra of crickets was illustrated by enlarged models to show the file that makes the song. It was interesting to note that even these delicate models were not damaged by vandalism, though thousands of boys visited the trail, and at the end of the season the trail, trampled by their feet, was barely 18 inches wide.

Dr. Sturtevant exhibited the recently introduced fly *Muscina pascuorum* and gave its record since 1922. It is now apparently not uncommon in New York City.

Mr. Woodruff spoke of finding the same fly in his house at Litchfield, Conn., October 19.

Mr. Olsen spoke of the Tamarisk insect.

Mr. Bird expressed his appreciation of the valuable work done by Dr. Lutz at the Field Station.

Mr. Mutchler reminded the members that if they did not desire the entire Zoological Record, they could purchase separately any single order in which they were interested.

MEETING OF NOVEMBER 17, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M., on November 17, 1925, in the American Museum of Natural History; President Frank E. Lutz in the chair with 22 members and 9 visitors present.

The President reported the receipt of the Slosson Collection in the museum and progress in labeling the specimens.

The Program Committee reported that Messrs. Hartzell and Bird would speak at the next meeting.

Mr. Leng announced the death on November 7 of H. W. Wenzel of Philadelphia.

Mr. Sherman announced the death of Fred C. Bowditch of Boston.

Mr. Schwarz read a paper, "Notes on the Bees of Rangeley, Maine," illustrated by specimens and by drawings of leaves cut by *Megachile*. He presented a summary of his notations regarding a nest of *Bombus terricola*, analyses of the leaf-cutting of *Megachile melanophæa*, comments on the attitude of rest assumed by this bee and certain others, observations regarding the matings of *Panniginus asteris* and certain evidences that had come to his attention of social tendencies manifested by male *Halictus*. He spoke at some length regarding a triungulin larva of a meloid beetle which he found on the thorax of an *Hylæus* bee and more briefly regarding a *Pseudagenia* which, when captured, was carrying a spider from which three pairs of legs had been amputated. By way of conclusion he told of a rather curious invasion of winged ants that on a certain day poured out in hordes from every fireplace in the hotel where he was stopping, notwithstanding the fact that these fireplaces had been in use frequently during his sojourn.

Dr. Felt, after pointing out the difficulties that result from the existence of 160,000 zoological genera without any indication in the names thereof of the class to which they belong, and the annual erection of about 1,500 more, proposed a plan, devised by S. C. Bishop and himself, for ameliorating the conditions stated. This plan involves the use of a prefix for each generic name indicating the phylum or class, and the order by their initial letters, and the family by letters arbitrarily assigned. Thus a prefix *Ic* would indicate Insecta Coleoptera, *Il* would indicate Insecta Lepidoptera; and *Icab* would indicate Insecta Coleoptera family Carabidæ. The generic name *Carabus* would be written *Icab Carabus* and would at once indicate the class, order, and family to which it belonged. A similar prefix would accomplish the same result for every zoological genus. Dr. Felt pointed out many secondary advantages, the elimination of the obnoxious prefix *Pseudo*, now so often used that already nearly 2,000 names begin with it, and the avoidance of substitutes for homonyms, among them.

Dr. Lutz thought some reflection upon the advantages and disadvantages, if any, of the proposal should precede discussion.

Mr. Davis thought it needless to take alarm at a condition which time would remedy and pointed out that in a well-studied group like Birds of North-eastern America the erection of new genera had ceased and that in the Orthoptera of the same region a similar result had been approximately reached.

Mr. Leng pointed out that part of the difficulty was removed in *Entomological News* by a parenthesis following the name including an abbreviation (col.) for example for Coleoptera.

Mr. Sherman said the solution of the difficulty of placing an unknown generic name had long been Scudder's, "Nomenclator Zoolozicus" Bull. 19, United States National Museum, which unfortunately had become practically out of print.

BOOK REVIEW

Insects of Western North America. By E. O. ESSIG. The Macmillan Company, 1926. \$10.00.

As a result of Prof. Essig's energy and ability, we now have an encyclopedic work on the insects of western North America or from Mexico to Alaska and from the Pacific Ocean to the Rocky Mountains. Although this is a large volume of 1,035 pages, including an extensive index of authors, host plants and subjects, it is devoid of padding, even transitional words being sacrificed to make room for entomological facts. Except for fifty pages that deal with such arthropods as millipedes, sowbugs, centipedes, spiders, ticks, mites, etc., the book is concerned entirely with the various orders of insects. Keys to the suborders and families are included and each family is treated as a unit. The amount of text devoted to the family and its better known species depends upon their economic significance. Injurious species are dwelt upon in some detail, inclusive of life history, habits, control, characteristic markings, distribution, etc., while the uneconomic ones are accorded briefer mention. Covering the field that Prof. Essig does, the accounts must of necessity be concise. Numerous bibliographic footnotes referring to the systematic and economic literature are available for those who want extended accounts. Seven hundred and sixty-two excellent illustrations accompany the work and add considerably to its value. The eastern entomologist will find in Prof. Essig's book that many species are common to both east and west and will be interested in the regional forms that occur. Packed as it is with facts and including, as it does, notes on so many species, this book is bound to remain for many years the standard reference work on the insects of Western North America. There is little in it that can become antiquated soon. Names may change, new facts may be discovered and methods and means of control may become out-of-date, the latter quite rapidly. No author can protect his book against the first two happenings, nor would he want to against the second. As for the third, Prof. Essig does not elaborate upon control methods and such as he mentions are only a small part of the large body of entomological information that is presented.

—H. B. WEISS.

A NEW BOOK ON HEMIPTERA

This is simply a notice of a new book by Dr. W. S. Blatchley, written by a grateful entomologist. A little over six years ago Dr. Blatchley's book on the Orthoptera of Eastern North America appeared, and now a thick volume of 1,116 pages on the "Heteroptera of Eastern North America" is published by the same author. At the end of the "Introduction" we note the line that "Joy's soul lies in the doing." If this be true Dr. Blatchley is a very happy man.

The introductory chapter deals with the structure, classification, relation to other insects, habits, collecting and preservation of Heteroptera. Then follows the descriptive catalogue giving keys for the families, genera and species, with a detailed description of each of the 1,253 species treated, together with notes on distribution. There are numerous illustrations, and any one turning the pages of the book will be apt to notice a portrait suggestive of the bug about which he seeks information, and so be led to the keys and detailed descriptions. At the end of the volume there is a bibliography covering 23 pages.

We suppose that some of the reviewers will find much fault, as usual, for among thousands of statements it is easy to make a wrong one, but we believe that the book will be of great service, and like Dr. Blatchley's other manuals in great demand as well.
—WILLIAM T. DAVIS.

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Volume XXXIV, page 246—Paragara should be Paragargara.

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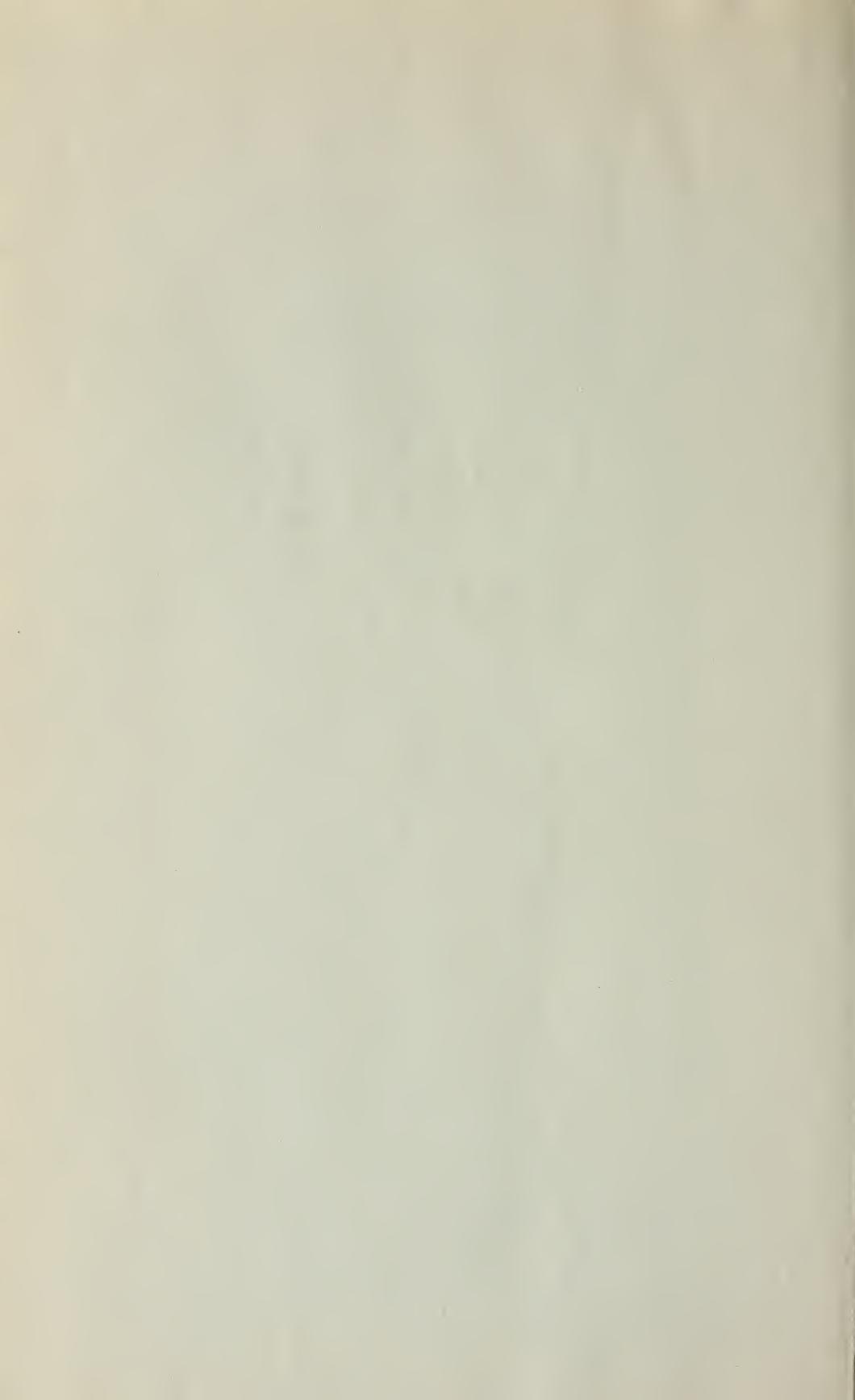
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