

# A REVISION OF THE NEARCTIC HEMEROBIIDAE, BERTHIDAE, SISYRIDAE, POLYSTOECHOTIDAE AND DILARIDAE (NEUROPTERA)

BY F. M. CARPENTER

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The insects treated in this revision are among the most typical of the Neuroptera (Planipennia). When the family Hemerobiidae was established by Leach (1815), it included nearly all of the insects now comprising the order. Since the beginning of the present century, however, and subsequent to the publication of Banks' "Revision of the Nearctic Hemerobiidae" (1905b), various genera have been removed from the Hemerobiidae and placed in separate families. The groups thus formed (Berthidae, Sisyridae, Polystoechotidae, Dilaridae) have little in common with the restricted family Hemerobiidae; but in order that the scope of the present revision be kept identical with that of Banks', these families have also been included.

During the course of this revisional study, I have examined somewhat more than eight thousand individuals of the families mentioned. Apart from the specimens in the Museum of Comparative Zoology, nearly all of these have been loaned to me by the following individuals, to whom I am indebted for their cooperation: Mr. E. P. Van Duzee, California Academy of Sciences; Dr. J. McDunnough, Canadian Department of Agriculture; Mr. A. B. Gurney, United States National Museum; Professor Franklin Sherman, Clemson College, South Carolina; Dr. C. S. Brimley, North Carolina Department of Agriculture; Dr. Richard Dow, New England Museum of Natural History; Dr. F. E. Lutz, American Museum of Natural History; Dr. H. H. Ross, Illinois State Natural History Survey; Professor C. E. Mickel, University of Minnesota; Dr. Hugo Rodeck, University of Colorado; Dr. C. B. Philip, Hamilton, Montana; Dr. R. B. Friend, Connecticut Agriculture Experiment Station; Professor C. P. Alexander, Massachusetts State College, Mr. J. N. Knull, Ohio State University; Dr. L. P. Wehrle, University of Arizona; Dr. Hugo Kahl, Carnegie Museum; Mr. J. A. G. Rehn, Academy of Natural Sciences, Philadelphia; Dr. W. T. M. Forbes, Cornell University;

and Professor H. B. Hungerford, University of Kansas. I am under special obligation to Professor R. C. Smith, of Kansas State College, for the loan of his extensive private collection of these insects, and for the opportunity of seeing many small collections sent to him for identification during the preparation of this revision. I am deeply grateful to Mr. D. E. Kimmins of the British Museum of Natural History for placing at my disposal the type specimens in the Museum collection, and for making detailed comparisons with McLachlan's types, which were received at the Museum after my visit there in 1938. As on previous occasions I am indebted to Professor Banks for many helpful suggestions and criticisms.

The morphology of the Neuroptera in general and of most of the families occurring in the Nearctic region has been extensively treated by Killington, in his excellent monograph of the British Neuroptera (1936). I have accepted in this revision the terminology and homologies proposed by him for the abdominal structures and most other parts of the body. My interpretation of the wing venation, however, is slightly different. Killington has followed Comstock's conclusions (1918) in his account of the venation of the Neuroptera; but I believe the evidence now available requires us to modify these. Martynov has demonstrated (1928) that in the existing Neuroptera the anterior branch of the media of both fore and hind wings is partially coalesced with the radius or with the stem of the radial sector (Rs), so that what appears to be the last (most proximal) branch of Rs is really part of the media, probably the anterior media of Lameere's terminology (1922). Martynov's views have been substantiated by evidence secured during the past ten years and have been applied by Tillyard (1932) and Carpenter (1935) to several groups of Neuroptera. Since I believe that Martynov's interpretation will eventually be accepted by neuropterists in general, it has been used here. This interpreta-

tion, as applied to the Hemerobiidae and related families, may be summarized as follows:

Fore wing: the *basal part of MA*, as it leaves M before coalescing with R1, can be seen in many Hemerobiidae and related families; it is the faint, obliquely transverse vein ("basal cross-vein") which has been used by Banks and others in the taxonomy of certain genera. In some species (e.g. *Hemerobius conjunctus* Fitch, *H. dorsatus* Banks) MA coalesces with R for a very short distance, the basal piece of MA joining R nearly as far distad as the point of separation of MA from R. In other species (e.g. *H. humulinus* Linn.) MA coalesces with R for a greater interval, the basal piece of MA joining R near the base of the wing. In still other species, which apparently represent a more advanced state of this evolution, MA coalesces with R from the very base of the wing, no free part of MA being discernible. In most Hemerobiid genera (apparently all except *Hemerobius*) there is a transverse vein present between MA and MP, shortly after the furcation of MP. It is my conviction that this is a true cross-vein and not the basal part of MA, because in several such species the latter is often visible at the very base of the wing. In certain genera of Hemerobiidae and related families the proximal branch of Rs has apparently migrated basally and has also become partially fused with MA; this is the case in some species (and some specimens of all species) of *Symphorobius*, *Megalomus*, *Sisyra*, *Psectra*, etc.

Hind wing: the coalescence of MA with Rs is more obvious here than in the fore wing. The basal piece of MA (termed the r-m cross-vein by Comstock) is usually longitudinally placed (except in *Berothidae*), not transversely. In many species of nearly all genera of Hemerobiidae MA is not actually coalesced with Rs but is only joined to it by a cross-vein. This apparently represents a more generalized condition than the true coalescence, the latter being the result of the shortening and subsequent elimination of the cross-vein. In certain genera of Hemerobioidea the coalescence of Rs and MA exhibits unusual features. In *Climacia* the coalescence takes place nearly at the middle of the wing, instead of close to the base of the wing; and in *Lomamyia* the basal part of MA is transverse, as in the fore wing. In most of the true Hemerobiidae (apparently all except *Psectra*) the radial sector, shortly after its origin, is joined to R1 by a cross-vein, termed in this paper the *basal radial cross-vein*. In *Hemerobius*

this cross-vein has nearly or entirely disappeared by shortening, so that Rs is in actual contact with R1. The position of this cross-vein varies greatly in the different genera; in *Kimminsia* it is proximal to the separation of MA from Rs (or of the connecting cross-vein), whereas in all other genera, so far as I am aware, it is distal to that point.

Although the families treated in this paper do not form a natural group by themselves, they do belong to one superfamily, Hemerobioidea, as defined by Tillyard (1926). Since nearly all of the Nearctic Neuroptera are referable to the Hemerobioidea, I include here a key to the families.

#### KEY TO THE NEARCTIC FAMILIES OF THE SUPERFAMILY HEMEROBIOIDEA

1. Fore legs raptorial ..... *Mantispidae*  
Fore legs cursorial ..... 2
2. Fore wings with two or more branches of Rs arising from the apparently fused stems of R1 and Rs ..... 3  
Fore wings with all branches of Rs arising from a single Rs stem ..... 4
3. Antennae of male pectinate; ovipositor exerted and long ..... *Dilaridae*  
Antennae of male moniliform or filiform; ovipositor not exerted ..... *Hemerobiidae*
4. Fore wing with recurrent humeral vein  
    *Polystoechotidae*  
Fore wing without recurrent humeral vein ... 5
5. Cross-veins of costal area forked in fore wing  
    ; ..... *Berothidae*<sup>1</sup>  
Cross-veins of costal area not forked in fore wing ..... 6
6. Sc and R1 free distally; gradate veins present  
    ; ..... *Chrysopidae*  
Sc and R1 coalesced distally; gradate veins absent ..... *Sisyridae*

#### FAMILY HEMEROBIIDAE

Antennae moniliform, multisegmented, usually nearly as long as the fore wing, the first segment enlarged; ocelli absent. Prothorax much broader than long, with the lateral margins prolonged into a lobe. Legs cursorial; all coxae well developed and free, the fore coxae especially long and slender. Abdomen cylindrical or nearly so; tenth tergite of male divided into two lateral plates, the *anal plates*; tenth sternite forming an internal plate,

<sup>1</sup> Navas (1919) has described as a *Berothid* a species from Patagonia (*Naizema patagonica*) which has a recurrent humeral vein in the hind wing as well as in the fore. It is probable that further study of this species will indicate that its affinities are really with another family.

consisting of a median *bridge*, connecting the two lateral, wing-like expansions (*wings*); the aedeagus attached to the bridge distally and supported by a median plate or two paired plates; parameres well developed, heavily sclerotized. Tenth tergite of female divided as in the male, but the plates differently shaped; eighth sternite reduced, small and heavily sclerotized.

Wings subequal. Fore wing: usually having a broader costal area than the hind; Sc terminating on the costal margin, with a series of forked veinlets connecting it to the costal margin; Rs and R1 coalesced even beyond the points of origin of several of the branches of Rs, these branches arising from the common stem of R1 and Rs (R1 + Rs); Rs with from two to many branches; anterior media (MA) coalescing with stem R1 + Rs for a short distance and arising from this stem as a branch of Rs. Hind wing: with a narrow costal space, containing unbranched veinlets; Rs not coalesced with R1 beyond the origin of any branches of Rs, as in fore wing; MA coalesced with Rs for a short interval, usually only touching it; Rs, shortly after its separation from MA is connected with R1 by a cross-vein, which is sometimes so very short that Rs itself is in actual brief contact with R1.

Very few observations have been made on the life history and general biology of the Nearctic Hemerobiidae. Of the fifty Nearctic species of the family the life-history of only six is known: *Hemerobius pacificus* Banks (Moznette, 1915); *H. humulinus* Linn. (Smith, 1923; Killington, 1937); *Micromus posticus* Hagen (Smith, 1923); *M. subanticus* Walker (Smith, 1934); *Symphorobius amicus* Fitch (Smith, 1923); *S. barberi* Banks (Smith, 1934). Fortunately, the life-history of the European species has been more thoroughly investigated, chiefly by Killington, Withycombe, and Kimmins. Of the twenty-nine species of Hemerobiidae included in Killington's monograph of the British Neuroptera, the life-history of eighteen is completely known, while that of most of the others is partially known. The following brief account of the biology of the Hemerobiidae is based mainly on the investigations of Smith in this country and those of Killington, Withycombe and a few others in Europe.

The eggs of the Hemerobiidae are elongate-oval, from .5 mm. to 1 mm. long, and usually about twice as long as wide. In most genera (e.g., *Hemerobius*, *Kimminsia*) the chorion is lightly sculptured, but in *Micromus* it is smooth. The incubation period

lasts from five to twelve days usually, but it may extend over the winter in some species. The number of eggs deposited in nature by a single female is not certainly known. Smith has noted that in the laboratory most females lay from thirty to forty eggs, but recorded one *H. humulinus* laying 460 eggs. Normally the eggs are laid singly, on leaves, twigs, or bark.

The larvae are fusiform and look much like those of the Chrysopidae, but differ in having a smaller head, shorter body, and no pulvilli in the second and third instars. They are not trash carriers like many Chrysopids.<sup>2</sup> The larvae are very active in all instars, and run rapidly, jerking the head from one side to the other as they do so. The terminal segment of the abdomen is often used to aid in walking and especially in climbing. The head is very small in proportion to the rest of the larva; the eyes contain six elements and are located directly behind the antennae; both antennae and labial palpi are three-segmented; all thoracic segments are large, the larva being broadest across the metathorax and first abdominal segment; the abdomen consists of ten segments; the legs are subequal and have a single tarsal segment. As in all other Neuropterous larvae (*Planipennia*) the mandibles and maxillae are elongate and grooved, and are fitted together so as to form a canal leading to the pharynx. The true mouth is non-functional; in fact, immediately after the larva has hatched from the egg, the integument of the head extends over the mouth and is subsequently withdrawn into the oral cavity, which is then permanently closed by the interlocking of the roof with the floor of the cavity. Liquid food is drawn up through the mandibular canal into the pharynx by the pumping action of the pharyngeal region. There is no evidence of extra-oral digestion. The digestive tract is blind, being closed at the posterior end of the mesenteron. The minute amount of solid food taken in through the mandibular canals is not eliminated until the imaginal stage is reached, when it is ejected from the anus as a hard pellet, enclosed in a peritrophic membrane. Liquid excretion in the larva is accomplished by the Malpighian tubules (usually eight). Some of these are attached to the hind

<sup>2</sup>The statement made by Sharp (1895) that some *Hemerobius* larvae carry trash has been accepted by Comstock in his *Introduction to Entomology* (1935, p. 297). It is obvious from Sharp's figure of the larva, which was reproduced by Comstock, that the insect concerned was really a Chrysopid, not a Hemerobiid.

intestine near the silk reservoir, which is a thin-walled sac, opening into the rectum. The fluid secreted by the Malpighian tubules apparently diffuses through the walls into the silk reservoir and thence passes into the rectum and anus.

As in nearly all other Neuroptera there are three larval instars, the third being the longest. The larval period is usually very short, extending from twelve to twenty-four days; but in the late fall the third instar alone may last three weeks. The number of broods annually varies specifically, as well as geographically in one species. Killington has found that the number is from one to four in the British Hemerobiids. One European species of *Hemerobius* (*stigma*) has a succession of broods, without any definite break between them, the adults being found on the wing during all months of the year. In the case of the Nearctic species of which there are extensive collecting data, I have been unable to find any breaks (exclusive of the winter months) in the records of the adult captures; this is true even of the data obtained from any one state or similar area. I am inclined to believe, therefore, that there is a succession of broods in most of our species of Hemerobiids, the adults emerging continuously from the spring through the fall.

All Hemerobiid larvae are carnivorous, feeding on a variety of small, soft-bodied insects, especially plant-lice. Some larvae show a definite host preference; this is indicated by the fact that such larvae are found only (or chiefly) on certain species of plants, with which particular species of aphidids are associated. The larvae are capable of devouring a surprisingly large number of such small insects. One larva of *Hemerobius* reared by Withycombe (1925) consumed 79 aphidids during its development; and larvae of *Kimminsia* and *Megalomus* were found by Killington to eat from 75 to 96 of the plant-lice. The highest record of food consumed is given by Laidlow (1936), who estimates from several experiments that one larva of *Hemerobius stigma* devoured on the average three thousand eggs and nymphs of an adelgid.

At the end of the last (3rd) instar the larva seeks a sheltered place, such as a crevice in bark, and there spins a cocoon. The silk is exuded from the anus, the three terminal segments of the abdomen being greatly stretched during this process. A very loose, outer frame of the cocoon is first made, and then the inner cocoon, which is composed of an open mesh of strands. The prepupal stage begins shortly after the cocoon is completed;

the head, prothorax and end of the abdomen bend downward, and the legs are drawn up. The prepupa is entirely unable to walk, or to spin another cocoon if it is removed from the first one. The prepupal stage may last from several days to several months; it is the condition in which many species hibernate. The pupal stage also may last from ten days to several months (in hibernation). Just before the adult is ready to issue, the pupa pushes its way out of one end of the cocoon and climbs to a place suitable for emergence.

The adults are usually crepuscular or even nocturnal, so that light traps provide an effective means of collecting them. They live for several months in nature, the females surviving for a longer time than the males. Both Killington and Withycombe have had representatives of several genera alive in the laboratory for two months. There are no definite records of inactive hibernation in the adult condition. The imagines are predaceous, feeding essentially on the same food as taken by the larvae; the jaws, however, are fitted for chewing, so that solid food is consumed. Three specimens of a *Megalomus* studied by Killington consumed an average of 315 female aphidids each during the nine weeks of their existence. The adults of *Hemerobius stigma* were found by Laidlow (1936) to devour on the average fifteen thousand eggs and nymphs of *Adelges* in about two months. Copulation takes place usually at night, the two insects being arranged in a linear position. Killington has described in some detail the process of mating in *Sympherobius fuscescens* (1931a): when in the presence of the female, the male runs actively about, with antennae vibrating and with the fore wings extended horizontally; on actually meeting the female, the male beats his antennae against hers for a moment, then swings about in a semi-circle and effects copulation. In this species the female regularly eats the spermatophore extracted from the male after pairing. The same behavior has been observed in other families of Neuroptera (e.g., Sisyridae) by Withycombe (1923). In most Hemerobiidae the female, after mating, usually curves the abdomen forward between the legs and brings the tip of it in contact with her mouth, suggesting the presence of a spermatophore, though none has been observed except in *Sympherobius*. Most of the Hemerobiidae, and perhaps all, respond to a disturbance during the day by feigning death.

Nothing is known of the parasites of the Near-

tic Hemerobiidae. Killington, however, has accumulated much information about parasitism in the European species. Nearly all of the parasites are Hymenoptera, these attacking the larvae. The degree of parasitism varies considerably in the different species. Killington records that six hundred Hemerobius larvae collected in 1932 showed only .5% parasitism, whereas two hundred prepupae of Wesmaelius collected during the same year had a parasitism of 6%. The larvae are also attacked by a disease similar to flacherie (Withycombe, 1923).

The generic classification of the Hemerobiidae was originally based upon their wing venation and the genera which have been long-established show marked venational differences. It is significant also that such genera likewise exhibit striking differences in genital structure. A few neuropterists, notably Krüger (1922b), have subsequently attempted to divide these into many other genera, but in nearly all cases the peculiarities indicated are either very trivial or variable within the species concerned. Of Krüger's nine genera which include Nearctic species, the following eight are clearly not valid:

1. Schneiderobius (genotype, *Hemerobius nitidulus* Fabr., European) was established to include several Palaearctic and three Nearctic species, *moestus* Banks, *simplex* Banks, and *kokaneeanus* Currie. It is not obvious just what characteristics were supposed to be peculiar to these species;<sup>3</sup> but since *moestus* and *simplex* are synonyms of *stigmaterus* Fitch, which Krüger placed in Hemerobius, it is certain that these characteristics do not hold.

2. Hagenobius was based upon five Nearctic species: *Hemerobius citrinus* Hagen (genotype), *H. hyalinatus* Fitch, *H. conjunctus* Fitch, *H. dorsatus* Banks and *H. nevadensis* Banks. These species were apparently segregated because the basal piece of MA (as interpreted above) is closer to the point of separation of MA from R than it is in most other species of Hemerobius. This

<sup>3</sup>Krüger's "monograph" of the Hemerobiidae was never completed, though the published part (Stett. Ent. Zeit., 1922, 83: 138-172) bears the subtitle, "1. Vergleichende Untersuchung des Geäders und vorläufige Übersicht und Mitteilung", and ends with the statement, "Fortsetzung im nächsten Band." Formal descriptions of his new Hemerobiid genera were not included in the published section, and it is difficult to determine from his anatomical discussion on what characteristics he intended to base his genera.

peculiarity exists in about 95% of the specimens of the species mentioned and it is a convenient one to use in a specific key; but it is certainly not constant enough for generic purposes. *H. nevadensis* furnishes a case in point. This species is a synonym of *H. simulans* Walker (which Krüger places in Hemerobius); the unique type of *nevadensis* has the basal piece of MA half-way between the basal position (as in *humulinus*) and the distal position (as in *conjunctus*).

3. Reuterobius (genotype, *Hemerobius pini* Stephens, European) included several Palaearctic and one Nearctic species, *H. cockerelli* Banks. The latter is a synonym of *conjunctus* (var. *pinidumus*) which Krüger places in Hagenobius. The genus was apparently based upon a more distal position of the basal piece of MA than was supposed to occur in Hagenobius. Such a position of this vein, however, does occur frequently in both *dorsatus* and *conjunctus*.

4. Pleomegalomus (genotype, *Megalomus pictus* Hagen, European) included one Nearctic species, *M. latus* Banks. The latter, however, is a synonym of *Megalomus moestus* Banks, which Krüger places in Megalomus. There is no mention in Krüger's paper of the reason for the new genus, but it obviously involves another variable characteristic.

5. Eurobius (genotype, *Symphorobius elegans* Stephens, European) was erected for several European and one Nearctic species, *perparvus* McLachlan. These were separated from the other Symphorobius apparently on the basis of the structure of the radial sector, which is very variable, however, in all the species of the genus.

6. Stenomicromus (genotype, *Micromus paganus* Linn., European) included, in addition to the genotype, one Nearctic species, *M. montanus* Hagen. Although it is true that *paganus* and *montanus* resemble each other more than they do other Micromus, there are no genital or other marked differences common to them.

7. Pseudomicromus was established for the single Holarctic species, *Micromus angulatus* Stephens. There are minor venational differences between this and the other Nearctic and Palaearctic species of Micromus, but they are no greater than those existing between other species of the genus. The same statement applies to the genitalia.

8. Paramicromus was erected for the Nearctic *Micromus posticus* Hagen, though Krüger took for the genotype *insipidus* Hagen, which has long been recognized as a synonym of *posticus*. There is no explanation given for this generic change,

apart from the indication that the number of inner gradate veins differs by one or two from the number in other *Micromus*. Krüger apparently had only one specimen of *posticus*, or at most only a very small series, for the number of inner gradate veins is very unstable and far exceeds the generic limits set by him. In addition to these invalid genera Krüger also erected the genus *Wesmaelius* for several European species and the Nearctic *longifrons* Banks and its synonym *transversus* Banks, all of which had previously been placed in *Boriomyia* Banks (1905b, nec 1904a). As Killington points out, *Wesmaelius* is separated from *Boriomyia* not only by the wing differences mentioned by Krüger, but also by differences in the genitalia and immature stages. I have accordingly followed Killington in accepting this genus as valid.

The family Hemerobiidae has a world wide distribution. In the Nearctic region the species of the family are more numerous in the northern part and at high altitudes than in the southern part and at low altitudes. The fifty species of the family occurring in the Nearctic region are referable to nine genera, which may be distinguished by the following key:

1. Fore wing with recurrent humeral vein ..... 2  
    Fore wing without recurrent humeral vein .... 7
2. Not more than four outer gradate veins in the fore wing ..... *Symphorobius* (p. 227)  
    Five or more outer gradate veins in the fore wing ..... 3
3. A conspicuous cross-vein present in the fore wing between MA and R5 (or R4 + 5) near the latter's origin ..... *Wesmaelius* (p. 225)  
    No such cross-vein present ..... 4
4. Rs of hind wing either in contact with R1 shortly after its separation from MA or joined to R1 by a cross-vein, which is far proximal to the origin of R5 (or R4 + 5) ..... 5  
    Rs of hind wing joined to R1 by a long (usually) cross-vein, which is very close or even distal to the origin or R5 (or R4 + 5)  
        *Megalomus* (p. 239)
5. A weak cross-vein present in fore wing between MA and MP1 + 2 shortly after the latter's origin ..... 6  
    No such cross-vein present *Hemerobius* (p. 198)
6. Basal radial cross-vein in hind wing proximal to the separation of MA from Rs *Kimminsia* (p. 214)  
    Basal radial cross-vein in hind wing distal to the separation of MA from Rs *Boriomyia* (p. 243)
7. Fore wing with costal space abruptly narrowed at the humeral angle; three or more branches of Rs arising from stem R1 + Rs  
        *Micromus* (p. 245)  
    Fore wing with costal space gradually narrowed

at humeral angle; two branches of Rs arising from the stem of R1 + Rs, one proximally and one distally ..... *Psectra* (p. 251)

#### Genus *Hemerobius* Linn.

- Hemerobius* Linnaeus, 1758, Syst. Nat., 1: 549;  
 Banks, 1905, Trans. Amer. Ent. Soc., 32: 29;  
 Killington, 1937, Monogr. Brit. Neuropt., 2: 1.  
*Schneiderobius* Krüger, 1922, Stett. Ent. Zeit., 83: 171.  
*Hagenobius* Krüger, 1922, *ibid.*, 171.  
*Reuterobius* Krüger, 1922, *ibid.*, 171.

Fore wing: oval or suboval, sometimes almost subtriangular; costal area usually broadened a short distance from the base; recurrent humeral vein present; costal veinlets forked; 2 or sometimes 3 branches of Rs arising from stem R1 + Rs (not including MA); basal part of MA usually near the base of wing, occasionally more distal, near the point of separation of MA from Rs; two series of gradate veins, with five or more in outer series.

Hind wing: Rs having very slight contact with MA, often connected by a cross-vein; Rs, shortly after separating from MA, diverges anteriorly and touches or very nearly touches R1; basal part of MA conspicuous, not usually sigmoidal; furcation of MP distal of the point of separation of MA from Rs; two series of gradate veins present, with five or more in outer series.

Anal plates of male well developed, each giving rise to a dorsal and ventral lobe or process; tenth sternite with the form characteristic of the family, the lateral plates well developed; parameres separate. Anal plates of female rounded; eighth sternite without the median sclerotized plate present in *Kimminsia*.

Genotype: *Hemerobius humulinus* Linn.<sup>4</sup> The strict application of the rules contained in the International Code of Zoological Nomenclature would require the recognition of *perla* as the genotype of *Hemerobius*, thus synonymizing the genus *Chrysopa* and the family *Chrysopidae*. The Committee on Generic Names of the Royal Entomological Society of London has proposed (Generic

<sup>4</sup>The generic name *Hemerobius* was established by Linnaeus for a group of species now relegated to a variety of genera and families. One of the species listed by Linnaeus (*perla*) was cited by Latreille (1810, Consid. gen. Anim. Crust. Arach. Ins.: 435) as the genotype of *Hemerobius*. *Perla* was also designated by Leach (1815) the genotype of *Chrysopa*, and that usage has unfortunately been followed almost without exception until the present time.

Names of British Insects, part 4, pp. 65-80, 1937) that the International Commission of Zoological Nomenclature promulgate an Opinion suspending the rules of priority in the case of these generic names. In anticipation of that Opinion, I have used the name *Hemerobius* in this paper as it has been employed in the past by nearly all entomologists. *H. humulinus* was designated the genotype by Banks (1905b).

The egg is minutely sculptured. The larvae are like those of *Kimminsia* and *Wesmaelius*, having the third antennal segment much longer than the first.

The Nearctic species of the genus have been classified in the past on a variety of characteristics, such as color of the head, the place of origin of the branches of Rs, the position of the last inner gradate vein, etc. A checking of these characteristics with the genital structure in the several thousand specimens which have passed through my hands has shown that most of them vary greatly within the species, and that they are consequently of much less taxonomic value than has been supposed to be the case. The following summary indicates the taxonomic characteristics which have been used in this paper and the extent to which they may be relied upon in general.

1. Color. The color of the body as a whole is decidedly variable, especially in dried specimens. In most species the color varies from light to dark brown. Nevertheless there are extreme conditions present in certain species; thus normal specimens of *pacificus* Banks are much lighter as a whole than those of *nigrans* n. sp., in which the body is nearly black. The color of the pronotum and mesonotum is especially helpful in the ready determination of certain species; in nearly all *Hemerobius* these nota are traversed longitudinally by a median, yellowish stripe, bordered laterally by dark brown; but in a few species (e.g. *stigmaterus*) the median stripe is reduced to a very thin line or is completely absent. The color of the wing membrane (apart from the markings) is also very variable. In nearly all of our species of *Hemerobius* there is a persistent tendency for the wings to be slightly reddish; this is almost always visible in the pterostigmal region, but it often spreads over the entire wing, as in many specimens of *stigmaterus* and *bistrigatus*.<sup>5</sup> The

wing markings, which are almost entirely confined to the fore wing, are subject to much greater variation than has been supposed. In most species the markings are of the same fundamental type, i.e., brownish maculations distributed over the entire wing; but in many species the markings are unusual because of their intensity in certain areas of the wing (e.g., *bistrigatus*).

2. Wing structure. (Figure 1.) The shape of the wing is surprisingly constant and provides the only distinction between certain species, apart from the genitalia (e.g., *pacificus* and *ovalis*, n. sp.). The shape of the costal space is very nearly the same in most members of the genus, but in

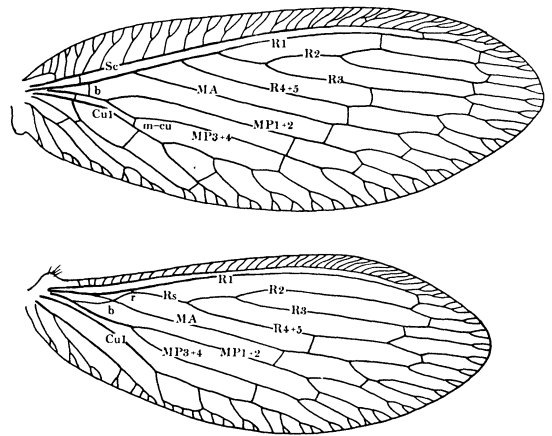


FIGURE 1. Wing venation of *Hemerobius stigmaterus* Fitch. Sc, subcosta; R1, radius; R2, R3, R4 + 5, branches of radial sector; MA, anterior media; MP, posterior media; Cu1 and Cu2, branches of cubitus; b, basal part of MA; r, basal radial cross-vein.

a few, as *costalis* and *nigrans*, n. sp., it is sufficiently different and constant to enable easy recognition of the species. The wing venation is highly variable and many of the venational characteristics formerly regarded as specific are clearly individual, e.g., the position of the last inner gradate vein of the fore wing. There are two venational features, however, which seem to be specifically constant and which are of the greatest use in the key. One of these is the position of the basal piece of the anterior media (MA) or the

of the European *Chrysopa carnea* Steph., which hibernates in the adult state, the imagines of the last brood change from green to reddish brown as winter approaches, the entire insect assuming a reddish hue. With the return of warm weather in spring the reddish color disappears and the insect becomes green again.

<sup>5</sup>There seems to be no correlation between these rufous specimens and seasonal temperature or altitude, but according to Killington (1936) in the case

basal cross-vein of Banks' terminology. In most of the Nearctic species this vein is close to the base of the wing (e.g., *humulinus* Linn.), but in several (e.g., *conjunctus*, *dorsatus*) it is further distal, nearly at the point of separation of MA from R1 + Rs. The position of this vein is constant in all but two or three per cent of the specimens; in these few exceptions it is more or less intermediate in position. The other characteristic mentioned is the point of origin of the first branch of Cu1 in the fore wing. In most species this is far distal to the m-cu cross-vein, but in some (e.g., *dorsatus*) it is at or very nearly at the cross-vein. The exceptions to this do not exceed two per cent of the specimens, so that this structure, like the foregoing one, is very useful as a key characteristic, even though it is not an absolute criterion of the species concerned.

3. Genitalia. The male genitalia provide the most stable and distinctive specific characteristics. In all of the species of the genus the male genitalia are alike in fundamental structure, so that there is no difficulty in homologizing the parts. The form of the distal processes of the anal plates is helpful in a few species only, for in most the plates are similar. The parameres also are so nearly alike that I have been unable to find specific characteristics in them. The ninth sternite and the aedeagus furnish the best differences. In the figures of the genitalia I have given two views, one lateral and one dorsal, the internal structures being indicated by dotted lines within the anal plates and the ninth sternite. The terminal abdominal segments of the female are very much alike in our species and I have found them of no taxonomic value, although Killington observed a slight difference in the form of the anal plates in the British species.

Hemerobius is a widely distributed genus, occurring in Europe, Africa, most of Asia, Java, the Philippines and both North and South America. Twelve species are found within the Nearctic region, and it is probable that a few undescribed species will eventually turn up from the northwestern states. Two of the Nearctic species (*humulinus*, *simulans*) are Old World insects, occurring in Europe and parts of Asia; eight species (*costalis*, n. sp., *conjunctus*, *simulans*, *nigrans*, n. sp., *kokaneanus*, *ovalis*, n. sp., *dorsatus*, *alpestris*) are restricted to the northern part of the Nearctic region or to high altitudes in the south; only two species (*humulinus*, *stigmaterus*) occur over all or nearly all of the region.

An unusually extensive synonymy of the Nearctic species has been created. In this revision twenty-one species have been placed in synonymy with the nine valid ones which have previously been described.<sup>6</sup>

The following key to the Nearctic species of Hemerobius has been based on wing and body characteristics which may be determined without dissection of the specimens. I have found it sufficient to give accurate determinations in about ninety-nine per cent of the individuals.

#### KEY TO THE NEARCTIC SPECIES OF HEMEROBIUS

1. Costal area of fore wing very abruptly broadened basally ..... *costalis*, n. sp. (p. 213)  
 Costal area of fore wing not abruptly broadened basally ..... 2
2. Cu1 in fore wing forked at or nearly at the m-cu cross-vein ..... 3  
 Cu1 in fore wing not so deeply forked ..... 4
3. Basal piece of MA in fore wing near or at the point of separation of MA from R1 + Rs; no conspicuous dark spot at m-cu cross-vein ..... *dorsatus* Banks (p. 211)  
 Basal piece of MA in fore wing near the base of the wing; a conspicuous dark spot at m-cu cross-vein ..... *simulans* Walker (p. 212)
4. Basal piece of MA in fore wing at or near the point of separation of MA from R1 + Rs ... 5  
 Basal piece of MA in fore wing near the base of wing or absent ..... 6
5. Fore wings heavily marked along Cu1 and inner gradate veins  
*conjunctus* var. *conjunctus* Fitch (p. 209)  
 Fore wings with faint markings along Cu1 and entirely without them  
*conjunctus* var. *pinidumus* Fitch (p. 211)
6. Fore wings with two nearly longitudinal, reddish brown streaks, one along Cu1 and the other along MA and R4 *bistrigatus* Currie (p. 208)  
 Fore wings with maculations or transverse bands only ..... 7
7. Frons mottled with dark brown spots on light brown or yellow ..... *alpestris* Banks (p. 207)  
 Frons uniformly colored or nearly so, not mottled ..... 8
8. Costal space very narrow for its whole length, only slightly widened above separation of MA from R1 + Rs ..... 9  
 Costal space at least moderately widened above separation of MA from R1 + Rs ..... 10
9. Maculations of fore wing uniform; no pronounced markings along Cu1 and inner gradate veins: body and frons black or nearly so  
*nigrans*, n. sp. (p. 207)

<sup>6</sup> This does not include the European synonymy of the two Holarctic species.



Maculations of fore wing along Cu1 and inner gradates; body and frons brown

*kokaneanus* Currie (p. 206)

10. Outline of distal half of fore wing not symmetrical with respect to the longitudinal axis of the wing ..... *pacificus* Banks (p. 203)

Outline of distal half of fore wing symmetrical with respect to the longitudinal axis of the wing ..... 11

11. Fore wing rather slender, apex pointed, median longitudinal stripe on pronotum very thin or absent ..... *stigmaterus* Fitch (p. 202)

Fore wing broad, apex more or less rounded .. 12

12. Hind margin of fore wing strongly curved ..... *humulinus* Linn. (p. 201)

Hind margin of fore wing only moderately curved ..... *ovalis*, n. sp. (p. 205)

*Hemerobius humulinus* Linn.<sup>7</sup>

Figure 2; plate 1, figure 1

*Hemerobius humulinus* Linnaeus, 1758, Syst. Nat., ed. 10, 1: 550; Killington, 1937, Monogr. Brit. Neuropt., 2: 5 (complete European synonymy).

*Hemerobius humuli* Linnaeus, 1761, Fauna suecica, 383; Walker, 1853, List Spec. Neuropt. Ins. Brit. Mus., 2: 286; McLachlan, 1868, Trans. Ent. Soc. London, 1868: 180; Banks, 1905, Trans. Amer. Ent. Soc., 32: 32.

*Hemerobius castaneae* Fitch, 1856, 1st and 2nd Rep. Ins. N. Y.: 94.

*Hemerobius tutatrix* Fitch, 1856, ibid.: 94.

*Hemerobius gossypii* Ashmead, 1895, Ins. Life, 7: 27.

*Hemerobius algonquinus* Banks, 1924, Bull. Mus. Comp. Zool., 65: 429.

*Hemerobius obliteratus* Walker, 1853, List Spec. Neuropt. Ins. Brit. Mus., 2: 289.

Head from light reddish brown to yellow; cheeks below eyes dark brown; vertex the same color as frons; pronotum, mesonotum, and metanotum with a broad median yellow or very light brown stripe, widest on mesonotum, and bordered by dark brown; abdomen brown above, light brown below. Fore wing: length (average), 8 mm.; width, 3.5 mm.; broad, subtriangular, apex pointed, at least slightly so; costal space broad proximally; veins usually conspicuously spotted; membrane

hyaline, with numerous light, grey-brown maculations; gradate veins at least lightly margined, usually brown and very conspicuous; only a small spot at the m-cu cross-vein, this spot being nearly always confined to the junction of the cross-vein with Cu; first fork of Cu1 not extending to m-cu; basal piece of MA near base of wing; two branches of Rs usually arising directly from R1 + Rs, the distal one ordinarily with only two main forks. Hind wing: hyaline, without maculations. Anal plates of male large, the upper process much larger than the lower, and possessing a prominent distal spine, which gives the appearance in lateral view

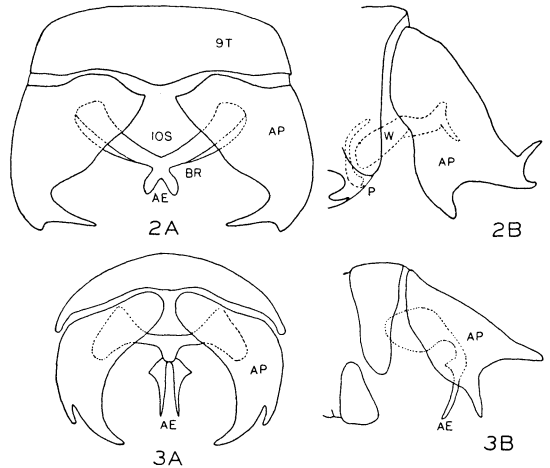


FIGURE 2. *Hemerobius humulinus* Linn. A, terminal abdominal segments of male, dorsal view; B, same, lateral view; AP, anal plate; AE, aedeagus; 9T, ninth tergite; 10S, tenth sternite; BR, bridge of tenth sternite; W, "wings" of tenth sternite; P, parameres.

FIGURE 3. *Hemerobius stigmaterus* Fitch. A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

that the upper process is forked distally; lower process of tenth tergite greatly reduced; tenth sternite small, only slightly broadened laterally; plates of aedeagus very small, divergent, as seen from above.

*Type:* The type of *humulinus* is missing from the Linnean collection in London. Since the type specimen or specimens were from Europe, I have not indicated a neotype, which should also be European.

*Distribution:*<sup>8</sup> In Canada, *humulinus* is common in the eastern provinces, as Newfoundland, Nova

<sup>7</sup>The name *humuli* has usually been used for this species in both American and European literature; but as Killington has pointed out (1931b), the spelling *humulinus* was given by Linnaeus in the 10th (1758) edition of his "Systema Naturae." The form *humuli* did not appear in print until 1761, in the "Fauna suecica."

<sup>8</sup>In recording the geographical distribution of the species considered in this paper, I have found it impracticable and usually unnecessary to publish the

Scotia, Quebec, and even in Ontario and Manitoba (Russell, Swan River, Deepdale, Hartney, Morris, Churchill); but it is rare in Saskatchewan (Indian Head, May 5, J. de Gruyse), and British Columbia (Agassiz, March 17; Vancouver, July, March). In the United States it is common from the Atlantic as far west as about the level of central Kansas, and as far south as the level of the southern borders of Tennessee and North Carolina. I have seen only one specimen from Colorado (Golden), one from Texas (no other data), and few from North Dakota (Linton, Lake Metigashe) and South Dakota (Knox). No occurrences are known to me from any Pacific or Rocky Mountain states, except the one in Colorado, nor from the Gulf states except Florida (Fort Mead). The adults have been collected from March to October, even in the more northern parts of the range. *H. humulinus* also occurs in Europe, from Spain and Corsica in the south to the Arctic Circle in the north (Killington, 1937).

In general appearance *humulinus* resembles the western *pacificus*, and the wing markings of the two are very similar. The shape of the fore wings provides the most obvious difference for separating the two insects. The costal space of *humulinus* is broader basally than that of *pacificus*; the posterior margin of the wing is nearly smoothly curved in *humulinus*, whereas in *pacificus* the distal half of the margin is nearly straight; also the wing markings (as well as the predominating wing color) are grey in most *humulinus* but yellow-brown in *pacificus*. The anal plates of the male of *humulinus* are unique in possessing an apparently forked dorsal process.

There is no question in my mind of the synonymy of Fitch's two species, *castaneae* and *tutatrix*, with *humulinus*. The types of both of these are in the Museum of Comparative Zoology, that of the former being a female and of the latter, a male. The type of *gossypii* Ashmead is apparently lost; at any rate it is not in the National Museum collection. Ashmead identified the species with the one from Georgia which Walker recognized as *humulinus* (1853, p. 286); but since Hagen

complete collecting data for all specimens. If a species has been taken at various, widely scattered localities in a state, I have merely listed that state as within the range; in such instances the insect probably occurs over all parts of that state which are ecologically satisfactory. If a species has been found at only a few localities in a state or under unusual geographical conditions, I have, of course, given complete collecting data.

had stated (1861, p. 265) that he believed Walker's Georgia specimen to be different from the European *humulinus*, Ashmead named his species *gossypii*. There is nothing whatever in Ashmead's description which enables us to recognize any one species of Hemerobius, so that our only basis for synonymizing this with *humulinus* is Ashmead's identification of his specimen as Walker's Georgia species, and Walker's determination of the latter as *humulinus*.

Banks' *algonquinus* was based upon three faded specimens of *humulinus*, one a male; the types are in the Museum of Comparative Zoology. The identity of *obliteratus* Walker has been uncertain in the past, and Banks, in his catalogue of the Neuropteroid insects of the United States (1907), was unable to place it definitely in any genus. The type, which was from Georgia, is in the British Museum, where I have been able to examine it (1938). The species is undoubtedly *humulinus*.

#### *Hemerobius stigmaterus* Fitch

Figures 1, 3; plate 1, figure 2

*Hemerobius stigmaterus* Fitch, 1853, 1st & 2nd Rep. Ins. N. Y.: 93; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 30.

*Hemerobius crispus* Walker, in part, (nec *crispus* Stephens) 1853, List Spec. Neuropt. Ins. Brit. Mus. **2**: 288.

*Hemerobius moestus* Banks, 1897, Trans. Amer. Ent. Soc., **24**: 25; 1905, *ibid.*, **32**: 31.

*Hemerobius dyari* Currie, 1904, Proc. Ent. Soc. Wash., **6**: 85; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 49.

Head reddish brown, frequently dark, face usually the same color as the vertex; pronotum with a very narrow median yellow stripe, or uniformly reddish brown; mesonotum and metanotum usually uniformly brown, rarely with a narrow median yellow stripe; abdomen brown. Fore wing: length (average), 8 mm.; width, 3 mm.; narrowly oval, apex pointed; costal area narrow basally, widest above separation of MA from Rs, flattened or even slightly concave at middle of wing; membrane hyaline, but often reddish, sometimes strongly so; maculations numerous, brown or reddish brown, sometimes very diffuse; inner gradate veins usually strongly margined, outer gradates faintly so; pterostigma usually reddish, more so than in other species; only a small spot at m-cu; basal piece of MA at base of wing; first fork of Cu1 not extending to m-cu; two

branches of Rs usually arising from R1 + Rs, the outer one with two main forks. Hind wing: membrane hyaline, often reddish; pterostigma usually reddish. Anal plates of male with the dorsal process more prominent than the lower, very strongly curved inward, as seen from above; tenth sternite of moderate size, the bridge produced into a prominent, rounded papilla, to which are attached the plates of the aedeagus; the latter bear a large, ventro-lateral tooth proximally.

*Types*: Four females, without locality data, in the Museum of Comparative Zoology; one of these, the first in the series, I have marked as the lectotype. Fitch gives no detailed collecting data in his description of this species, but states that the insect is common in "Northern and Western States." Allotype, by present designation: Pingree Park, Colorado, August 14, 1934; R. C. Smith, collector; in the Museum of Comparative Zoology.

*Distribution*: This is the most widely distributed of our Hemerobius, so far as the Nearctic region is concerned. Its general range is from Labrador to British Columbia in Canada; and across the entire United States. I have seen no specimens from Montana, North Dakota, South Dakota, Kentucky, Tennessee, South Carolina, Georgia, and the Gulf states; but the lack of specimens from these states is almost certainly due only to their not having been collected, rather than to the actual absence of the species. The collecting records of *stigmaterus* indicate that the adults may be found from March to October, even in Canada. The insect apparently hibernates in the adult stage, also, for I have seen several specimens collected in snow during January in Maryland (H. S. Barber) and during December in British Columbia.

*Stigmaterus* is the most difficult of the Nearctic Hemerobius to identify without the use of the male genitalia. The very narrow stripe on the pronotum and the slender pointed wings are the only general characteristics which are constant enough to use in separating the insect from its close relatives. The wing markings are subject to much variation, more than in any other Nearctic species of the genus. In the majority of specimens the wing membrane is hyaline and covered with many small maculations; but such specimens grade into others in which the maculations have become so diffuse as to tint most of the membrane reddish brown. In such cases the tinting is usually most noticeable along the posterior margin of the wing from the base to the

apex, extending inward to about the level of the first fork of Cu1. The color of the pterostigma of both fore and hind wings is likewise subject to much variation. In most specimens it is decidedly rufous, especially in those individuals having the diffuse wing markings; in others the pterostigma of either wing shows no trace of coloration. This characteristic, the color of the pterostigma, is therefore not a satisfactory diagnostic feature, for, as I have already mentioned, a rufous pterostigma may occur in almost any of our species of Hemerobius.

The male genitalia, on the other hand, are very distinctive. The curvature of the dorsal process of the tenth tergite can readily be seen, even without magnification; and the prominent, rounded process of the tenth sternite, at the base of the aedeagus, is a very constant and useful taxonomic structure.

The synonymy of *stigmaterus* is rather extensive, chiefly because of the variation of the wing markings. Two of the specimens (b, c, "North America") which Walker (1853) identified as the European *crispus* Stephens belong to *stigmaterus*; this has been ascertained by Kimmins' publication of a figure of the male genitalia of one of these specimens (1932, p. 87) and by my examination of the specimens themselves in the British Museum. Banks' *moestus*, which was based upon a single female now in the Museum of Comparative Zoology, is unquestionably this species. *H. dyari* Currie is likewise a synonym. This species, established for a unique female, now in the United States National Museum, was separated from *moestus* by the color of the pterostigma which, though usually reddish in *stigmaterus*, is often without color. The most obvious characteristic of *stigmaterus*, the flattened or concave costal margin, is clearly present in the type (♀) of *dyari* and is mentioned by Currie in his description. The unique type (♂) of *simplex* Banks, now in the Museum of Comparative Zoology, although slightly smaller than most specimens of *stigmaterus*, has the wing markings and genital structure typical of the latter.

*Hemerobius pacificus* Banks

Figure 4; plate 1, figure 3

*Hemerobius pacificus* Banks, 1897, Trans. Amer.

Ent. Soc., **24**: 24; 1905, *ibid.*, **32**: 33.

*Hemerobius pallescens* Currie, 1904, Proc. Ent. Soc. Wash., **6**: 80.

*Hemerobius discretus* Navas, 1917, Mem. Pont. Acad. Rom., ser. 2, **3**: 5.

Head with face and vertex yellow to light brown, sometimes slightly reddish; pronotum usually with a wide median yellow stripe, rarely uniformly light brown; mesonotum mostly yellow, bordered laterally by dark brown. Fore wing: length, 9-10 mm.; width, 3.7-4 mm.; broadly triangular; posterior margin more or less straight for its distal half, not smoothly curved as in *humulinus*; costal area wide, more so basally than in *ovalis* n. sp.; membrane hyaline, maculations distinctly yellow-brown; gradate veins usually only faintly margined; spot at m-cu reduced, often absent; basal piece of MA at base of wing; first

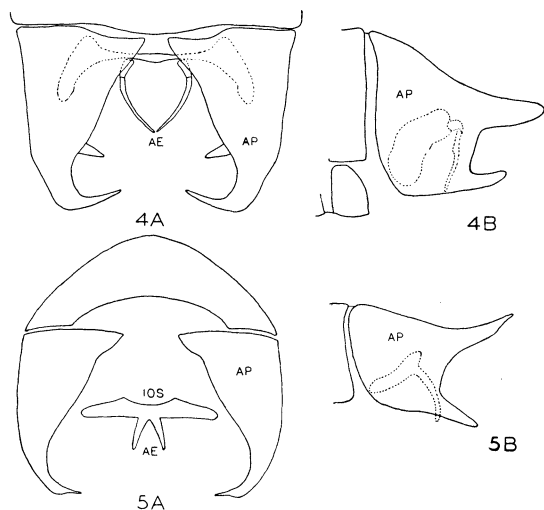


FIGURE 4. *Hemerobius pacificus* Banks. A, terminal abdominal segments of male (lectotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

FIGURE 5. *Hemerobius ovalis*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

fork of Cu1 not extending to m-cu; two branches of Rs usually arising from R1 + Rs, the outer one with two main forks. Hind wing: hyaline, without maculations. Anal plates of male with the dorsal process much larger than the lower and abruptly curved inward distally; tenth sternite of normal size, the lateral extremities not greatly extended; plates of aedeagus slender, directed ventrally, not curved when seen in lateral view, but curved towards each other, their bases widely separated.

*Types*: In his description of *pacificus* Banks mentioned two types, both from Olympia, Washington (T. Kincaid). Only one of these, a male, is in the Museum of Comparative Zoology; this is here designated the lectotype. I have been

unable to locate the other specimen from Olympia. Allotype, by present designation: Corvallis, Oregon, December 10, 1913; in the Museum of Comparative Zoology.

*Distribution*: BRITISH COLUMBIA; ALASKA (Ft. Yukon, Savonoski); ALBERTA (Banff, Laggan); SASKATCHEWAN (Saskatoon); WASHINGTON; OREGON; CALIFORNIA; UTAH (Monticello, Logan, Richfield, Eureka); NEW MEXICO (Socorro Co., Sante Fe, Los Lunas); ARIZONA; COLORADO (Boulder, Ft. Collins, La Veta Pass, Colorado Springs); IDAHO (Wallace); TEXAS (Ft. Davis, Jeff Davis Co., 5000 ft., Mrs. O. C. Poling). The adults of this species have been found in most of the states and provinces from April through October; but they have also been collected in December, February and March (Oregon; British Columbia) and even January (Seattle, Washington). The general range of this insect is clearly the western part of the Nearctic region, from the Pacific to the eastern limits of the Rocky Mountains; but it is much more common in the Pacific states than further inland. I have seen one specimen of this species labelled Lincoln, Nebraska (April 10, 1908); the determination is certain because the insect is a male, but I am doubtful of the authenticity of the locality data.

In its general appearance *pacificus* resembles *humulinus* and even more closely *ovalis*, n. sp. The wings of *pacificus* are broadly triangular, as in *humulinus*, but the apical margin has a very different contour (plate 1, figs. 1, 3), the costal area is differently shaped, and the wing markings are slightly different in color. *Pacificus* can also be distinguished from *ovalis*, n. sp., by the shape of the wing, which is broadly and symmetrically rounded apically in the latter. The male genitalia are like those of *ovalis*, n. sp., in general form, but differ chiefly in the shape and position of the plates of the aedeagus.

The type (♀) of *pallescens* Currie, from Humboldt Co., California, and now in the United States National Museum, is clearly *pacificus*. Navas' *discretus*, the type of which was collected at Jemez, New Mexico, is probably *pacificus*. The type was originally in the Navas collection and its present location is unknown to me. No figure accompanies the description, and although Navas states that the insect resembles *hyalinatus* (*pinidumus*), I doubt very much that he knew the latter species. Navas describes the prothorax as having a median yellow stripe bordered by reddish

brown. This almost certainly excludes *stigmaterus* as an identical species, and leaves *pacificus* as the only Hemerobius known from the southwestern states which fits Navas' description. The yellow markings on the wings of *discretus* are especially characteristic of *pacificus*. Tentatively, therefore, I have synonymized *discretus* with the latter.

**Hemerobius ovalis**, n. sp.

Figure 5; plate 1, figure 5

Head with face varying from yellow to brown; vertex usually yellow or light brown; pronotum with a prominent median yellow stripe, bordered by darker brown; mesonotum and abdomen mostly light brown. Fore wing: length, 8-9 mm.; width, 2.8-3 mm.; oval, with a broadly rounded apex; costal area not so broad as in *pacificus*; wing membrane hyaline, veins light brown, maculations light brown; inner and outer gradates usually distinctly margined with brown; spot of m-cu small; basal piece of MA at base of wing; first fork of Cu1 not extending to m-cu; two branches of Rs arising from R1 + Rs, the outer with two main forks. Hind wing: hyaline, without maculations. Anal plates of male with the dorsal process larger than the lower and curved inward distally; tenth sternite small, its lateral extremities not much expanded, but with a prominent dorsal, acute projection at the extremities of the bridge; plates of aedeagus prominent, curved ventrally; their bases are close together, but the plates diverge widely, though curved toward each other distally.

*Holotype* (♂): Claremont, California (C. F. Baker); in the Museum of Comparative Zoology. Allotype: Great Alpine Creek, Tahoe, California, July 5, 1915 (E. P. Van Duzee); in the Museum of Comparative Zoology.

*Paratypes*: 1 ♂, Santa Paula, California, October 11, 1917 (Woglum); 1 ♀, Gilroy, California, June (Crotch); 1 ♀, Comox, British Columbia, June 26, 1933 (J. McDunnough); 1 ♂, Nordegg, Alberta, June 12, 1921 (J. McDunnough); 1 ♀, Nordegg, June 23, 1921 (J. McDunnough); 1 ♀, Nordegg, July 29, 1921; 1 ♀, Pavilion Lake, British Columbia, June 7, 1938 (J. K. Jacob); 1 ♂, Seton Lake, Lillooet, British Columbia, May 28, 1926 (J. McDunnough); 1 ♀, Salmon Arms, British Columbia, March 2, 1925 (E. R. Buckell); 1 ♀, Nordegg, June 29, 1921 (J. McDunnough); 1 ♀, Nicolaus, California, July 27, 1935 (R. H. Beamer); all in the Museum of Comparative Zoology.—1 ♀, Nordegg, Alberta, July 21, 1921 (J. McDunnough);

2 ♀, Nordegg, July 29, 1921; 2 ♀, Nordegg, July 4, 1921; 1 ♀, Nordegg, June 22, 1921; 1 ♀, Nordegg, June 26, 1921; 1 ♀, Nordegg, June 28, 1921; 1 ♀, Nordegg, June 27, 1921; 1 ♂, Vancouver, British Columbia, August 22, 1926 (J. Stanley); 1 ♂, Vavenby, British Columbia, October, 1921 (T. A. Moillier); 1 ♂, Departure Bay, British Columbia, July 8, 1929; 1 ♀, Oliver, British Columbia, July 26, 1933 (C. B. Garrett); 1 ♀, Oliver, July 24, 1933; 1 ♀, Oliver, May 16, 1923; 1 ♀, Victoria, British Columbia, September 28, 1927 (W. Downes); 1 ♂, Oliver, August 2, 1923; 1 ♀, Oliver, June 5, 1923; all in the Canadian National Collection, Ottawa.—1 ♂, San Francisco, California, July 24, 1925 (H. H. Kiefer); 1 ♀, Paradise Valley, Mt. Ranier, Washington, July 25, 1920 (E. C. Van Dyke); 1 ♂, Nanaimo, Biol. Sta., British Columbia, June 24, 1920 (E. C. Van Dyke); 1 ♂, Clarksburg, Solano Co., California, July 24, 1931 (A. T. McClay); all in the California Academy of Sciences.—1 ♀, Los Angeles, California; 1 ♂, same June 10 (Dyar and Caudell); 1 ♀, Fks. Logan Canyon, Utah, March 12, 1934 (W. H. Thomas); 1 ♀, Sacramento, California, September, 1928 (R. A. Blanchard); all in the United States National Museum.—1 ♂, Nicolaus, California, June 27, 1935 (R. H. Beamer); 1 ♀, same, July 27, 1935; both in University of Kansas Museum.

*Distribution*: CALIFORNIA; BRITISH COLUMBIA; ALBERTA; ALASKA (Virgins' Bay, Tanana); WASHINGTON; WYOMING (Yellowstone National Park); OREGON (Independence); UTAH (Logan, Richfield). The adults have been collected from March to November. The species doubtless occurs also in Montana, Idaho and Nevada.

*Ovalis* resembles *pacificus* in general appearance and it has been nearly consistently confused with it in the past. The existence of the species did not in fact come to my attention until I had observed the striking differences in the structure of the male genitalia. The wings of *ovalis* differ from those of *pacificus* mainly in the slightly narrower costal space basally and the symmetrically rounded apex. The male genitalia show greater differences from those of *pacificus* than one would expect from the similarity of the rest of the insects. The bases of the plates of the aedeagus, which are widely separated in *pacificus*, are contiguous or nearly so in *ovalis*.

It is interesting to note that this insect has a range somewhat like that of *pacificus*, except that

it is apparently absent from Arizona and New Mexico, where the latter is common.

*Hemerobius kokaneeanus* Currie

Figure 6

*Hemerobius kokaneeanus* Currie, 1904, Proc. Ent. Soc. Wash., **6**: 85; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 31.

*Hemerobius hesperus* Banks, 1924, Bull. Mus. Comp. Zool., **65**: 429.

Head light brown or brown, vertex lighter in color than face; pronotum with a median yellow or light brown stripe (sometimes not clearly defined), bordered by darker brown; mesonotum and metanotum mostly yellowish or light brown, often darker laterally; abdomen light to dark brown. Fore wing: length, 6-6.5 mm.; width, 6.2-6.4 mm.; slender, long, with the apex broadly rounded; costal area exceedingly narrow proximally and not much widened beyond; membrane either hyaline or distinctly brown, especially posterior half; maculations brown, usually very well developed along Cu1 and the inner gradate veins and along the longitudinal veins between the two sets of gradates; maculations at m-cu prominent; basal piece of MA at base of wing; Cu1 not forked to m-cu; two branches of Rs arising from stem R1 + Rs, the outer one with two main forks. Hind wing: membrane usually tinted with brown, frequently distinctly smoky. Anal plates of male with the upper process larger than the lower, and curved inwards, much as in *stigmaterus*; tenth sternite small, with a prominent dorsal protuberance on each "wing"; plates of aedeagus nearly straight, and with a prominent ventral tooth towards the inner side; between the plates of aedeagus there is a conspicuous sharp tooth arising from the tenth sternite.

*Holotype* (♀): Kokanee Mt., British Columbia, 9000 ft., August 10; in the United States National Museum. Allotype, by present designation: Thompson, Montana, August 25, 1918 (A. L. Melander); in the Museum of Comparative Zoology.

*Distribution*: BRITISH COLUMBIA (Hedley, August, C. B. Garrett; Kokanee Mt.; Ainsworth, April 22, 1938, G. S. Walley); WASHINGTON (Pullman); CALIFORNIA (Tahoe, July 10); MONTANA (no other data); COLORADO (Pine-gree Park, August, 10,000 ft., C. W. Sabrosky); QUEBEC (Cascapedia R., August 27, August 9, June 3, June 11, M. L. Prebble, W. J. Brown).

This small species may be readily recognized by

the narrow costal space and the slender fore wings having rounded apices. The color markings are somewhat variable, but the well developed maculations along Cu1 and the inner gradate veins are usually present. In respect to wing markings this species resembles *conjunctus*. The male genitalia are like those of *ovalis* in general form and especially in the shape of the tenth sternite, but the latter species lacks the tooth between the plates of the aedeagus. The color of

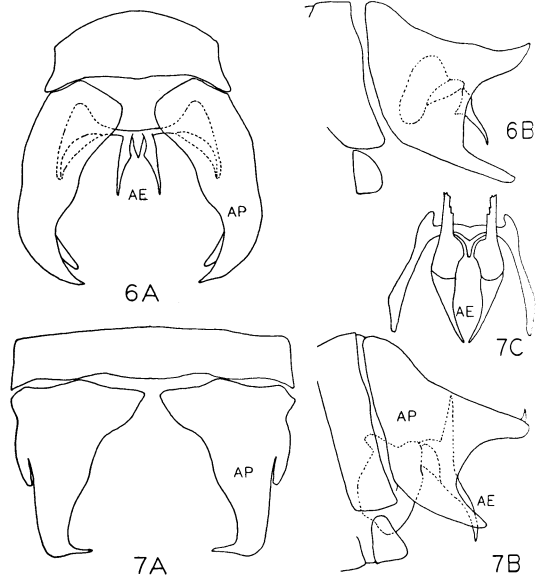


FIGURE 6. *Hemerobius kokaneeanus* Currie. A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

FIGURE 7. *Hemerobius nigrans*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, lateral view; C, dorso-posterior view of tenth sternite and aedeagus. Lettering as in figure 2.

the wings is subject to extensive individual variation. The few specimens which I have seen indicate a correlation between the intensity of the brown color of the maculations and the season, specimens collected from April to June being much lighter than those collected in August. A larger series of individuals, however, might disprove this suggestion.

*Hesperus* Banks was described from two females collected at Tahoe, California. One of these types is in the Museum of Comparative Zoology, and it is clearly *kokaneanus*.

The occurrence of this species in Quebec is very interesting in view of the fact that all other records of the insects are western. Since several

specimens of both sexes were collected in Quebec by different individuals and at different times, the locality data and the determination seem to be dependable. Apparently *kokaneanus* is essentially a northern species which extends across Canada and enters into the United States only at high altitudes.

***Hemerobius nigrans*, n. sp.**

Figure 7

Head black, vertex nearly black, with a faint indication of some brown; antennae grey; pronotum and mesonotum uniformly black or very dark brown, sometimes a very faint indication of a thin, lighter, median streak on pronotum; abdomen dark brown. Fore wing: length, 6 mm.; width, 2 mm.; slender, oval, the apex rounded; costal area narrow, much as in *kokaneanus*; membrane hyaline, but with many large, dark grey-brown maculations, those around the inner gradate veins usually fused to form one or two large spots, though these are no darker than the smaller maculations; spot at m-cu of the same color as other maculations; basal piece of MA at base of wing; 2 branches of Rs arising from stem R1 + Rs, the outer one with two main forks; first fork of Cu1 not extending to m-cu. Hind wing: hyaline, but with some indication of a brownish tint, occasionally smoky. Anal plates of male with the upper process larger than the lower and bearing distally a conspicuous tooth, which is directed inwards; tenth sternite and plates of aedeagus large, the former with greatly expanded extremities and a small dorsal tooth at the ends of the bridge; the plates of the aedeagus extend upwards beyond the tenth sternite, forming a pair of processes nearly as long as the rest of the plates; these upper processes have several fine teeth distally and along the inner margin; lower part of plates converging, the apices nearly touching between the plates the tenth sternite projects slightly in the form of a shallow tooth.

*Holotype* (♂): Mt. Lolo, Kamloops, British Columbia, June 2, 1938 (J. K. Jacob) in Canadian National Collection. Allotype: same collecting data as holotype; also in Canadian National Collection.

*Paratypes*: 1♂, with same collecting data as holotype; 1♀, Clinton, British Columbia, June 13, 1938 (G. S. Walley); 1♂, Great Alpine Creek, Tahoe, California, June 21, 1915 (E. P. Van Duzee); all in the Museum of Comparative Zoology.—1♀, Yellowstone Nat. Park, Wyoming,

July 19, 1930 (E. C. Van Dyke); in the California Academy of Sciences.—1♀, Laramie, Wyoming, July 5, 1938; in R. C. Smith collection.

In addition to the types, I have seen five other specimens: 1♀ from Longs Peak, Colorado, 9000 ft., July 1, 1926 (E. C. Van Dyke); 1♀, Mt. Kaiser, Fresno Co., California, 10,000 ft. (E. P. Van Duzee); 1♀, La Veta Pass, Colorado, June 27; 1♀, Aspen Grove, British Columbia, May 3, 1934; 1♂, Crabtree Meadow, 10,550 ft., Tulare Co., California, July 29, 1935.

This strikingly marked species is much like *kokaneanus* in size and shape of the wings; but it is at once distinguished by the uniformity of the maculations on the wings and the black color of the body. The male genitalia are remarkable for the dorsal extension of the plates of the aedeagus. The species will probably turn up at high altitudes throughout the western states.

***Hemerobius alpestris* Banks**

Figure 8

*Hemerobius alpestris* Banks, 1908, Trans. Amer. Ent. Soc., **34**: 261.

Head brown, but with face mottled with very dark brown; one dark stripe between antennae and two thin vertical stripes on each side of the face; clypeus usually very dark brown; rest of face light brown or yellow; vertex usually median brown, with a thin stripe of dark brown bordering the antennal sockets; pronotum usually uniformly medium brown, sometimes with a faint indication of a thin, median stripe; mesonotum uniformly brown; abdomen brown. Fore wing: length, 7 mm.; 3 mm.; broadly oval; costal area very narrow, but abruptly widened above separation of MA from Rs; membrane either hyaline or somewhat smoky, especially along the posterior border; veins brown, maculations medium brown, never dark brown, and of nearly uniform intensity; spot at m-cu nearly absent; basal piece of MA at base of wing; first fork of Cu1 not reaching to m-cu; two branches of Rs arising from R1 + Rs, the outer with two main forks. Hind wing: hyaline or slightly smoky, without maculations. Anal plates of male with the dorsal process bearing a slender, distinct tooth on the inner margin near the apex; ventral process much reduced; tenth sternite of moderate size, the lateral extremities extended forwards and forming a point; plates of aedeagus straight from above and nearly straight from the side; the bridge extended in the form of a small tooth between the plates of the aedeagus,

*Holotype* (♂): Sugar Loaf Mt., Colorado, May 13 (S. A. Rohwer); in the Museum of Comparative Zoology. Allotype, by present designation: Pingree Park, Colorado, August 14, 1934 (R. C. Smith); in the Museum of Comparative Zoology.

*Distribution*: COLORADO (Longs Peak, Rocky Mt. Nat'l. Park, 9000 ft., July 12, and June 30, E. C. Van Dyke; Mt. Manitou, June 21; Pondre Canyon, August 22, 1925, R. H. Beamer, P. W. Lawson; Pingree Park, 9000 ft., August; ARI-

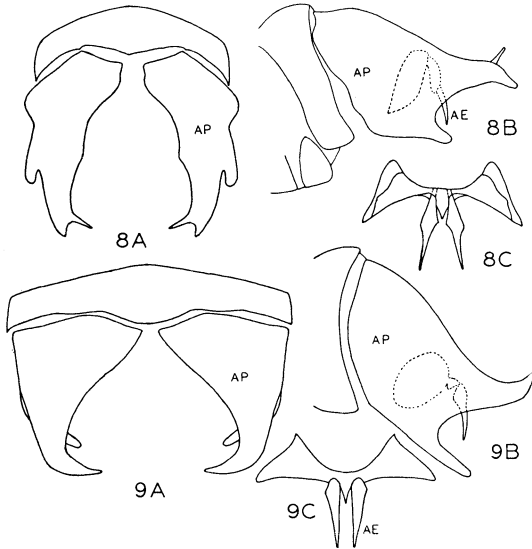


FIGURE 8. *Hemerobius alpestris* Banks. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, dorso-posterior view of tenth sternite and aedeagus. Lettering as in figure 2.

FIGURE 9. *Hemerobius bistrigatus* Currie. A, terminal abdominal segments of male (allotype), dorsal view; B, lateral view; C, posterior view of tenth sternite and aedeagus. Lettering as in figure 2.

ZONA (Mt. Lemon, Catalina Mts., 7000 ft., July 26; Chiricahua Mts., Cochise Co., 8-9000 ft., July 15).

This species resembles *stigmaterus* superficially, having a similarly colored thorax. It is unique among our species, however, in possessing a mottled face and the abruptly broadened costal area, which is nevertheless narrow at the base. It is evidently confined to high altitudes; none of the specimens which I have seen were collected under 8000 ft. It is probably common locally, for Dr. Smith secured nine specimens in a short time at Pingree Park in Colorado.

*Hemerobius bistrigatus* Currie

Figure 9; plate 1, figure 4

*Hemerobius bistrigatus* Currie, 1904, Proc. Ent. Soc. Wash., 6: 79.

Face and vertex usually light brown or yellow, face sometimes darker than vertex, cheeks dark brown; pronotum with a wide median yellow stripe bordered by dark brown; mesonotum mostly light brown or yellow, bordered by darker brown; abdomen brown. Fore wing: length (average), 7 mm.; width, 3 mm.; oval, apex rounded; costal area narrow, almost as in *kokaneeanus*; wing membrane mostly tinted yellow or very light brown, except for the area between the two streaks mentioned below, which is hyaline; gradate veins not margined, and true maculations, when present, occur only along R1 + Rs; MA usually strongly margined with dark brown to the middle of wing, R4 + 5 being margined from there to apex; Cu1 and MP margined distally; two conspicuous longitudinal streaks are formed by the margination of these veins; free piece of MA present at base of wing; Cu1 not forked to m-cu; two branches of Rs arising from R1 + Rs, the outer with two main forks. Hind wing: usually hyaline, but often yellowish. Anal plates of male very much like those of *kokaneeanus*, the dorsal process of the plates being much larger than the lower and curved inward distally; lower process straight; tenth sternite with a prominent dorsal, acute projection, and with an acute tooth between the plates of the aedeagus; the latter straight and nearly parallel.

*Holotype* (♀): Little River, Humboldt Co., California, May 31; in the United States National Museum. Allotype, by present designation: Boyer, Oregon, August 15, 1937; in the Museum of Comparative Zoology.

*Distribution*: CALIFORNIA (Humboldt Co.; San Francisco, March 5, F. X. Williams; Fallen Leaf Lake, Tahoe, July 14, E. C. Van Dyke); BRITISH COLUMBIA (Vancouver, February 1 and March 8, 1931, H. B. Leech); OREGON (Boyer, May 6, July 29, August 3 and 15); IDAHO (Priest Lake, June 3, A. L. Melander).

This rare species has strikingly marked wings, which enables easy recognition of most specimens. These wing markings are very variable, however; in some specimens the margination of the veins extends to the base of MA and Cu1, whereas in others it does not extend proximally to the middle of the wing. In some specimens, also, the wing membrane is perfectly clear, while in others it is



very yellow. The pterostigma is frequently reddish, which was probably responsible for Banks' synonymizing *bistrigatus* with *stigmaterus* (*moestus*). That *bistrigatus* is distinct from *stigmaterus* is proven by the difference in the male genitalia. The genital structure of *bistrigatus*, though very different from that of *stigmaterus*, is remarkably similar to that of *kokaneeanus*; the only very obvious difference is in the form of the plates of the aedeagus; in *kokaneeanus* these diverge, whereas in *bistrigatus* they are parallel. This is a surprisingly trivial difference in view of the great discrepancy in wing markings.

*Hemerobius conjunctus* var. *conjunctus* Fitch

Figure 10

*Hemerobius conjunctus* Fitch, 1856, 1st and 2nd Rept. Ins. N. Y.: 94; Hagen, 1861, Synop. Neuropt. N. A.: 203; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 35.

*Hemerobius venustus* Banks, 1897, Trans. Amer. Ent. Soc., **24**: 25; Banks, *ibid.*, **32**: 49.

*Hemerobius citrinus* Hagen, 1861, Synop. Neuropt. N. A.: 204; Krüger, 1922, Stett. Ent. Zeit., **83**: 153.

*Hemerobius glacialis* Currie, 1904, Proc. Ent. Soc. Wash., **6**: 88.

*Hemerobius caudelli* Currie, 1904, *ibid.*, p. 87.

*Hemerobius kootenayensis* Currie, 1904, *ibid.*, p. 88.

*Hemerobius cockerelli* Banks, 1901, Psyche, **9**: 286.

Head with face and cheeks dark reddish brown, frequently almost black; vertex yellow or light brown, often slightly reddish, but always lighter than most of face; antennae yellow; pronotum, mesonotum and metanotum with a wide median yellow stripe, bordered laterally by dark brown, which is usually darker on the pronotum than on the following segments; abdomen light to dark brown. Fore wing: length, 5.3 to 8 mm.; width, 3 to 3.5 mm.; oval, slightly pointed; costal area of moderate width, about as in *dorsatus*; membrane hyaline, maculations grey-brown; most of the maculations are faint, but a larger and darker spot is present in the region of the fork of MP and the first fork of Cu1, the latter one being much longer than that of *simulans*; smaller dark spots are also present on Cu1 distally and along the inner and outer gradate veins, the latter therefore being heavily and broadly margined; basal piece of MA usually at or near the point of separation of MA from Rs; first fork of Cu1 not extending to m-cu cross-vein; two branches of Rs arising directly from R1 + Rs, the outer

with two main forks. Hind wing: hyaline, without maculations. Anal plates of male with the lower process slender and longer than the dorsal one, which is curved inwards; tenth sternite rather small, the lateral plates not greatly extended; plates of aedeagus widely separated, with a shallow tooth between them, and each plate with a prominent ventral tooth proximally, readily visible in lateral view.

*Holotype* ( $\delta$ ): (no locality data) in the Museum of Comparative Zoology; the specimen was probably collected in New York, for Fitch, in his report on the New York insects, usually

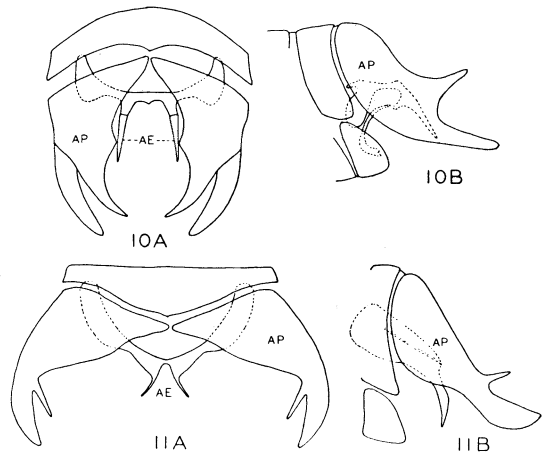


FIGURE 10. *Hemerobius conjunctus* var. *conjunctus* Fitch. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

FIGURE 11. *Hemerobius dorsatus* Banks. A, terminal abdominal segments of male (lectotype), dorsal view; B, same, lateral view. Lettering as in figure 2.

mentioned the state in which his specimens were collected if they were not secured in New York. Allotype, by present designation: Baddeck, Cape Breton, Nova Scotia, September 14, 1931 (A. G. B. Fairchild).

*Distribution*: LABRADOR (Hopedale, July, W. W. Perrett); NEWFOUNDLAND (St. Johns, June); QUEBEC (Cascapedia; Seven Isles, July 28; Knowlton, August; Kazubazun, June; Bradore Bay, July); NOVA SCOTIA (Kentville, June, July; S. Milford, June); PRINCE EDWARD ISLAND (Hampton, August); MAINE (Mt. Katahdin); VERMONT (White Horse, July 3, H. G. Dyar); NEW HAMPSHIRE (Mt. Washington; Ossipee Mt., August); NORTH CAROLINA (Black Mts., June); TENNESSEE (Newfound Gap, Smoky Mts., September); ON-

TARIO (Biscotasing, June–September; Ottawa, April); SASKATCHEWAN (Indian Head, June, August, J. de Gryse); ALBERTA (Lake Louise, August 16, 5600 ft., G. S. Walley; Moraine Lake, August 1, J. McDunnough); BRITISH COLUMBIA (Clinton, June 19, 1938, J. K. Jacob; Nelson, June 1, A. A. Dennys; Kootenay District, July); ALASKA (Healy, June 24, J. M. Aldrich; Savoniski, Naknek Lake, July, A. J. Basinger); MONTANA (No other data); WYOMING (West Yellowstone, July 16, E. C. Van Dyke); COLORADO (Pingree Park, August 14, R. C. Smith; Sherbon, Eagle Co., 7900 ft., August 11, C. Clagg; Gothic, 9500 ft., July 16, C. P. Alexander; Rocky Mt. National Park, July 25, H. H. Ross; Berthoud Pass, 10,000 ft., July 24, H. H. Ross); NEW MEXICO (Las Vegas, August, H. S. Barber; Las Vegas Mts., T. D. A. Cockerell; Taos, August 20, 1923, R. H. Beamer).

This is a northern insect; it is mainly Canadian, extending into the United States only along the Rocky and Appalachian Mountain ranges. Although I have seen a great many specimens of *conjunctus*, they have been collected at widely scattered localities, which have consequently been recorded above.

This species apparently exists in two forms. The typical one (var. *conjunctus*) is heavily marked and easily recognized; the other form (var. *pinidumus* Fitch), which is redescribed below, differs in having almost no wing markings whatever, in addition to being much smaller. Most of the specimens which I have seen of these forms are strikingly different, but I have been led to regard them only as forms of one species for two reasons. In the first place, some of the smaller specimens possess definite markings and more or less grade into the typical *conjunctus*; and secondly, the male genital structure of the two is absolutely identical, even in the complicated details. The typical *conjunctus* is much more common than the smaller and paler form. Many entomologists would doubtless question the status of *pinidumus* as a variety or form of any sort, since its geographical range is within that of the typical *conjunctus*. However, inasmuch as the pale form has been described as a separate species, I have considered it advisable to retain a varietal name for such individuals.

The genital structure of the males of *conjunctus* resembles superficially that of *stigmaterus*, at least when viewed from above; but the aedeagus and tenth sternite are very different. The plates of the

aedeagus are unlike those of most of our Hemerobius in that they are widely separated proximally. The wing markings of var. *conjunctus* are very distinctive. The long, dark brown maculation on the fore wing, extending from the fork of MP to the first fork of Cu1, and the heavy spots along Cu1 and the inner gradates are a combination not found in other species. The position of the free part of MA in the fore wing adds to the obvious features of this insect, although that condition also occurs in var. *pinidumus*. In spite of the fact that the position of the free part of MA is subject to some individual variation, in fully 90% of the specimens of *conjunctus* which I have seen this part of the vein is close to its separation from Rs.

An extensive synonymy of var. *conjunctus* has been established. The type of *cockerelli* Banks (in the Museum of Comparative Zoology) is a male and an examination of its genital structure shows it to be *conjunctus*. The other species which have been placed above as synonyms of *conjunctus* are based upon females, with the possible exception of *citrinus*; but their wing structure and markings clearly indicate their specific identity. *Venustus* Banks (type in the Museum of Comparative Zoology) was founded on a heavily marked specimen of *conjunctus* and has already been placed in synonymy of the latter by its author (Banks, 1905b, p. 49). Currie's three species (*glacialis*, *caudelli*, *kootenayensis*), the types of which are in the United States National Museum, were based upon unique females collected in the Kootenay District of British Columbia, and were separated from previously described species on the size (alar expanse greater or less than 12 mm.), or on the position of one of the gradate veins, or on the position of the point of forking of the "third radial sector." These venational details are of course subject to great individual variation, as I have pointed out above, and have no specific value. In all respects the types, which I have been able to examine, are typical *conjunctus*. *Citrinus* was described very briefly by Hagen (1861) and no collecting data were given except "North America." Hagen did mention that the wings were yellow; and Krüger (1922b), who has examined the type in the Berlin Museum, states that the free basal piece of MA (in the terminology of the present paper) is close to the separation of MA from Rs. *Conjunctus* is the only Nearctic species to which these two characteristics would apply.

*Hemerobius conjunctus* var. *pinidumus* Fitch  
*Hemerobius pinidumus* Fitch, 1856, 1st and 2nd  
 Rep. Ins. N. Y.: 95.

*Hemerobius hyalinatus* Fitch, 1856, *ibid.*, 95.

*Hemerobius canadensis* Banks, 1897, *Trans. Amer. Ent. Soc.*, **24**: 26.

Head varying from yellow to light brown, the face usually darker than the rest, as in var. *conjunctus*; pronotum with a median yellow stripe, bordered by dark brown; mesonotum and metanotum light brown, almost uniformly colored, the lateral margins only slightly darker than the median area; abdomen brown. Fore wing; length, 5-6 mm.; width, 2.5-3 mm.; membrane hyaline, often lightly tinted with yellow-brown; costal area as in var. *conjunctus*; wing markings usually absent, but occasionally a faint indication of them is present; MA as in var. *conjunctus*; first fork of Cu1 not extending to m-cu; Rs as in var. *conjunctus*. Hind wing: hyaline, sometimes faintly yellow, without maculations. Male genitalia as in var. *conjunctus*.

*Holotype* (♂): (no locality data) in the Museum of Comparative Zoology; the specimen was probably collected in New York State, as in the case of the type of var. *conjunctus*. Allotype, by present designation: Aylmer, Quebec, July 29, 1927 (G. S. Walley); in the Museum of Comparative Zoology.

*Distribution*: QUEBEC (Kazubazun, August 16, G. S. Walley; Fairly Lake, May, June, R. Ozburn; Aylmer, July 29, August 3, G. S. Walley; Covey Hill, July 2; Sherbrooke, May 10); MAINE (N. E. Bay); NEW HAMPSHIRE (Hampton, May 10, S. A. Shaw); MASSACHUSETTS (Cambridge); NEW YORK (Ithaca, May 17); WISCONSIN (Brule, August 16); MINNESOTA (Cass Lake, August 1, R. H. Daggy); COLORADO (Longs Peak, 9000 ft., July 12, E. C. Van Dyke); BRITISH COLUMBIA (Kamloops, August 1, G. J. Spencer).

This form differs from the typical one by its smaller size and the absence of wing markings, although in some specimens there is an indication of the markings as present in the latter. *Hyalinatus* Fitch, the type (♂) of which is in the Museum of Comparative Zoology, is a synonym of this form. *Canadensis* Banks, the type (♀) of which is in the same Museum, is also a synonym and since 1907 has been so regarded by Banks.

*Hemerobius dorsatus* Banks

Figure 11; plate 1, figure 7

*Hemerobius dorsatus* Banks, 1904, *Can. Ent.*, **36**:

61; Banks, 1905, *Trans. Amer. Ent. Soc.*, **32**: 34.

Head and face yellow or light brown, usually with a narrow, median dark brown stripe leading up from the clypeus; antennal sockets margined with dark brown; pronotum, mesonotum and metanotum with a continuous light brown or yellow median stripe, bordered by dark brown; abdomen dark brown. Fore wing: length (average) 9 mm.; width, 3.7 mm.; broadly oval; apex rounded; costal area much broader basally than in *simulans*; membrane hyaline with many brown maculations; veins brown, usually light; gradate veins margined lightly with brown; only a small brown spot at the first fork of Cu1 and usually two similar spots more distally on Cu1; basal part of MA at or very near the separation of MA from Rs; Cu1 forked to or very nearly to the m-cu cross-vein; two or three branches of Rs arising directly from R1 + Rs, but when there are only two such branches the outer one has three main forks. Hind wing: hyaline, but with Cu1 margined with brown, especially distad of the first fork. Anal plates of male with the lower process broad, the dorsal process very small, in the form of a slender tooth; tenth sternite well developed and curved slightly, the plates of the aedeagus divergent.

*Types*: The three cotypes of this species are in the Museum of Comparative Zoology: 2 ♀, Ft. Collins, Colorado, August; and 1 ♂, Veta Pass, Colorado, July 1. The latter specimen is here designated the lectotype.

*Distribution*: COLORADO (Sheephorn Eagle Co., August 1, 7900 ft., C. Clagg; Williams Fork, Grand Co., July, 8300 ft.; Summit, August, 8211 ft.; Rocky Mt. Nat'l. Park; Platte Canyon; Veta Pass; Vega Pass; Ft. Collins, August); UTAH (St. George, July 21, E. W. Davis; Provo, July 12); BRITISH COLUMBIA (Chilcotin, August 10, G. J. Spencer; Clinton, June, J. K. Jacob; Jesmond, July; Rolla, July, P. N. Vroom); ALBERTA (Nordegg, July 3-August 8, J. McDunnough; Lethbridge, July 28, E. H. Strickland, and September, H. L. S. Seams; Banff, August; Peace River District, July 19, L. S. Russell; Waterton Lakes, June 24, J. McDunnough; Banff, July, August); SASKATCHEWAN (Saskatoon, August 19, K. M. King); MACKENZIE DISTRICT (N. W. T.) (Cameroon Bay, Great Bear Lake, July 16, T. N. Freeman); ALASKA (Savonoski, Naknek Lake, July, J. S. Hine). This is another northern *Hemerobius*, so far recorded only from

western Canada, Alaska, and high altitudes in Colorado and Utah. The adults have been collected from late June through August.

This species resembles *simulans* in habitus but can readily be distinguished from it by the presence of the extra branch of Rs in the fore wing, as well as by the distal position of the basal part of MA, though the latter does not always hold. The anal plates of the male are very distinctive in possessing the tooth-like dorsal process.

*Hemerobius simulans* Walker

Figure 12, plate 1, figure 6

*Hemerobius simulans* Walker, 1853, List. Spec. Neuropt. Ins. Brit. Mus., **2**: 285; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 33; Kimmins, 1932, Ent., **65**: 87; Killington, 1937, Monogr. Brit. Neuropt., **2**: 18.

*Hemerobius crispus* Walker (in part, d, e) *nec* Stephens, 1853, *ibid.*: 288; Kimmins, 1932, Ent., **65**: 88.

*Hemerobius orotypus* Wallengren, 1870, Ofv. K. Vet.-Akad. Förhandl., **27**: 155; McLachlan, 1899, Ent. Mo. Mag., **35**: 131; Killington, 1929, Trans. Ent. Soc. Hamps. S. Eng., **1929**: 19.

*Hemerobius placidus* Banks, 1908, Trans. Amer. Ent. Soc., **34**: 260; Kimmins, 1932, Ent., **65**: 87, fig. 1B.

*Hemerobius nevadensis* Banks, 1904, Can. Ent., **36**: 61; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 35.

Head varying from light reddish brown to brown; antennae usually greyish yellow; pronotum with a median yellow or yellow-brown stripe, not so broad as in *humulinus*; mesonotum and metanotum yellow or light brown above, darker brown laterally; abdomen usually dark brown or even black. Fore wing: length (average) 8 mm.; width, 2 mm.; slender, pointed; costal area unusually narrow at the very base; widest above separation of MA from Rs; first fork of Cu1 at or very nearly at the m-cu cross-vein; wing membrane hyaline, often slightly brownish, with faint brown maculations; inner and outer gradate veins faintly margined; a very prominent dark brown spot around m-cu and the first fork of Cu1; sometimes a few other spots occur on the more distal part of Cu1; two branches of Rs arising directly from R1 + Rs, the outer with two main forks. Hind wing: hyaline, faintly brown, without maculations. Anal plates of male with a well developed dorsal process and a more slender ventral one; the dorsal process curved inward slightly at its

tip; tenth sternite small; aedeagus directed ventrally at its origin, but curved sharply upwards distally, in side view appearing almost semi-circular; bridge of tenth sternite projecting posteriorly over the proximal portion of the aedeagus; lateral extremities of tenth sternite broadened and flattened.

*Holotype* ( $\delta$ ): St. Martin's Falls, Albany River, Hudson's Bay; in the British Museum of Natural History. Allotype, by present designation: Holliston, Massachusetts, September 8 (N. Banks); in the Museum of Comparative Zoology.

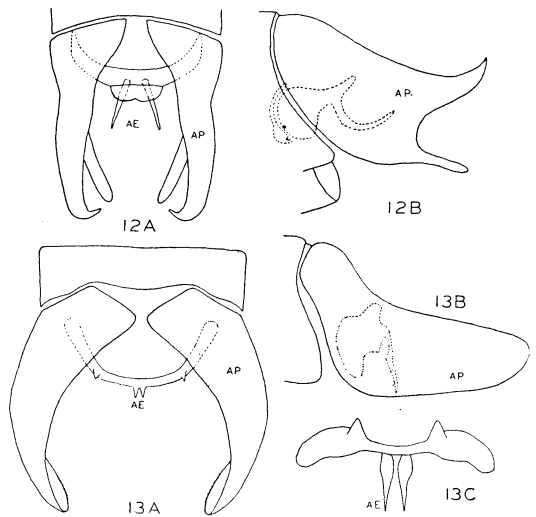


FIGURE 12. *Hemerobius simulans* Walker. A, terminal abdominal segments of male, dorsal view; B, same, lateral view. Lettering as in figure 2.

FIGURE 13. *Hemerobius costalis*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, posterior view of tenth sternite and aedeagus. Lettering as in figure 2.

*Distribution*: QUEBEC (Wright, May 19; Thunder River, August; Wakefield, July 14; Queen's Park, July 30; Laniel, July); ONTARIO (Ottawa, May 20, August; Niagara Glen, June 1; Biscotasing, July 15; Tinagami, September 10; Asperitos Isl., Georgian Bay); NEWFOUNDLAND (St. Johns, July 21); NEW BRUNSWICK (Fredericton, May); ALBERTA (Nordegg, June 17, July 22, J. McDunnough; Laggan, July 10; Edmonton, April 28); ALASKA (Tanana, June 24); BRITISH COLUMBIA (Salmon Arm, April, November, A. A. Dennys); MAINE (Mt. Katahdin); MASSACHUSETTS (Peru, August 26; Amherst, April 29); NEW HAMPSHIRE (White Mts., August 25, C. P. Alexander); NEW YORK (Lake Placid, August 12; Fulton Co., Sep-

tember); MICHIGAN (Whitefish Point; Isle Royale, August, C. Sabrosky). This is one of our two Holarctic species of *Hemerobius*; in Europe, according to Killington, *simulans* ranges from the Pyrenees and Carpathians to northern Scandinavia. It has also been recorded in Greenland and eastern Siberia. In the Nearctic region it has been taken in the adult stage from April to the middle of September.

*Simulans* resembles *humulinus* in general appearance, but has more slender wings, a heavier spot at m-cu in the fore wing, and the deeper first fork of Cu1. The male genitalia are unique among our species of the genus in having a dorsally curved aedeagus.

The synonymy of *orotypus* Wallengren has been demonstrated by Kimmins (1932), who has published a figure of the male genitalia of *simulans*. The two specimens (d, e) from Nova Scotia determined by Walker (1853, p. 288) as *crispus* Stephens are also *simulans*, as already stated by Kimmins (1932). Banks' *placidus*, the types of which are in the Museum of Comparative Zoology, is likewise this species; two of the types are males and their genital structure is identical with that of the type of *simulans*, which I have been able to examine in the British Museum. It is my conviction that *nevadensis* Banks is also this insect. The type of *nevadensis* is a female, with faded wings; Cu1 is deeply forked, as in *simulans*, and there is a large, though faint, spot around m-cu. The basal part of MA in the fore wing is not at the very base of the wing, as is usual in *simulans*, but is half way from the basal position to the separation of MA from Rs.<sup>9</sup> As I have already mentioned, however, the position of this vein does not hold constant in *all* specimens of this species or of any other *Hemerobius*, and I regard the type of *nevadensis* as an example of this abnormal condition. So far as our present records are concerned, the type locality of *nevadensis* (Ormsby Co., Nevada) is far removed from any other locality at which specimens of *simulans* have been taken, the nearest being British Columbia and Alberta; but I suspect that further collecting will reveal the presence of *simulans* in several of the Rocky Mountain states.

### *Hemerobius costalis*, n. sp.

#### Figure 13

Head varying from yellow to brown; antennae yellow; pronotum with a median yellow or light brown stripe, bordered laterally with dark brown, much as in *humulinus*; mesonotum and metanotum yellow or light brown above, somewhat darker laterally. Fore wing: length (average): 8 mm.; width, 3 mm.; subtriangular; costal margin strongly convex basally, the costal area very wide; apex pointed; first fork of Cu1 extending to about the level of m-cu; basal part of MA at the base of the wing; two branches of Rs arising directly from R1 + Rs, the outer with either two or three main forks; wing membrane hyaline, sometimes faintly yellowish, with light greyish brown maculations; inner and outer gradates faintly margined with grey-brown. Hind wing: hyaline, without maculations. Anal plates of male with a stout ventral lobe, but no dorsal process; the lower edge of the anal plates turned upwards and bearing numerous denticulate tubercles along the distal part of the turned edge; tenth sternite prominent, with a large pointed lobe at the ends of the bridge; viewed from above, the extremities of the sternite curve slightly ventrally; aedeagus of moderate size, its plates slender as viewed from the side, and possessing only a small anterior projection.

*Holotype* (♂): Eastport, Maine, July 14, 1909 (C. W. Johnson); in the Museum of Comparative Zoology. Allotype: Mt. Greylock, Massachusetts, August 5 (C. W. Johnson); in the Museum of Comparative Zoology.

*Paratypes*: 2♂ Cameron Bay, Great Bear Lake, Mackenzie, August 1, 1937 (T. N. Freeman); 1♀, 1♂ same, August 6; 1♂, same, August 18; 1♀ same, August 2; 1♂, Katmai, Alaska, August (J. S. Hine); 1♀, 1♂, Savonoski, Naknek Lake, Alaska, July (J. S. Hine); all in the Museum of Comparative Zoology.—1♂, Banff, Alberta, July 30, 1932 (C. B. Garrett); 3♂, Cameron Bay, Great Bear Lake, Mackenzie, August 1, 1937 (T. N. Freeman); 1♂, same, August 2; 2♂, same, July 27; 2♂, same, August 20; 1♂, 1♀, same, August 18; 1♀, Fort Wrigley, Mackenzie R., July 27 (C. H. Crickmay); 1♀, Keremeos, British Columbia, August 3 (C. B. Garrett); 1♀ Sioux Lookout, Ontario, June 19, 1919 (J. Russell); all in the Canadian National Collection, Ottawa.—2♀, 2♂ Savonoski, Naknek Lake, Alaska, July 25, 1919 (J. S. Hine); 1♀, same, August 1, 1919; all in the Ohio State University Museum.

<sup>9</sup>Banks has stated (1905b, p. 35) that the "basal cross vein connecting media to radius ends near origin of first radial sector," but this is hardly the case. The basal piece of MA (basal cross-vein) is only about half-way out to the point of separation of MA from Rs.

In addition to the types, I have also seen specimens of this species from the following localities: Knowlton, Quebec; White Mts., New Hampshire; Grand Isle, Vermont; Newton, Massachusetts; Digby, Nova Scotia; Waubamie, Ontario; Cascade Lodge, Rocky Mt. Nat'l. Park, Colorado; Great Slave Lake, Mackenzie; and Anclosage, Alaska. The adults have been collected from June through August.

This species has been identified in the past as the European *H. marginatus* Stephens. Walker (1853, p. 286) determined a specimen of Hemerobius from Nova Scotia as *marginatus*, and although Hagen (1861) was of the opinion that Walker's specimen was different from *marginatus*, he did not propose a new name for the species. McLachlan subsequently (1899) identified a female from New Hampshire as *marginatus*, and Banks (1905b), who at that time had no European specimens available for comparison, accepted the determination as probably correct. Killington (1937, p. 65) figures a lateral view of the apex of the male abdomen of *marginatus*, but does not describe or figure the tenth sternite. I therefore dissected the genitalia of several European males of *marginatus* contained in the Museum of Comparative Zoology. These dissections revealed a structure very different from that of our Nearctic specimens. In a posterior view of the sternite of the European specimens the lateral extremities of the sternite are seen to be directed dorsally, not ventrally, as in our insects, and in a lateral view the prominent, pointed dorsal lobes of our specimens are lacking in the European ones. The anal plates, although having the same general form in both species, are longer and more slender in the Old World specimens. The wings also show some differences, those of the latter being relatively shorter and broader and having a wider costal area. It seems clear, therefore, that there are really two species concerned, the Nearctic one being named here *costalis*. The close relationship between the two is emphasized by the similarity of the anal plates, which are very different from those of all other Nearctic and Palaearctic species. It is very probably either that one of these species has been derived directly from the other, or that both have been derived from an immediate, common ancestor. In this connection it is interesting to note that both are restricted to northern parts of their respective regions. According to Killington, *marginatus* occurs in northeastern Europe from Fin-

land and Scandinavia and the British Isles to southern France. *Costalis* apparently extends across Canada from Nova Scotia to British Columbia, Yukon, Mackenzie and Alaska; it enters only into northern New England and the northern part of the Rocky Mountain region.

*Costalis* is readily distinguished from the other Nearctic species of Hemerobius by the very broad costal area. So far as its wing venation is concerned, it is closest to *simulans* and *dorsatus*, both of which have the first fork of Cu1 extending to the m-cu cross-vein.

#### Genus *Kimminsia* Killington

*Kimminsia* Killington, 1937, Monogr. Brit. Neuropt., **2**: 254.

*Boriomyia* Banks, 1905 (*nec* 1904), Trans. Amer. Ent. Soc., **32**: 36.

Fore wing: oval; costal area broadened basally; recurrent humeral vein present; costal veinlets forked; two or sometimes three branches of Rs arising from stem R1 + Rs (not including MA); basal piece of MA either absent (usually) or present at base of wing; MA connected to MP 1 + 2 by a strong cross-vein just beyond the origin of the latter; two series of gradate veins, more than five veins present in the outer series.

Hind wing: Rs coalesced with MA for a considerable distance and joined to R1 by a cross-vein before the separation of MA from Rs; basal piece of MA conspicuous, not usually sigmoidal; furcation of MP at about the same level as (or even proximal to) the separation of MA from Rs; two series of gradate veins, more than five in the outer series.

Anal plates of male well developed, with a distal process or with rows of teeth ventrally; tenth sternite with broad "wings," each bearing a distal process ventrally; a single median plate of the aedeagus; parameres fused anteriorly. Anal plates of female broad; eighth sternite with a median sclerotized plate.

Genotype: *Hemerobius betulinus* Strøm.

The immature stages of all the Nearctic *Kimminsia* are entirely unknown. According to Killington the egg and larva of the European species are similar to those of Hemerobius.

Most of the Nearctic Hemerobiids previously placed in *Boriomyia* must now be referred to *Kimminsia*. Banks' description of *Boriomyia* and his designation of the genotype (*Hemerobius disjunctus* Banks) were contained in his revision of the Nearctic Hemerobiidae (1905b); but the gen-

eric name was used by him the preceding year in a local (Washington, D. C.) list of Neuroptera for *H. fidelis* Banks and *H. speciosus* Banks, without description or genotype designation.<sup>10</sup> In 1930 Banks established the subgenus *Allotomyia* for *fidelis* and *speciosus* and subsequently raised that to a genus (1935). Killington has correctly pointed out that since *Boriomyia* was used for *fidelis* and *speciosus* in 1904, even without type citation, it must be used for those species, *Allotomyia* being a synonym. He accordingly established the genus *Kimminsia* for the other species (*disjuncta*, etc.) formerly included in *Boriomyia* also.

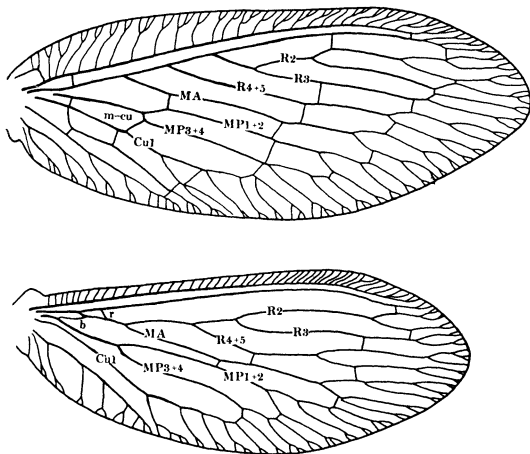


FIGURE 14. Wing venation of *Kimminsia disjuncta* (Banks). Lettering as in figure 1.

The species now referred to *Kimminsia* have been classified in the past on essentially the same characteristics used in *Hemerobius*. The foregoing remarks regarding the taxonomy of *Hemerobius* likewise apply here; but the color of the head and thorax is specifically more constant in *Kimminsia* than in *Hemerobius* and hence can be used for determination with greater accuracy. Also the ninth sternite of the female provides very good taxonomic characteristics in the form of the ventral sclerotized plate.

*Kimminsia*, like *Hemerobius*, has a wide distribution, having been recorded from Europe, Africa, New Zealand, and North and South America. Ten species have been found in the Nearctic

region; most of these are restricted to the northern part or to high mountains further south.

KEY TO THE NEARCTIC SPECIES OF *KIMMINSIA*

1. Pronotum with a conspicuous longitudinal yellowish stripe, bordered laterally with dark brown .....2  
Pronotum without such a median stripe .....6
2. Mesonotum with a median yellow stripe, extending the length of the segment .....3  
Mesonotum with the anterior part of the median yellow stripe marked with a dark brown transverse band or two brown spots .....4
3. Face with the upper part very dark brown, the lower part light brown and the transition very abrupt .....*coloradensis* Banks (p. 217)  
Face uniformly dark brown or if the upper part is darker than the lower, the transition is very gradual .....*disjuncta* Banks (p. 215)
4. Fore wings with heavy maculations between Cu1 and the posterior border; almost no maculations elsewhere .....*posticata* Banks (p. 218)  
Fore wings with the maculations more nearly uniformly distributed over the entire wing ...5
5. Anal plates of male with a very long ventral process, inwardly curved; eighth abdominal sternite of female consisting of a small median plate without gonapophyses; maculations of fore wing at the gradate cross-vein between MP3 + 4 and Cu1 strongly developed  
*furcata* Banks (p. 219)  
Anal plates of male without such a curved ventral process; eighth abdominal sternite of female with a pair of tapering, posterior gonapophyses; maculations of fore wing at the gradate cross-vein between MP3 + 4 and Cu1 weakly developed .....*involuta*, n. sp. (p. 219)
6. Face, vertex and pronotum light yellowish brown, with scattered red specks  
*longipennis* Banks (p. 221)  
Face, vertex and pronotum not so marked .....7
7. Fore wing without maculations (except a faint darkening near end of Cu1); veins not spotted  
*brunnea* Banks (p. 221)  
Fore wing with conspicuous maculations; veins spotted .....8
8. Fore wing without distinct transverse bands  
*pretiosa* Banks (p. 223)  
Fore wing with distinct transverse bands .....9
9. Mesonotum with dark brown along anterior border, and light brown behind; wing membrane hyaline or nearly so ...*schwarzi* Banks (p. 223)  
Mesonotum uniformly light brown; membrane somewhat smoky .....*fumata*, n. sp. (p. 225)

*Kimminsia disjuncta* (Banks)

Figures 14, 15

*Hemerobius disjuncta* Banks, 1897, Trans. Amer. Ent. Soc., 24: 25.

<sup>10</sup> Mr. Banks has explained to me that although his revision was published after the Washington list, it was sent off for publication before the latter, which did not therefore include genotype designation.

*Boriomyia disjuncta* Banks, 1905, Trans. Amer.

Ent. Soc., **32**: 39.

*Hemerobius frostinus* Navas, 1933, Boll. Soc. Ent.

Ital., **65**: 109, fig. 5.

Face usually uniformly dark reddish brown, almost black, the upper part sometimes a little darker than the lower, but with no sharp demarcation, as in *coloradensis*; vertex light brown, the antennal sockets margined behind with dark brown; pronotum with a wide median yellow

ventral arms and shorter dorsal ones. Ninth sternite of female not much longer than high; sclerotized plate of the eighth sternite about twice as long as broad, with a slightly concave posterior margin and with two lateral appendage-like arms (gonapophyses) attached to the middle of the plate and directed posteriorly.

*Holotype* (♀): Mt. Washington, New Hampshire; in the Museum of Comparative Zoology. Allotype, by present designation: Needham,

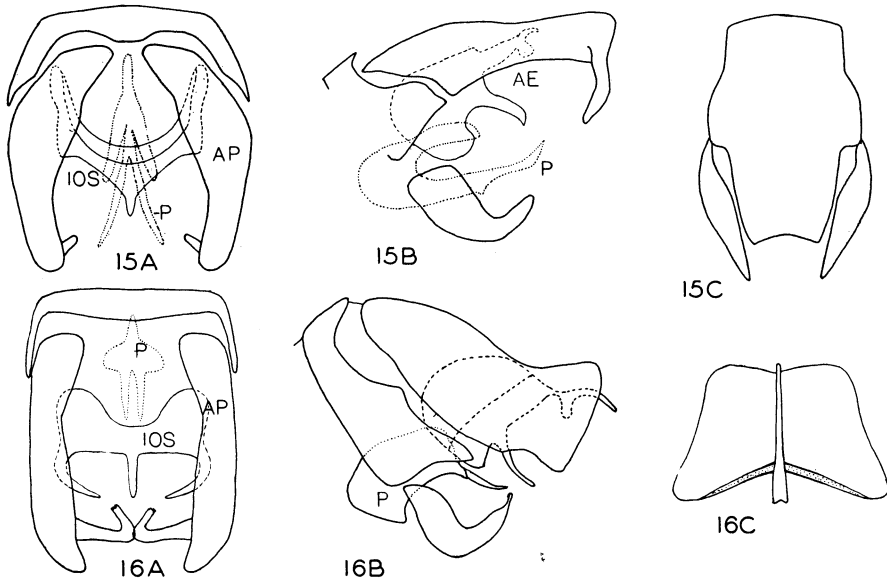


FIGURE 15. *Kimminsia disjuncta* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, eighth abdominal sternite of female (holotype) ventral view. Lettering as in figure 2.

FIGURE 16. *Kimminsia coloradensis* (Banks). A, terminal abdominal segments of male (lectotype), dorsal view; B, same, lateral view; C, eighth abdominal sternite of female (allotype), dorsal view. Lettering as in figure 2.

stripe, and a thin median dark brown line; mesonotum and metanotum with a median yellow stripe; abdomen brown above. Fore wing: length (average), 9 mm.; width, 3.5 mm.; apex pointed; costal area much narrower basally than in *coloradensis*; membrane hyaline, markings brown consisting of numerous small spots; cross-veins margined; spot at gradate cross-vein between MP3+4 and Cu1 well developed. Hind wing: hyaline, without markings. The anal plates of male appear slender as seen in lateral view, and possess a long and slender terminal process directed ventrally; tenth sternite of moderate size, the aedeagus much shorter than in *coloradensis*; each "wing" of the tenth sternite gives rise to a slightly curved ventral process; parameres large, with a pair of long

Massachusetts, August 18 (A. P. Morse); in the Museum of Comparative Zoology.

*Distribution*: NOVA SCOTIA (Baddeck, Cape Breton Isl., June 15, G. Fairchild); QUEBEC (Alymer, June; Knowlton, June); ONTARIO (Biscotasing, August, September; Ottawa, August; Kearney, June; Arnprior, September; Vineland Sta., May); WISCONSIN (Rib Mts., St. Park, August 27); MANITOBA (Aweme, May, October); SASKATCHEWAN (Saskatoon, May); ALASKA (McKinley Peak, July 16, F. W. Morand; Bering Sea, Canadian Arctic Exped., July, 1913); MONTANA (Bitterroot Pass, July 29); IDAHO (Wallace, August 21); WYOMING (Laramie, July 5); COLORADO (Summit Co., July; Nederland, 10,000 ft., July, F. M. Carpen-



ter; Wolf Creek Pass, July, C. Clagg); NORTH CAROLINA (Black Mts., Mt. Mitchell, September, N. Banks); NEW YORK (Axton, Adirondack Mts.; Catskill Mts., Greene Co.); NEW HAMPSHIRE (Mt. Washington); MASSACHUSETTS (Needham, Amherst, Cummington); MAINE (Mt. Katahdin, August).

This northern species resembles *coloradensis* and *involuta*, n. sp., in general appearance, but can be readily distinguished by body coloration, as indicated in the key. There are also slight wing differences, the costal area being narrower basally than that of *coloradensis* and the wing as a whole being more slender than that of *involuta*, n. sp. The genital structures of both sexes show marked differences from those of all other members of the genus. The eighth sternite of the female is surprisingly different from that of *coloradensis* in view of the similarity between the male genitalia of the two species. *Disjuncta* is much more common in Canada, especially in the eastern provinces, than it is in the United States, where it is quite rare outside of New England. Navas' *frostinus* was based upon a specimen from Framingham, Massachusetts. I have not seen the type, which was in Navas' collection, but the figure of the wing which accompanies the description, shows beyond doubt that the insect is *disjuncta*.

*Kimminsia coloradensis* (Banks)

Figure 16

*Hemerobius coloradensis* Banks, 1897, Trans. Amer. Ent. Soc., **24**: 26.

*Boriomyia coloradensis* Banks, 1905, *ibid.*, **32**: 38.

Lower part of face light brown, upper part, below antennae and extending to about the level of the middle of the eyes, very dark reddish brown, the lower margin of this area being very sharply defined; space between antennae dark brown; sides of head below antennae light brown; vertex light brown, with a very thin median dark brown longitudinal stripe; antennal sockets margined with dark brown behind; pronotum with a wide median yellow or light brown stripe, bordered by dark brown and containing a very thin median dark brown stripe, continuing that of the vertex; on each side of this dark stripe there is usually a small spot of dark brown; mesonotum and metanotum with a prominent median light brown stripe, bordered by dark reddish brown; abdomen grey-brown. Fore wing: length (average), 9 mm.; width, 3.5 mm.; oval, apex broadly rounded, costal space very broad basally, widening

abruptly from the base of the wing; veins dark brown, spotted; membrane hyaline; maculations consisting of numerous grey-brown spots; gradate veins strongly margined, and the points of origin of the branches of Rs and R1 + Rs are usually strongly marked with brown; the spot at the gradate vein between MP3 + 4 and Cu1 is usually darker than the others. Hind wing: hyaline, without markings. Anal plates of male broad in lateral view, each bearing a long, slender cylindrical process, terminating in a toothed head; these processes are directed towards the inner part of the segment, so they are usually not visible from the side; tenth sternite prominent, bearing a pair of slender, lateral, curved processes, extending ventrally and also bearing two flat lobes, extending dorsally; aedeagus short, about as long as the lateral process of the tenth sternite. Ninth sternite of the female small, semi-circular; eighth also very small and simple in structure, bearing a thin median process on its ventral surface, which widens slightly distally; this process is attached only to the anterior edge of the eighth sternite.

*Types*: Two cotypes, both from the same locality, Ft. Collins, Colorado (F. C. Baker), were mentioned by Banks after his description of the species, but I have been able to find only one of them in the Museum of Comparative Zoology. This is a male and it is here designated as the lectotype. Allotype, by present designation: Chimney Gulch, Golden, Colorado (Oslar); in the Museum of Comparative Zoology.

*Distribution*: CALIFORNIA (Bishop, Inyo Co., June 22, E. P. Van Duzee; Mono Lake, June 22, E. P. Van Duzee); OREGON (Crater Lake, July 19, E. P. Van Duzee); BRITISH COLUMBIA (Clinton, June; Hedley, July); ALBERTA (Lethbridge, September 11, J. H. Pepper); UTAH (Mirror Lake, Uinta Mts., 10,500 ft., August); COLORADO (Florissant; Leadville, July; Golden; Ft. Collins; Rocky Mt. Nat'l. Park; Pingree Park, 9000 ft., August; Saguache Co., July 10, R. H. Painter); WYOMING (Laramie, July 5, J. N. Knull).

This uncommon species has in the past been confused in collections with *disjuncta* Banks and *involuta*, n. sp. It differs from both of these in having a broader costal area basally and in having the dark brown markings on the face restricted to a definite band below the antennae. The anal plates of the male are like those of *involuta*, n. sp., but have the distal processes directed inwards, rather than ventrally; the aedeagus

is much shorter than it is in *involuta*, n. sp. The eighth sternite of the female abdomen is exceptionally small and simple, not at all like that of *involuta*, n. sp., or *disjuncta*.

*Kimminsia posticata* (Banks)

Figure 17

*Boratomyia posticata* Banks, 1905, Trans. Amer. Ent. Soc., 32: 39.

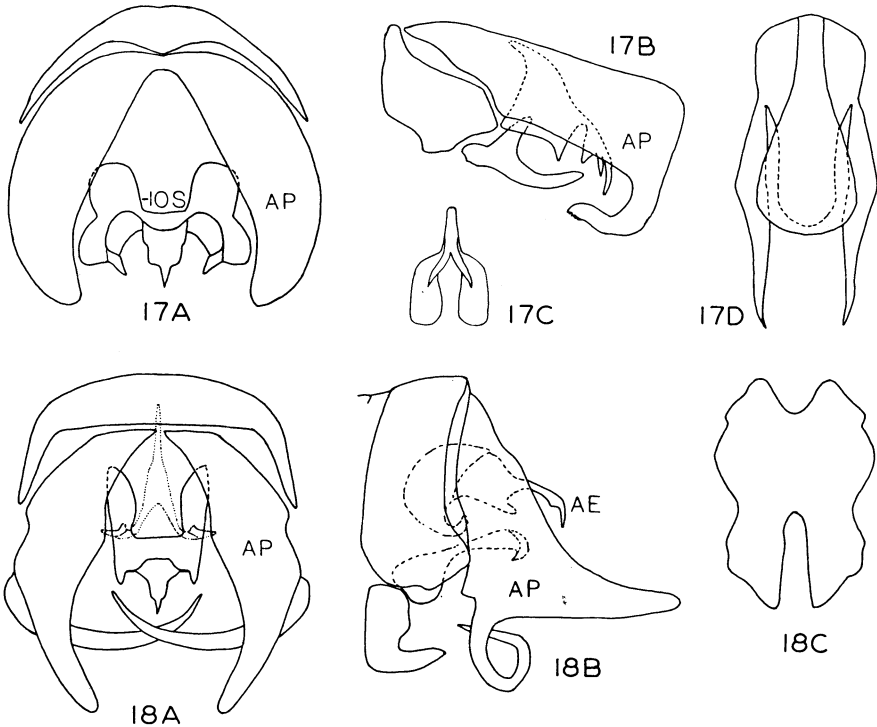


FIGURE 17. *Kimminsia posticata* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres, dorsal view; D, eighth abdominal sternite of female (holotype), dorsal view. Lettering as in figure 2.

Face with the upper part dark brown, the lower light brown, usually without sharp demarcation between the two areas; vertex light brown or yellow, pronotum with a wide median yellow stripe, containing a thin median dark stripe; mesonotum with a wide yellow stripe, but the anterior part of the yellow area contains a round, dark patch on each side of the median dark line, the spots usually being contiguous; also on posterior half of the mesonotum there is a dark brown spur-like process, extending into the yellow area from each side, the spur being curved and directed anteriorly; abdomen brown. Fore

wing: length (average), 10 mm.; width, 4 mm.; rather slender for a species of *Kimminsia*, with a moderately wide costal area as in *disjuncta*; membrane hyaline; maculations very dark grey-brown, not very numerous but restricted to certain areas; spot around the gradate vein between  $MP3 + 4$  and  $Cu1$  very large and continued proximally by a series of maculations forming short stripes between  $Cu1$  and the posterior mar-

FIGURE 18. *Kimminsia furcata* (Banks). A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, eighth abdominal sternite of female (allotype), ventral view. Lettering as in figure 2.

gin; gradate veins margined; apical part of wing, distal of outer gradate veins containing many heavy and large maculations. Hind wing: usually slightly smoky posterior of  $Cu1$  and anterior of  $MP1 + 2$ ; no true maculations. Anal plates of male large and broad, as viewed from the side, terminating in a pair of long, curved processes, which are readily seen in a lateral view; tenth sternite complete, with a pair of posterior and a pair of anterior lobes; aedeagus appears serrate, seen from the side; parameres fused anteriorly, with two flat posterior plates and a pair of short pointed processes anteriorly. Ninth sternite of

female rather long, nearly twice as long as wide; eighth sternite complex, consisting of three parts: a median flat plate, rounded posteriorly; a pair of elongate, pointed processes attached to the plate just anterior to the middle; and a median spatulate process attached to the anterior edge of the plate, the rest being free.

*Holotype* (♀): South Utah, July 1900; in the Museum of Comparative Zoology. Allotype, by present designation: Banff, Alberta, July 6, 1922 (C. B. D. Garrett); in the Canadian National Collection, Ottawa.

*Distribution*: UTAH (no other locality, July); COLORADO (Fairplay, July 11; Longs Peak, 9000 ft., July 12, 1926, E. C. Van Dyke); ALBERTA (Banff, July); NEW MEXICO (Red River, August 4, 1938, R. W. Kaiser; Colfax Co., August 21, 1927, R. H. Beamer); ARIZONA (Flagstaff, July 30, J. N. Knull).

This rare insect is the most strikingly marked of the Nearctic species of *Kimminsia*, the heavy markings along the posterior border of the fore wing being unique. The male genitalia are unusual in having a serrate aedeagus, and the eighth sternite of the female abdomen is remarkable for the broad median plate, apparently homologous with the slender one in *coloradensis*. Although I have seen only six specimens of this species, the localities listed above are widely scattered over the western part of the Nearctic region, so it is probable that the insect has a much more extensive range than is now indicated.

*Kimminsia furcata* (Banks)

Figure 18

*Boriomyia furcata* Banks, 1935, *Psyche*, **42**: 55.

Face nearly uniformly brown or very dark brown, at least to the clypeus; vertex brown, with a thin median darker stripe; pronotum with a wide median light brown stripe, traversed by a thin median longitudinal dark brown line, as in *coloradensis*; mesonotum with the brown area on the anterior part as in *involuta*, n. sp., though it is often somewhat divided medially; abdomen brown. Fore wing: length, 8-9 mm.; width, 3.5-4 mm.; apex slightly pointed; costal space as in *disjuncta*; maculations grey-brown, numerous, much as in *disjuncta*; spot at gradate vein between MP3 + 4 and Cu1 very heavy. Anal plates of male approximately triangular in shape, extended posteriorly into a slender, cylindrical lobe, and giving rise to a long and very slender process ventrally, which is strongly curved to the opposite

side; tenth sternite small but complicated, with a pair of lateral, anterior, flat lobes; aedeagus long and slender; parameres fused anteriorly, but strongly divergent posteriorly. Ninth sternite of female large, but not long or tapering, with a small notch in the ventral margin near the apex; eighth sternite small, in the form of a heavy sclerotized plate with a deep incision in the posterior border and a shallow one in the anterior margin; teeth and hooks absent.

*Holotype* (♂): Argentine Pass, Colorado; (T. D. A. Cockerell); in the Museum of Comparative Zoology. Allotype, by present designation: Nordegg, Alberta, June 27, 1921 (J. McDunnough); in the Canadian National Collection.

*Distribution*: COLORADO (Argentine Pass); ALBERTA (Nordegg, June, July, 1921, 7 specimens; Lake Louise, July 16, 1938, G. S. Walley; Banff, August 17, 1927; Shovel Pass, Jasper Park, July 1, 1915).

This is apparently another uncommon species, but the seven specimens collected by Dr. McDunnough at Nordegg indicates that it may be locally common, at least. The holotype is the only specimen which I have seen outside of Alberta. The species resembles *involuta*, n. sp., in general appearance, but it is smaller and has a more conspicuous spot at the gradate vein between MP3 + 4 and Cu1. The male genitalia are very unusual in the possession of the long ventral processes on the anal plates; and the eighth sternite of the female abdomen is equally unusual for the absence of lateral hooks and for having an irregular outline.

*Kimminsia involuta*, n. sp.

Figure 19

Face usually uniformly brown or dark brown, occasionally the upper part slightly darker than the lower; vertex light brown, with a thin median dark stripe; pronotum with a wide median yellow stripe and a thin median dark brown line within the latter, as in *coloradensis*; mesonotum with a wide median yellow stripe, which encloses a conspicuous dark brown median patch on the anterior half of the notum; abdomen brown. Fore wing: length, 11 mm.; width, 5 mm.; broad, with a slightly rounded apex; costal area slightly broader basally than in *disjuncta*, but not so broad as in *coloradensis*; membrane hyaline, markings grey-brown, numerous, much as in *disjuncta*; spot at gradate vein between MP3 + 4 and Cu1 present but weak, not nearly so strong as in *disjuncta* or *furcata*. Anal plates of male broad,

resembling those of *coloradensis* but with the distal process directed ventrally, so that it is easily visible from the side; tenth sternite large and complex, giving rise to a ventral, curved, posterior process; aedeagus long and slender; parameres complex, consisting of a flat basal piece, which is split and forked dorsally, and a pair of long, slender, dorsal, strongly curved processes. Ninth sternite of female long, fully twice as long as wide, as viewed from the side; eighth sternite long,

1♂, Nordegg, June 30; 1♂, Nordegg, July 21; 1♀, Nordegg, July 14; 1♀, Nordegg, July 6; 1♂, Waterton, Alberta, July 10, 1923 (H. L. Seamans); 1♀, Hedley, British Columbia, July 23, 1923 (C. B. Garrett); 1♀, Banff, Alberta, August 24, 1922 (C. B. Garrett); 1♂, Kaslo, British Columbia, August 14, (R. P. Currie); 1♂, near Gilpin, July 29, 1934 (N. Dondelinger) all in the Museum of Comparative Zoology.—From Nordegg, Alberta, 1921 (J. McDunnough,

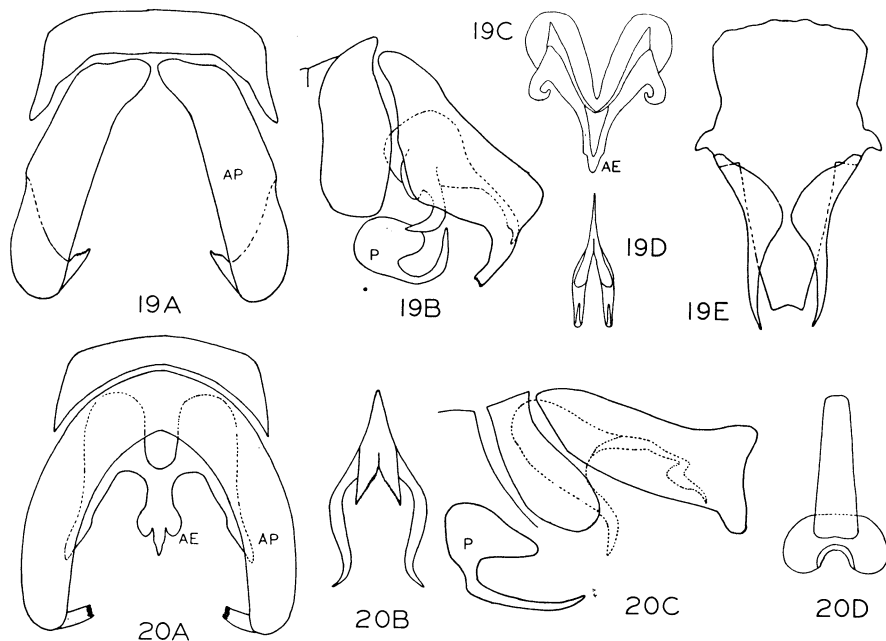


FIGURE 19. *Kimminsia involuta*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, tenth sternite of same, dorsal view; D, parameres of same, dorsal view; E, eighth abdominal sternite of female (allotype), ventral view. Lettering as in figure 2.

FIGURE 20. *Kimminsia longipennis* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, parameres of same, dorsal view; C, terminal segments in lateral view; D, eighth abdominal sternite of female (holotype), dorsal view.

the anterior half approximately square, the posterior half with convergent sides and an emarginate posterior border; attached to the sides of the sternite at about the middle are a pair of elongate, tooth-like processes, slenderly pointed, but very broad just beyond their bases.

*Holotype* (♂): Rundle Mt., 5-7,000 ft., Banff, Alberta, June 25, 1924 (Owen Bryant); in the Museum of Comparative Zoology. *Allotype*: Banff, Alberta, July 17, 1925 (Owen Bryant); in the Museum of Comparative Zoology.

*Paratypes*: 1♂, Nordegg, Alberta, July 21, 1921 (J. McDunnough); 1♂, Nordegg, July 13; 1♂, Nordegg, July 3; 1♂, Nordegg, July 29;

collector): 1♂, June 15; 1♀, 1♂, June 17; 1♀, 1♂, June 27; 2♂, June 30; 1♀, June 22; 1♀, June 26; 1♂, July 3; 3♂, July 10; 1♂, July 12; 4♂, July 16; 1♀, July 13; 1♀, July 18; 1♀, July 29; 1♂, August 12; 1♂, Hope Summit, British Columbia, August 15, 1931 (A. N. Gartrell); 1♀, Banff, Alberta, August 4, 1922 (C. B. Garrett); 1♀, Hedley, British Columbia, June 28, 1927 (C. B. Garrett); 1♂, White Horse, Yukon, July-August, 1920 (A. P. Hawes); 1♀, Banff, August 5, 1925 (O. Bryant); 1♀, Waterton Lakes, Alberta, August 29, 1926 (K. M. King); all in the Canadian National Collection, Ottawa.—2♂, Longs Peak, Colorado, 9000 ft.,

July 12, 1926 (E. C. Van Dyke); in the California Academy of Sciences.—1♀, Banff, Alberta, July 17, 1915 (O. Bryant); 1♀, Banff, July 23, 1925 (O. Bryant); 1♂, Banff, August 5, 1925 (O. Bryant); 1♀, Laggan, Alberta, July 10, 1925 (O. Bryant); 1♂, Pingree Park, Colorado, August 14, 1934; all in R. C. Smith collection.—1♂, Kaslo, British Columbia, August 6 (R. P. Currie); 1♂, Kokanee Mt., British Columbia, August 10 (R. P. Currie); 1♀, Revelstoke, British Columbia, August 14 (R. P. Currie); all in the United States National Museum.—1♂, Wallace, Idaho, August 6, 1937 (O. Huelleman); 1♂, Yellowstone Nat'l. Park, Wyoming, July 30, 1933 (J. C. Jones); both in University of Minnesota collection.

*Distribution*: The exact localities at which this species has been collected are listed above; the general range of the insect, so far as known, is included in the three Canadian Provinces, Yukon, British Columbia, and Alberta; and the mountainous states, Idaho, Wyoming, and Colorado.

In the past this species has been confused with *coloradensis* and *disjuncta*; an examination of the material in the National Museum collection shows that the specimens recorded as *disjuncta* by Currie (1904b, p. 89) from British Columbia belong here. The wings are indeed very similar to those of the species mentioned, but do differ in shape and in the intensity of the maculations, especially of the spot at the gradate vein between MP3 + 4 and Cu1. The fore wing of *involuta* is proportionally broader than that of any other Nearctic *Kimminsia*, being only about twice as long as wide. The species may also be readily distinguished from *coloradensis* and *disjuncta* by the large median brown area on the mesonotum, this notum being entirely yellow in the other two species. The male genitalia are distinctive in the possession of the long aedeagus and complex ninth sternite; the eighth sternite of the female abdomen is unusually long, and is unique in having the long, lateral teeth.

*Kimminsia longipennis* (Banks)

Figure 20

*Boriomyia longipennis* Banks, 1920, Bull. Mus. Comp. Zool., 64: 333.

Face yellow or very light brown, with numerous red specks and a larger red spot on the side of the head, just below the eye; antennae and legs yellow; vertex, pronotum and mesonotum uniformly yellow or very light brown, with scattered red specks;

abdomen medium brown. Fore wing: length (average) 10 mm.; width, 3 mm.; slender, apex pointed, as in *disjuncta*; costal area rather narrow, as in the latter; veins light brown, spotted with widely separated red specks; membrane hyaline, only faint indications of light brown maculations; the only prominent spot is the one around the gradate vein between MP3 + 4 and Cu1. Hind wing: hyaline, no maculations. Anal plates of male of moderate size and width; distal process prominent, inwardly curved; tenth sternite large, the "wings" giving rise to a long curved process ventrally; aedeagus large and broad; parameres fused anteriorly, the free part forming a pair of sigmoidal arms. Ninth sternite of female only a little longer than wide, not prominent; eighth sternite with almost no sclerotization; at the posterior end of the sclerite there is a "U"-shaped ridge, attached to a very thin, semicircular membrane; anterior to this there is a broad, median flat plate, very weakly sclerotized, attached at its anterior border apparently to the edge of the preceding segment, but not attached to the semicircular plate mentioned.

*Holotype* (♀): Berkeley, California; April 1, 1915; in the Museum of Comparative Zoology. Allotype, by present designation: Leona Hts., California, August 27, 1908 (J. C. Bradley); in the Cornell University collection.

*Distribution*: This species has been taken so far only in California, but I have seen twenty-one specimens in addition to the types. These were collected at Carmel, May 19, 1913 (E. C. Van Dyke); Lompoc, July 22, August 6-8, 1935 (R. H. Beamer); Orange Co., July 14, 1929.

*Longipennis* is the palest of our species of *Kimminsia*. The reduced condition of the eighth sternite suggests that it is not at all closely related to our other species of the genus, though the broad median plate is doubtless the homologue of the similar structure in *disjuncta*. The wings and body of *longipennis* are unique in being marked with the red specks.

*Kimminsia brunnea* (Banks)

Figure 21

*Boriomyia brunnea* Banks, 1920, Bull. Mus. Comp. Zool., 64: 333.

Face usually uniformly dark brown, rarely light reddish brown; vertex dark reddish brown; pronotum and mesonotum uniformly reddish or dark brown; occasionally with an indication of transverse dark markings on the pronotum, but never

any sign of a median yellow stripe; abdomen brown, usually reddish. Fore wing: length, 9 mm.; width, 3.2 mm.; oval; costal area narrow at base and gradually broadened; membrane and veins brown, often with a reddish tint near or around pterostigma; no maculations except for a faint indication of dark brown at the gradate vein between MP3 + 4 and Cu1. Anal plates of male

a flat plate, with parallel sides, except anteriorly where the plate widens and terminates in a shallowly incised margin; and (2) a pair of flat, broad plates near the posterior end.

*Holotype* (♀): Midvale, Montana (C. E. Brown); in the Museum of Comparative Zoology. Allotype, by present designation: Ranger's Sta., Blue Riv. Valley, Summit Co., Colorado, 8211

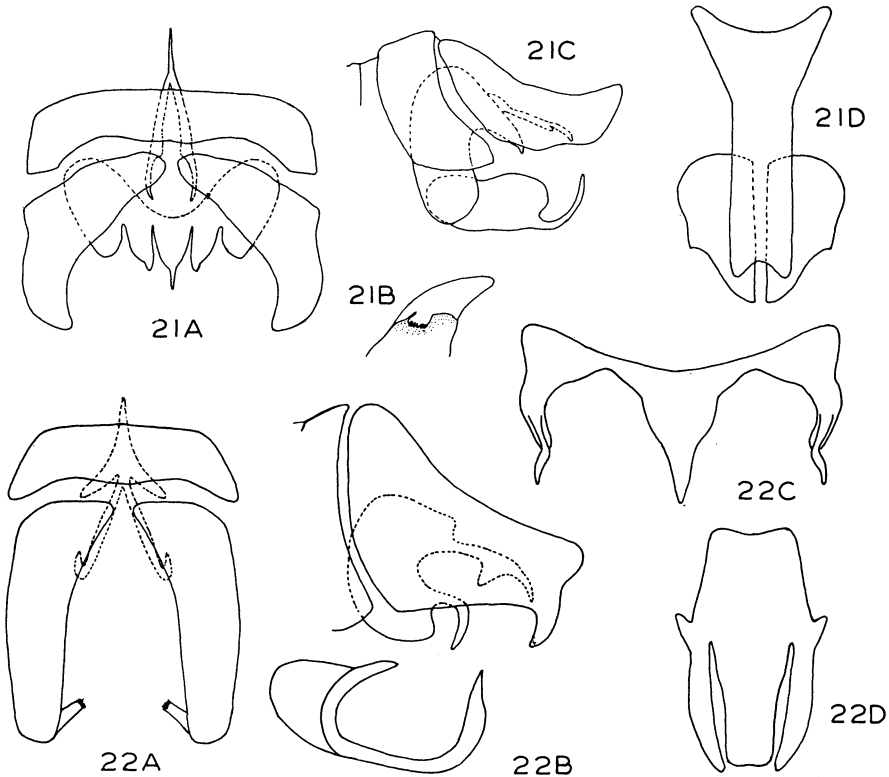


FIGURE 21. *Kimminsia brunnea* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, tip of anal plate of same, inner view; C, terminal abdominal segments of same, lateral view; D, eighth abdominal sternite of female (holotype), dorsal view.

FIGURE 22. *Kimminsia pretiosa* (Banks). A, terminal abdominal segments of male (lectotype), dorsal view; B, same, lateral view; C, tenth sternite and aedeagus; D, eighth abdominal sternite of female, ventral view.

of moderate size and width; distal process reduced to a very short stub on inner side of the anal plates, and not visible from an exterior lateral view; tenth sternite complex, consisting of two large anterior lobes and a pair of small, slender posterior ones near the aedeagus; the latter long and slender, as seen from the side; parameres fused at the very anterior end, each consisting of a broad flat plate, terminating in a small, curved hook. Ninth sternite of female large but not very long, only about one and a half times as long as wide; eighth sternite large, consisting of (1)

ft., July 12 (C. S. Clagg) in the Museum of Comparative Zoology.

*Distribution*: ALBERTA (Moraine Lake, August 9, J. McDunnough); WASHINGTON (Paradise Valley, Ranier Nat'l. Park, July 17, E. C. Van Dyke); CALIFORNIA (Crabtree Meadow, Tulare Co., July 23, 1915, 10,550 ft.); COLORADO (Longs Peak, 9000 ft., June, July, E. C. Van Dyke; Pingree Park, August, R. H. and L. D. Beamer; Needle Mts., 11,900 ft., August 17, F. H. Knowlton; Sheephorn, Eagle Co., 7950 ft., August 11, C. S. Clagg; Mt. Manitou, June

21, E. C. Van Dyke; Blue River Valley, Summit Co., 8211 ft., August 12, C. S. Clagg); MONTANA (Midvale); WYOMING (Laramie, July 5, 1932, J. N. Knull; Centennial, July 2, 1931, J. N. Knull).

The uniformly brown wings of this species make it the most easily recognized species of *Kimminsia* in our fauna. The male genitalia are closest to those of *coloradensis*, but differ in many obvious details, such as the short distal process and the lobed tenth sternite. The 8th sternite of the female abdomen is unique in structure, but presumably the paired posterior plates are the homologues of the long, tooth-like structures in *disjuncta*, *involuta*, etc.

*Kimminsia pretiosa* (Banks)

Figure 22

*Boriomyia pretiosa* Banks, 1908, Trans. Amer. Ent. Soc., **34**: 260.

Face with the upper part from the antennae to about the level of middle of eyes, very dark brown; much lighter below; vertex medium brown; pronotum uniformly light brown or reddish brown, without dark lateral areas or median yellow stripe; mesonotum with the anterior border dark brown, almost black; rest of mesonotum light brown; abdomen dark brown. Fore wing: length (average), 7 mm.; width, 3 mm.; oval, apex round; costal area narrow basally, but very broad further distally, the point of greatest width being somewhat more distal than in other species of *Kimminsia*; membrane faintly brownish; veins brownish, spotted; maculations brown and faint, of uniform intensity, there being no heavy spot at the gradate vein between MP3 + 4 and Cu1; cross-veins only faintly margined. Hind wing: membrane hyaline, no maculations. Anal plates of male very broad, especially basally, terminating in a short distal process, directed ventrally; tenth sternite large, with a pair of broad lateral "wings," each having a posterior, curved process; aedeagus long and rather slender, with a short but prominent ventral tooth near the base; parameres large, coalesced anteriorly, forming two long curved posterior arms and a pair of much shorter ones dorsally. Ninth sternite of female about as broad as long; eighth sternite small, consisting of an elongate, approximately rectangular plate, with a pair of broad lateral processes arising near the middle.

*Types*: Five cotypes (3♀, 2♂) are in the Museum of Comparative Zoology, all from Golden, Colorado, July 22, 1907 (Oslar); one cotype (♂)

from the same series is now in the Canadian National collection; and another cotype (♂) from Clear Creek, Colorado, is in the United States National Museum. One of the males from Golden, in the Museum of Comparative Zoology, is here designated the lectotype.

*Distribution*: COLORADO (Longs Peak, 9000 ft., July, E. C. Van Dyke; Golden, July; Boulder, October; Ft. Collins); ARIZONA (Williams, August 9; Flagstaff, July 27, 1936; Grand Canyon Nat'l. Park, July 13); OREGON (Antelope Mt., Harney Co., 5500 ft.); NEBRASKA (Pine Ridge, Dawes Co., July 8, L. Bruner).

This uncommon species and the following one (*schwarzi*) stand apart from all our other species of *Kimminsia* in lacking the yellow stripe and the dark brown sides of the pronotum. The wings of *pretiosa* are characterized by the uniformity of the maculations and the absence of the usually strong one at the gradate vein between MP3 + 4 and Cu1. Both male and female genitalia are very close to those of *schwarzi*, remarkably so, in view of the difference in wing markings.

*Kimminsia schwarzi* (Banks)

Figure 23

*Hemerobius schwarzi* Banks, 1903, Proc. Ent. Soc. Wash., **5**: 241.

*Boriomyia schwarzi* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 38.

*Boriomyia ultima* Banks, 1930, Psyche, **37**: 223.

Face uniformly dark reddish brown or nearly so; vertex brown; pronotum usually uniformly light brown, rarely with a darker median area, but never with a median yellow stripe or dark lateral borders; mesonotum with dark brown anterior margin, otherwise uniformly light brown; abdomen dark brown. Fore wing: length (average), 8 mm.; width, 3.3 mm.; broadly oval, apex rounded; costal area not quite so narrow at the base as in *pretiosa* and not so wide at its greatest width; membrane hyaline or faintly yellow; veins spotted; markings dark brown; inner gradate veins strongly margined with brown, forming a distinct, transverse band; the outer gradate veins more faintly margined; m-cu and gradate vein below it strongly margined, forming a short, basal transverse band; usually another, but fainter transverse band is present between the inner gradate veins and the basal band. The anal plates of the male are large and very broad, terminating in a short, distal, ventral tooth; tenth sternite large, its "wings" having a prominent

posterior process, strongly curved ventrally; aedeagus long, but very broad as viewed from above; parameres fused anteriorly, forming two long, slender posterior arms, strongly curved dorsally, and two, short, broad dorsal arms near the base of the others. Ninth sternite of female rounded, only a little longer than broad, as in *pretiosa*; eighth sternite small, with the rectangular plate incised anteriorly, and with a pair of lateral arms, as in *pretiosa*.

This uncommon species, although obviously a close relative of *pretiosa*, differs from it in both body and wing characteristics, e. g., the wing markings, shape of the costal area, and the uniformly brown face. The male genitalia are surprisingly like those of *pretiosa*, but the aedeagus lacks the ventral tooth and is much broader, and the parameres are differently curved. The eighth sternite of the female abdomen is also very much like that of *pretiosa*; the only difference which seems at

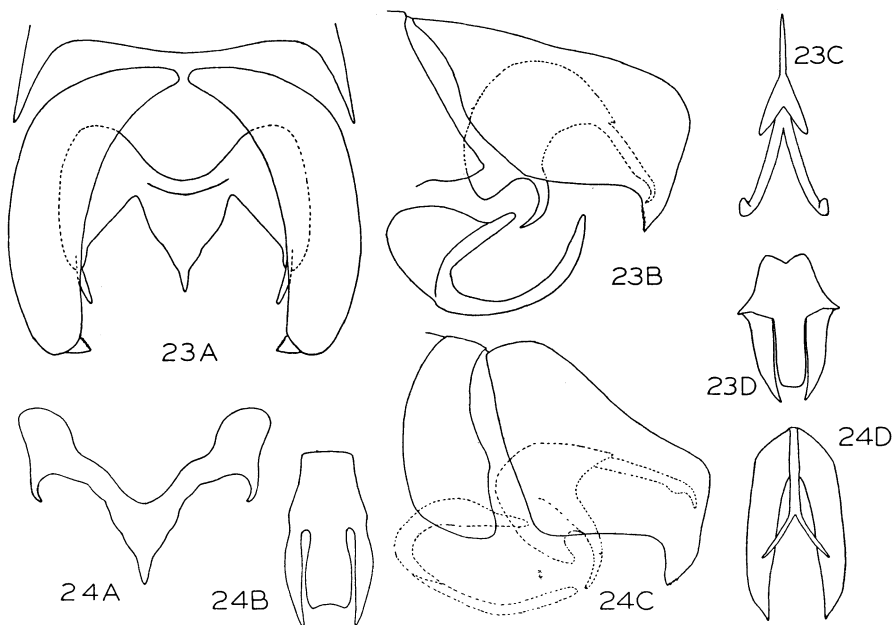


FIGURE 23. *Kimminsia schwarzi* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view; D, eighth abdominal sternite of female (holotype), ventral view.

FIGURE 24. *Kimminsia fumata*, n. sp. A, tenth abdominal sternite of male (holotype), dorsal view; B, eighth abdominal sternite of female (allotype); C, terminal abdominal segments of male, lateral view; D, parameres of male, dorsal view.

*Holotype* (♀): Williams, Arizona, July 23; in the United States National Museum. Banks mentioned after his description paratypes from Mesilla, New Mexico. Two specimens (♂, ♀) from this locality are in the Museum of Comparative Zoology and bear the type labels. Of these specimens, the male is really the allotype, since it is the only type specimen of that sex.

*Distribution*: CALIFORNIA (Fallen Leaf Lake, Lake Tahoe, July 1, 14, 1915, E. C. Van Dyke; Gold Lake, Sierra Co., June 29, E. C. Van Dyke, Crabtree Meadow, Tulare Co., July, 10,550 ft.); ARIZONA (Williams, May, H. S. Barber); NEW MEXICO (Mesilla); COLORADO (Longs Peak, 9000 ft., July 12, E. C. Van Dyke).

all obvious is the deep incision in the anterior border of *schwarzi*, this being absent in *pretiosa*. It may be, however, that a larger series of both species will indicate that this slight difference is individual, rather than specific.

I have placed *ultima* in synonymy with *schwarzi* on the basis of the eighth sternite of the female. The three type specimens of *schwarzi* are in very poor condition and there is slight indication of the markings on the wings. The eighth sternite of the female paratype of *schwarzi*, however, is identical with that of the holotype (♀) of *ultima*. All the other specimens of *schwarzi* which I have seen have the wing markings like those of the type of *ultima*, and among these there are two males



whose genitalia are exactly like those of the allotype of *schwarzi*. I have therefore been led to the conclusion that the types of *schwarzi* have faded wings and that *ultima* is a synonym of that species. As Banks pointed out, the type of *ultima* possesses a median dark area on the pronotum; this is not visible in the types of *schwarzi*, but among the additional specimens which I have seen there are various degrees of intensity of darkening, so that this characteristic seems to be variable within the species.

**Kimminsia fumata**, n. sp.

Figure 24

Face uniformly dark brown, sometimes almost black; vertex also dark brown, at least anteriorly; pronotum uniformly medium brown, occasionally with a few darker spots, but never with a median yellow stripe; mesonotum uniformly medium brown, without a darker anterior border; abdomen brown. Fore wing: length (average), 8 mm.; width, 3.5 mm.; oval, apex rounded; costal area moderately wide, as in *schwarzi*; membrane smoky; veins brownish but spotted; markings brown, forming four transverse bands, as in *schwarzi*, though less distinct. Anal plates of male very broad but short, with a prominent, stout, distal tooth, extending ventrally; tenth sternite large, with small lateral "wings," bearing a long, curved, posterior process; aedeagus long and slender as seen from the side, without a ventral tooth; parameres fused basally, forming two flat posterior arms and two short, more slender ones above. Ninth sternite of female somewhat longer than broad; eighth small, the median piece deeply incised anteriorly, narrow posteriorly and bearing two broad, lateral arms extending posteriorly.

*Holotype* (♂): Longs Peak Inn, Boulder Co., Colorado, 9000 ft.; July 13, 1926 (E. C. Van Dyke). Allotype: same locality data, July 12; both in the California Academy of Sciences.

*Paratypes*: 2♀, same data as allotype, one in the California Academy of Sciences, the other in the Museum of Comparative Zoology.

This species is close to *schwarzi*, but differs in the smoky wings, absence of the dark anterior border of the mesonotum and details of genital structure. The male genitalia are like those of *schwarzi* in general form, but the anal plates are broader, and the posterior process on the "wings" of the tenth sternite are longer. The long arms of the parameres are much broader than in

*schwarzi*. The eighth sternite of the female abdomen is very close to those of *schwarzi* and *pretiosa*, differences in the shape of the arms being slight.

Genus *Wesmaelius* Kruger

*Wesmaelius* Kruger, 1922, Stett. Ent. Zeit., **83**: 170; Killington, 1937, Monogr. Brit. Neuropt., **2**: 97.

Fore wing: oval; costal area abruptly broadened at base; recurrent humeral vein present; costal veinlets branched; usually three branches of Rs arising from R1 + Rs, sometimes two or four (not including MA); a strong cross-vein present

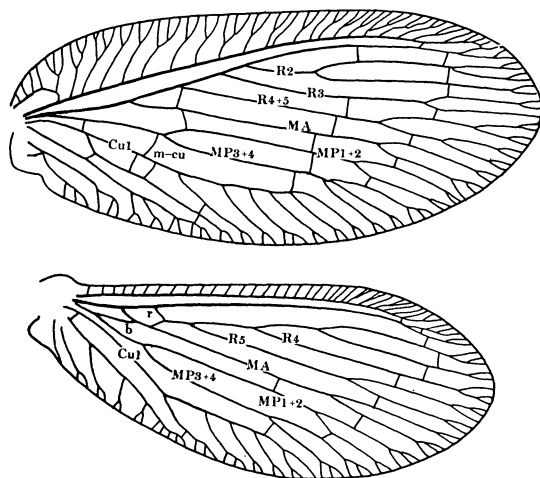


FIGURE 25. Wing venation of *Wesmaelius longifrons* (Walker). Lettering as in figure 1.

between MA and MP1 + 2, just after the origin of the latter; a similar cross-vein present between MA and R5 at the latter's origin; two series of gradate veins, five or more cross-veins in the outer.

Hind wing: Rs coalescing with MA for a considerable distance; the cross-vein joining R1 to Rs is after the separation of MA from the latter; furcation of MP at about the level (or even proximal to) the separations of MA from Rs; two series of gradate veins, more than four cross-veins in the outer series.

Antennae slightly longer than the fore wing; prothorax broader than long, the lateral margins prolonged into a lobe. Anal plates of male triangular, with a heavily sclerotized ventral process, bearing teeth; tenth sternite with extensive "wings," each bearing a posterior process ventrally; aedeagus with a median plate; parameres fused anteriorly. Anal plates of female much smaller than the ninth sternite, which is elongate;

eighth sternite with a sclerotized median plate, as in *Kimminsia*.

Genotype: *Hemerobius concinnus* Stephens.

The life history of the single Nearctic species of the genus is entirely unknown. The egg and the larva of the British species are like those of *Kimminsia* and *Hemerobius*, except that the larval jaws are relatively longer (Killington).

*Wesmaelius* is at present known only from the Holarctic region and contains but one Nearctic species.

*Wesmaelius longifrons* (Walker)

Figures 25, 26

*Hemerobius longifrons* Walker, 1853, List Spec.

Neuropt. Ins. Brit. Mus., **2**: 291.

*Boriomyia longifrons* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 37.

*Hemerobius alternatus* Fitch, 1856, 1st & 2nd Rept. Ins. N. Y.: 93.

*Hemerobius transversus* Banks, 1904, Can. Ent., **36**: 61.

*Allotomyia borealis* Banks, 1935, Psyche, **42**: 56.

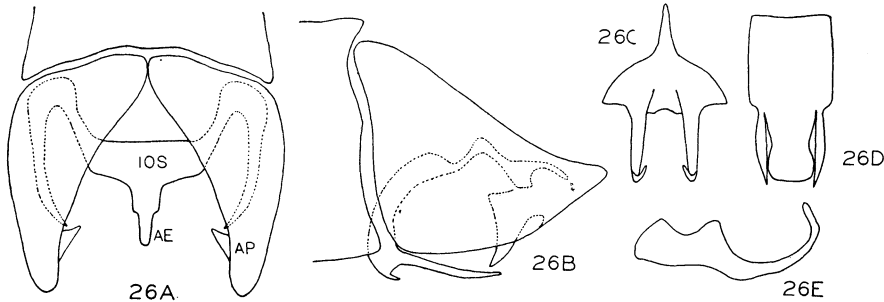


FIGURE 26. *Wesmaelius longifrons* (Walker). A, terminal abdominal segments of male, dorsal view; B, same, lateral view; C, parameres of same, dorsal

view; D, eighth abdominal sternite of female, dorsal view; E, parameres of male, lateral view. Lettering as in figure 2.

*Holotype* ( $\delta$ ): St. Martin's Falls, Albany River, Ontario, Canada; in the British Museum. Allotype, by present designation: Covey Hill, Quebec, June 25; in the Museum of Comparative Zoology.

*Distribution*: NOVA SCOTIA; QUEBEC; ONTARIO; MANITOBA; SASKATCHEWAN (Indian Head); ALBERTA (Banff; Kananaskis); BRITISH COLUMBIA (Hedley, Victoria); ALASKA (Savonoski, Naknek Lake); MAINE;

Face uniformly dark brown, almost black; vertex usually yellow; pronotum with a very wide median light-brown stripe, bordered laterally by a thin margin of dark brown, or uniformly light brown without dark lateral margins; pronotum also usually with dark brown area along anterior border, except near the mid line; mesonotum either uniformly light brown, or with some dark brown laterally and along the anterior border; abdomen medium brown. Fore wing: length, 10 mm.; width, 5 mm.; broadly oval, usually, but very variable in shape, apex rounded; membrane hyaline, markings grey or grey-brown; cross-veins strongly margined, especially the inner gradates; the m-cu cross-vein and the one below

it usually very strongly margined; the margination of the cross-veins forms either four nearly continuous bands across the wing, or eight (rarely six) short ones, the extent of the markings being variable. Anal plates of male large, triangular, with a distal, ventral process, appearing as a pointed tooth from a lateral view; tenth sternite large, "wings" slender, with a pair of long posterior arms; aedeagus short, with a blunt tooth below; parameres coalesced anteriorly, forming two long anterior, curved arms. Female with the ninth sternite elongate, triangular, fully twice as long as broad; eighth large, consisting of a flat median plate, bearing two lateral posterior arms.

NEW HAMPSHIRE; VERMONT; NEW YORK (Wells; Ithaca; Fulton Co.); MICHIGAN (Isle Royale; Douglass Lake); COLORADO (Sunset; Selkirk Mts.; Mt. Manitou; Estes Park; Gold Hill; Golden; Colorado Springs); WASHINGTON (Underwood); WYOMING (Teton Mts.; Wind River Range); UTAH (Logan; La Sal Mts.); OREGON (Mt. Hood; Haines); ARIZONA (Flagstaff; Williams; Grand Canyon). The adults have been collected from June through October.

This widely distributed species is a very distinctive one. It is the only Nearctic Hemerobiid possessing the basal cross-vein between R5 and MA near the origin of the latter, and the only one in

which the cross-vein in the hind wing between Rs and R1 occurs after the first fork of Rs. The male and female genital structures are equally distinctive.

The type (♀) of Fitch's *alternatus* is in the Museum of Comparative Zoology and an examination of its genital and wing structure shows that it is a synonym of *longifrons*, as it has been recognized by Banks in the past. The type (♂) of *transversus* Banks, which is in the same museum, is likewise this species; the wings have more extensive bands than most specimens, but as I have previously pointed out the wing markings are unusually variable in this species. *Allotmyia borealis* Banks was based upon a damaged male of *longifrons*; this has already been noted by the author of the species on a label attached to the type in the Museum of Comparative Zoology.

#### Genus *Symphorobius* Banks<sup>11</sup>

*Symphorobius* Banks, 1904, Proc. Ent. Soc. Wash., 6: 209; Banks, 1905, Trans. Amer. Ent. Soc., 32: 40; Killington, 1937, Monogr. Brit. Neuropt., 2: 111.

*Palmobius* Needham, 1905, Bull. N. Y. State Mus., 86: 17.

*Spadobius* Needham, 1905, *ibid.*: 16.

*Niremberge* Navas, 1909, Rev. R. Acad. Cienc. Madrid, 7: 377.

*Eurobius* Krüger, 1922, Stett. Ent. Zeit., 83: 171.

Fore wing: usually slenderly oval; costal area either narrow or broad, not usually abruptly widened at base; recurrent humeral vein present; costal veinlets forked; one or two branches of Rs arising from stem R1 + Rs (not including MA); R4 + 5 usually coalesced with MA for a considerable distance basally; MP connected by a cross-vein to MA shortly after the former's origin; two series of gradate veins, four or less in outer series.

Hind wing: MA usually having slight contact with Rs or joined to it by a cross-vein; basal cross-vein between R1 and Rs beyond the separation of MA from Rs (or connecting cross-vein) and far proximal to origin of R4 + 5; furcation of MP distal of separation of MA from Rs (or connecting vein); not more than two outer gradate veins, often none; only one or two in the inner gradate series.

Anal plates of male with at least one distal process; tenth tergite with elongate "wings" and a

single median plate of the aedeagus, which has a complicated form; ninth tergite with a conspicuous ventral extension of the posterior border; parameres nearly completely fused; ninth sternite triangular, often elongate. Anal plates of female small; ninth tergite enlarged ventrally.

Genotype: *Hemerobius amicus* Fitch.

The egg of the species of this genus is minutely sculptured, like that of *Hemerobius*. The larva is relatively shorter and broader than that of *Hemerobius*; the third antennal segment is very short and broadened basally. The life history of two Nearctic species is known: *S. amicus* Fitch (Smith, 1923) and *S. barberi* Banks (Smith, 1934).

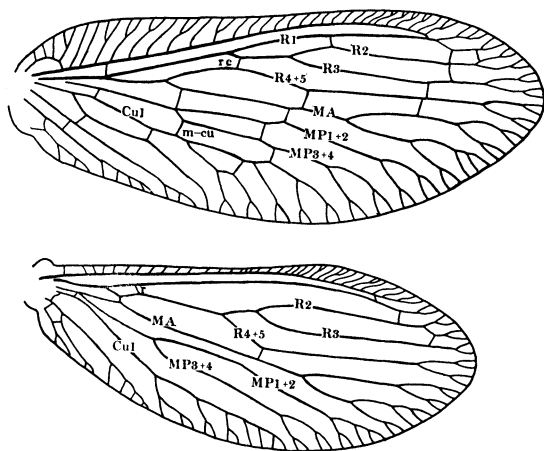


FIGURE 27. Wing venation of *Symphorobius amicus* (Fitch). rc, radial cross-vein; other lettering as in figure 1.

Several attempts have been made to divide *Symphorobius* into two or more genera. Navas and Krüger, noting that in some species the first branch of Rs (R4 + 5) was coalesced with MA and in others arose directly from R1 + Rs, proposed a splitting of the genus on this difference. Although it is true that among the individuals of certain species one of these two types of radial sectors predominates, in other species both types occur with nearly equal frequency. This venational difference cannot, therefore, be satisfactorily used as the basis of generic separation. Needham's genus *Spadobius* was based upon a single specimen of *S. amicus* having an adventitious cross-vein between R1 and R4 + 5 near the origin of the latter. Such adventitious veins occur commonly in all Hemerobiidae and certainly have no specific value. Some venational characteristics, however, are sufficiently constant in our Nearctic species of *Symphorobius* to be of taxonomic use.

<sup>11</sup>The generic synonymy given here includes only that involving the Nearctic species.

Best of these is the cross-vein, termed the radial cross-vein, present in some species between R4 + 5 and some part of Rs above. In a number of species this vein is completely absent (e.g., *barberi*); in others it connects R4 + 5 with R2 + 3 (e.g., *umbratus*); and in others it connects R4 + 5 to R1 + Rs before the origin of R2 + 3 (e.g., *occidentalis*). The presence or absence and the position of this cross-vein are surprisingly stable. I have found them to hold constant in all but about two per cent of the Nearctic specimens, and in most species I have seen no exceptions. The shape of the wing is also of much taxonomic value, some species having a broad costal area (e.g., *barberi*) and others having this space very narrow (e.g., *angustus*). Although the color of the body is nearly the same in all species, the color of the fore wings differs so greatly between many species that in spite of some individual variation, it has much taxonomic value. The male genitalia furnish the most significant specific structures. The shape and the number of the processes on the anal plates are remarkably constant, and these can usually be examined without relaxing or dissection of the abdomen. The ninth sternite of the male abdomen and the parameres also exhibit excellent specific differences. The terminal abdominal segments of the female are so much alike that I have found them of no use in distinguishing the species.

Symphorobius occurs in Europe, Asia and North and South America. The genus is especially well represented in the Nearctic region, which includes the fifteen species considered below and probably several others still unknown. These Nearctic Sympherobius, unlike members of the other genera of Hemerobiidae, are most abundant in the southern part of the region, and many of the species are confined to the southern states.

KEY TO THE NEARCTIC SPECIES OF SYMPHEROBIUS

1. Radial cross-vein present in fore wing.....2  
    Radial cross-vein absent.....9
2. Fore wing with all cells either margined with dark brown or filled with dark brown and margined with hyaline membrane.....3  
    Fore wing without such markings; the membrane hyaline and spotted with gray or brown.....5
3. Costal area of the fore wing narrow  
    *gracilis*, n. sp. (p. 231)  
    Costal area of the fore wing broad.....4
4. First fork of Cu1 at a point far distal of the cross-vein m-cu; radial cross-vein between R4 + 5 and R1 + Rs, before the origin of R2 + 3 .....*occidentalis* Fitch (p. 230)

- First fork of Cu1 at the level of the m-cu cross-vein; radial cross-vein between R4 + 5 and R2 + 3.....*umbratus* Banks (p. 230)
5. Radial cross-vein of fore wing between R4 + 5 and R2 + 3.....*amiculus* Fitch (p. 228)  
    Radial cross-vein of fore wing between R4 + 5 and R1 + Rs, before the origin of R2 + 3...6
6. Costal area of fore wing broad  
    *californicus* Banks (p. 232)  
    Costal area narrow.....7
7. Veins of fore wing nearly uniformly brown  
    *similis*, n. sp. (p. 236)  
    Veins of fore wing with conspicuous brown and white markings.....8
8. Large species, fore wing over 6 mm. long; mesonotum yellow medially, with a large black spot on each side.....*angustus* Banks (p. 233)  
    Small species, fore wing about 4 mm. long; mesonotum nearly uniformly brown, only slightly darker laterally than medially  
    *bifasciatus* Banks (p. 233)
9. Fore wing membrane predominately brown, hyaline area in form of small spots  
    *arizonicus* Banks (p. 234)  
    Fore wing membrane predominately hyaline...10
10. Fore wing maculations forming three distinct bands across the central part of the wing  
    *pictus* Banks (p. 234)  
    Fore wing maculations in the form of small, irregular spots, distributed more or less uniformly over the wing.....11
11. Costal area of the fore wing broad  
    *barberi* Banks (p. 235)  
    Costal area of the fore wing narrow.....12
12. Fore wing very slender, inner gradate veins widely separated.....*perparvus* McLachlan (p. 236)  
    Fore wing at most only moderately slender, the two upper and the two lower gradate veins close together.....13
13. Veins of fore wing uniformly brown, maculations diffuse.....*distinctus*, n. sp. (p. 238)  
    Veins of fore wing spotted with brown and white; maculations few.....14
14. Fore wing membrane hyaline  
    *killingtoni*, n. sp. (p. 238)  
    Fore wing membrane yellow  
    *limbus*, n. sp. (p. 236)

*Symphorobius amicus* (Fitch)

Figures 27, 28

- Hemerobius amicus* Fitch, 1856, 1st & 2nd Rept. Ins. N. Y.: 95.  
*Symphorobius amicus* Banks, 1904, Proc. Ent. Soc. Wash., 6: 209; 1905, Trans. Amer. Ent. Soc., 32: 42.  
*Symphorobius buenoi* Navas, 1912, Broteria, 10: 198, fig. 7a; 1914, Bull. Brook. Ent. Soc., 9: 20.

Head medium to dark brown, shiny; pronotum medium brown, dull, usually slightly mottled with grey; antennae slender, the basal third dark grey, the rest light brown; legs yellowish. Fore wing: length, 3.5 mm.; width, 1.3-2 mm.; broad, apex usually rounded but sometimes nearly pointed; costal space rather broad, nearly as in *barberi*; wing membrane usually hyaline, but sometimes the brown maculations are so diffuse that the membrane appears nearly uniformly brown; veins

"wings" slightly flattened, but slender; aedeagus very prominent, curved anteriorly over the tenth tergite (anal plates); parameres coalesced anteriorly, but separating posteriorly to form a pair of flattened, irregular plates; ninth tergite with only a short posterior projection from the ventral border.

*Holotype* (♀): in the Museum of Comparative Zoology. This specimen bears no locality data, but Fitch states in his description that specimens

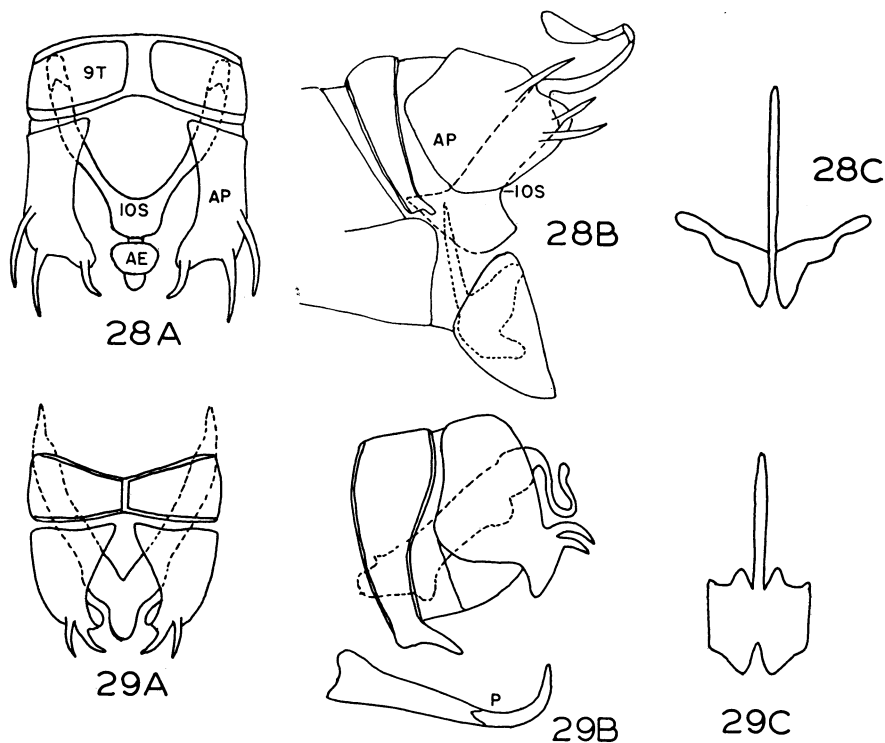


FIGURE 28. *Sympherobius amicus* (Fitch). A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view. Lettering as in figure 2.

FIGURE 29. *Sympherobius occidentalis* (Fitch). A, terminal abdominal segments of male, dorsal view; B, same, lateral view; C, parameres of same, dorsal view. Lettering as in figure 2.

often light and marked with dark brown spots, one of these being at the base of each microtrichium; maculations mostly grey-brown, sometimes yellow-brown; inner gradate veins very dark brown, often very heavily and widely margined, especially those of the posterior part of the wing; at least the two upper and two lower inner gradates close together; radial cross-vein between  $R4 + 5$  and  $R2 + 3$ . Hind wing hyaline, no maculations. Anal plates of male large, each with three posterior processes, two lateral and one more nearly median, the latter being very short and more curved than the other two; tenth sternite large, with the

were taken in New York and Illinois, so that the type was undoubtedly collected in one of those states. Allotype, by present designation: Cambridge, Massachusetts, July 13 (F. M. Hull); in the Museum of Comparative Zoology.

*Distribution*: Although this species probably occurs in the eastern United States and Canada as far west as Oklahoma and Nebraska, the actual records show a very spotted distribution. I have seen specimens from various localities in the following states and provinces: Nova Scotia, Ontario, New Hampshire, Vermont, Massachusetts, New York, Ohio, Illinois, West Virginia, Virginia, North

Carolina, Georgia, Florida, Arkansas (Washington Co.), Louisiana, Nebraska (Lincoln), Kansas, Michigan (E. Lansing), Wisconsin (Brule), Minnesota (Benn, Eveleth), Oklahoma (Roff, Parson, El Reno, Cheyenne, Okemah, Pearson), and Texas (Galveston). Most of the adults have been collected during June and July, but a few have been taken in March, April, May, August and early September.

This is one of our two species of *Symphorobius* having the radial cross-vein between  $R4 + 5$  and  $R2 + 3$ , the other being the very distinctive *umbratus*. The wing markings are exceptionally variable in *amiculus*. In some specimens the membrane is very light, while in others it is decidedly light brown, as a result of the more generally diffuse maculations. The heavy brown maculations near the fork of Cula are always present, though in some they extend much further forwards than in most. In spite of the variation in wing markings and wing shape, the position of the radial cross-vein is constant, so far as the origin of  $R2 + 3$  is concerned, and this enables easy recognition of the species. The anal plates of the male also furnish distinctive characteristics in the form and arrangement of the three posterior processes.

Navas' *buenoi*, from White Plains, New York, is without doubt this species. Although Navas stated that the specimen was like *umbratus*, his figure shows that the type is nothing more than *amiculus*. It is very doubtful that he had a specimen of *umbratus* for comparison, since this is an extremely rare species.

*Symphorobius umbratus* (Banks)

Figure 30

*Hemerobius umbratus* Banks, 1903, Proc. Ent. Soc. Wash., **5**: 242.

*Symphorobius umbratus* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 41.

Head uniformly dark brown; antennae light brown; pronotum and mesonotum and abdomen uniformly medium brown. Fore wing: length, 5 mm.; width, 2.5 mm.; broadly oval; costal area wide, as in *barberi*; radial cross-vein between  $R4 + 5$  and  $R2 + 3$ ; wing membrane almost uniformly brown, except that all veins are narrowly margined by a hyaline strip; the brown area in each cell thus formed is margined by slightly darker brown; gradate veins normally arranged, with the two upper and two lower ones close together. Hind wing: very nearly hyaline, with only a faint trace of brown. Anal plates of male with three

processes, the lateral one being smoothly curved, the other two being at least slightly furcate. The detailed structure of the tenth sternite has not been determined.

*Holotype* ( $\delta$ ): Williams, Arizona, June 10; in the United States National Museum.

In addition to the type specimen, I have seen only a broken female, from Albuquerque, New Mexico (Osler). This was mentioned by Banks at the time of his description of the species. Apparently the insect has not been collected subsequently.

This is a very distinct insect. In general appearance it resembles *occidentalis* and *gracilis*,

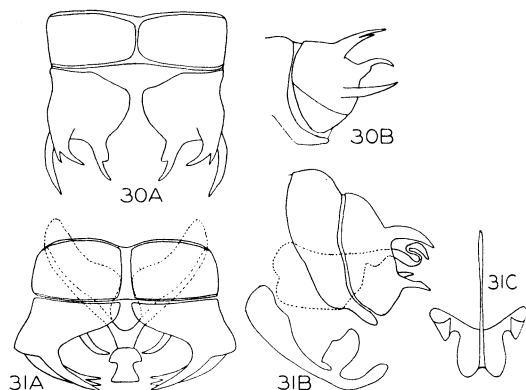


FIGURE 30. *Symphorobius umbratus* Banks. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view.

FIGURE 31. *Symphorobius gracilis*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, lateral view; C, parameres of same, dorsal view.

n. sp., but differs in the uniformity of the brown on the wing membrane, the broader costal area, the position of the radial cross-vein, the color of the body, and in the genital structure, at least in the form of the processes on the anal plates of the male.

*Symphorobius occidentalis* (Fitch)

Figure 29; plate 1, figure 10

*Hemerobius occidentalis* Fitch, 1856, 1st & 2nd Rept. Ins. N. Y.: 95; Hagen, 1861, Synop. Neuropt. N. A.: 201.

*Symphorobius occidentalis* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 40.

Face black, shiny; vertex medium or dark brown, nearly black, the rest light brown or yellow; pronotum with a very thin light median stripe bordered laterally by a wide dark brown

stripe on each side, this in turn margined laterally with yellow; mesonotum with a continuation of the median yellow stripe of the pronotum, and with a "V" formed by the converging of the extensions of the lateral borders of the pronotum; metanotum and abdomen dark brown to medium brown. Fore wing: length, 5 mm.; width, 2 mm.; moderately broad; costal area not quite so broad as in *amiculus*; radial cross-vein connected to R1 + Rs before the origin of R2 + 3; branches of Cu1 arranged so that they are mostly parallel to MP and the branches of Rs; membrane brownish, veins dark brown; cells of wing margined by a heavy dark brown border; cross-veins conspicuously margined with dark brown; a very dark brown patch at the inner angle of wing. Hind wing: membrane smoky, maculations absent. Anal plates of male small, with two short, strongly curved posterior processes; tenth sternite large, the two "wings" very long, extending well into the eighth segment; aedeagus broad, short; parameres coalesced anteriorly, forming a pair of broad, flat plates posteriorly.

*Types*: Fitch apparently had only one specimen of this species, collected at the Henderson River, Illinois (probably in Henderson County). This specimen seems to have been lost, for it is not in the Museum of Comparative Zoology or the United States National Museum. Fortunately, the insect is a very distinctive one, and Fitch's description enables us to recognize the species almost without question. There are but three Nearctic species of *Symphorobius* known to me which possess the peculiar margination of the cells mentioned by Fitch. One of these has been collected in Arkansas and Kansas, where it is not uncommon; a second, described below as *gracilis*, is known only from North Carolina; the third, *umbratus* Banks, has been found only in Arizona and New Mexico. These three species differ in various characteristics not mentioned by Fitch (body color, wing venation, genital structure). Of these species it seems far more probable that the first, from Kansas, is *occidentalis*, which was described from Illinois. It is on the basis of that interpretation that I have redescribed the species here.<sup>12</sup> I do not consider it advisable, however,

to designate a neotype of *occidentalis* until other Illinois specimens have been found. Curiously enough, although I have examined many hundreds of specimens of Hemerobiids from Illinois, chiefly collected by Dr. Ross and his associates, I have found no specimens of *occidentalis* among them.

*Distribution*: ILLINOIS (Henderson River, October); KANSAS (Onaga; Manhattan, August 8, R. C. Smith); ARKANSAS (Washington Co., July 23, 1938); DISTRICT OF COLUMBIA (Washington, according to Hagen's identification); TEXAS (College Sta., June 23, 1938, R. H. Beamer).

This rare species resembles the following (*gracilis*, n. sp.) but the thorax of the latter is uniformly brown, not marked with yellow, and there are numerous venational and other wing differences. There is also a slight resemblance to *umbratus* Banks, but the wing markings are not very similar. The distal processes on the anal plates are very short, more so than in any of the other Nearctic *Symphorobius*.

#### *Symphorobius gracilis*, n. sp.

Figure 31

Face dark reddish brown, vertex much lighter reddish brown; pronotum and mesonotum uniformly dark brown; abdomen dark brown. Fore wing: length, 5 mm.; width, 2 mm.; narrow, costal space narrow, nearly as in *angustus*; membrane hyaline, but with the hyaline area restricted to a narrow strip on each side of all veins; cells of the wings filled with dark brown, as in *umbratus* though the margin of the brown area is darker than the inner part, giving much the appearance of the wing of *occidentalis*; radial cross-vein just at origin of R2 + 3 in the type, but that is probably not its normal position; Cu1 forked nearly to m-cu; veins nearly uniform brown, not spotted. Anal plates of male with three distal processes, the lower lateral one furcate at tip; tenth sternite large, the "wings" very much expanded; parameres also large, the separated portions forming a complicated and gracefully curved spatulate plate.

*Holotype* (♂): Raleigh, North Carolina, June 11, 1934 (R. R. Leiby); in the Museum of Comparative Zoology. The female is unknown.

This striking species resembles *umbratus* in general appearance, but it has a more slender

<sup>12</sup>Hagen (1861) recorded a specimen of *occidentalis* from Washington, D. C., pointing out that the antennae of his specimen were longer than those described by Fitch, who stated that in the type the antennae were shorter than the body and all black. The antennae of Fitch's specimen were undoubtedly

broken, for they are longer than the body in all other species of *Symphorobius*, and in some species they are black for only about a third of their length.

wing and a narrower costal area. The male genitalia also are very distinctive; only one of the processes on the anal plates is furcate, instead of two, as in *umbratus*.

*Symphorobius californicus* Banks

Figures 32; plate 2, figure 12

*Symphorobius californicus* Banks, 1911, Trans. Amer. Ent. Soc., 37: 346.

Head medium to light brown, clypeus often darker brown; vertex usually light brown, never

straight, and the inner one very small and straight; tenth sternite large, with a distinct tooth-like projection visible in side view just below the aedeagus; ninth tergite with a very long posterior extension ventrally; parameres much as in *amiculus*.

*Types*: Banks mentioned three types of this species: "From Los Angeles, Claremont, and Pasadena, California." I have been able to locate only two of these types, one ( $\delta$ ) from Pasadena (J. Grinnell) and the other ( $\delta$ ) from Claremont (Baker); both are in the Museum of Compara-

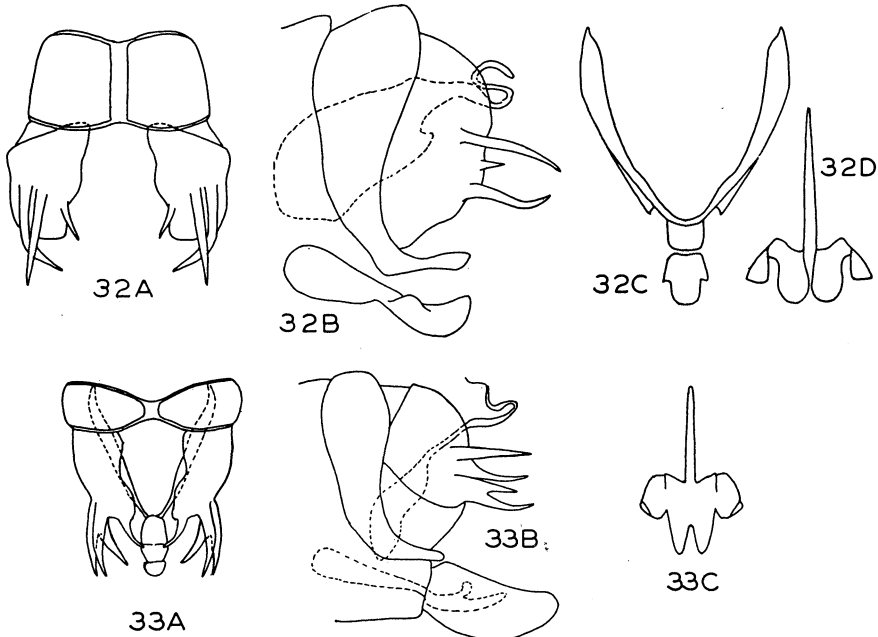


FIGURE 32. *Symphorobius californicus* Banks. A, terminal abdominal segments of male (lectotype), dorsal view; B, lateral view; C, tenth sternite of same, dorsal view; D, parameres of same, dorsal view.

FIGURE 33. *Symphorobius bifasciatus* Banks. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

black or very dark brown; pronotum with a distinct median yellow stripe bordered laterally with dark brown; mesonotum usually medium yellow-brown, somewhat variegated; abdomen medium brown. Fore wing: length, 5 mm.; width, 2.5 mm.; broadly oval, costal space broad, but not so broad as in *barberi*; radial cross-vein short, between R4 + 5 and R2 + 3; membrane hyaline or slightly brownish; cross-veins and Cu1 strongly margined with dark brown; sometimes also branches of Cu1 and not infrequently other veins are irregularly spotted with dark brown. Hind wing: hyaline, maculations absent. Anal plates of male with three distal processes, the lateral one being smoothly curved, the middle one long but

tive Zoology. An examination of the genital structure of these shows that the specimen from Claremont is really *barberi* Banks (1903). The other specimen, from Pasadena, is therefore now designated the lectotype of *californicus*. Since this is a male and no female type has been established, a female from Bericia, California, in the Museum of Comparative Zoology, is now designated the allotype.

*Distribution*: CALIFORNIA (Pasadena, Bericia, Berkeley, Laguna Beach, Claremont, San Francisco, San Mateo Co., Placer Co., Carmel, Fresno, Alameda, Santa Barbara, Mt. View, Alhambra, Richmond, Ventura, Ramona, Leona Hts.). The adults have been collected from March to Novem-



ber. The species appears to be confined to California, but it is hardly uncommon there, for I have seen at least sixty specimens.

*Californicus* resembles *barberi* and *angustus* in certain respects. The radial cross-vein is present in *californicus* and is situated like that in *angustus*, but the costal area and the wing as a whole is broad, as in *barberi*. The male genitalia are closest to those of *barberi*, which has the outer process of the anal plates strongly twisted, instead of smoothly curved, as in *californicus*.

#### *Symphorobius bifasciatus* Banks

Figure 33

*Symphorobius bifasciatus* Banks, 1911, Trans. Amer. Ent. Soc., **37**: 347.

Head with light brown face, the lower part not darker than medium yellowish brown; vertex light brown; antennae light brown; pronotum with a fairly wide median yellow stripe, bordered laterally by brown, usually not very dark; mesonotum yellow medially, with dark brown laterally; abdomen brown. Fore wing: length, 3.7 mm.; width, 1.6 mm.; narrow, but slightly broader than in *angustus*; membrane hyaline; costal space narrow, as in *angustus*; maculations light brown; cross-veins, Cu1 and its branches, Cu2 and the anals strongly margined with brown, not quite so dark as in *angustus*; marginations around gradate veins broadly diffuse, forming two transverse bands; radial cross-vein between R4 + 5 and R1 + Rs, before the origin of R2 + 3. Anal plates of male with three distal processes, all long, the lower one deeply forked; ninth sternite with a long posterior prolongation ventrally; tenth sternite small with rather slender "wings"; parameres as in *angustus*.

*Holotype* (♂): "Colorado" (G. F. Baker); in the Museum of Comparative Zoology.

*Distribution*: COLORADO (no further data); ALBERTA (Lethbridge, June 10, 1926, J. E. Revell; and June 18, 1929, J. H. Pepper).

This small species, which is apparently very rare, resembles *angustus* closely in wing and body markings; it may be distinguished from the latter by the lighter brown of the wing marginations, and the lighter color of the head, as well as by the male genitalia. The anal plates of *bifasciatus* are very unusual in possessing a deeply forked process.

#### *Symphorobius angustus* (Banks)

Figure 34; plate 2, figure 16

*Hemerobius angustus* Banks, 1904, Trans. Amer. Ent. Soc., **30**: 102.

*Symphorobius angustus* Banks, 1905, *ibid.*, **32**: 41.  
*Symphorobius tristis* Navas, 1914, Bull. Brook. Ent. Soc., **9**: 15, fig. 2.

Head with face dark brown, almost black; in some specimens the upper part of the face is dark reddish brown, but at least the lower part is nearly black; vertex dark brown or black; antennae dark, grey-brown; pronotum with a thin, median yellow stripe, bordered by dark brown laterally; abdomen dark brown. Fore wing: length, 6.5 mm.; width, 2.8 mm.; slender, with a very narrow costal area; membrane hyaline; almost all veins margined with dark brown, especially the cross-veins, Cu1 and its branches, Cu2 and the anals; in some specimens the maculations around the gradate veins are unusually wide and diffuse, giving the appearance of two bands across the wing as in *bifasciatus*; radial cross-vein between R4 + 5 and R1 + Rs, before the origin of R2 + 3, as in *californicus*. Anal plates of male with four distal processes, all strongly curved, including the very short one; ninth sternite with a prominent anterior extension ventrally; tenth sternite small, with broader "wings" than in *californicus*; parameres as in the latter, but with a shorter fused portion.

*Types*: Banks indicated the cotypes of this species as follows: "One specimen from Mesilla, N. Mex. (A. P. Morse), and others from Las Vegas Hot Springs, August (Barber and Schwarz)." The specimen from Mesilla, a female, is in the Museum of Comparative Zoology, and it is here designated the lectotype. One specimen, also a female, from the Las Vegas locality is in the United States National Museum. Allotype, by present designation: Pingree Park, Colorado, August 12, 1926 (R. C. Smith); in the Museum of Comparative Zoology.

*Distribution*: UTAH (Manila, August 11, G. F. Knowlton, F. C. Harmston); NEW MEXICO (Las Vegas, Mesilla, Santa Fe); COLORADO (Longs Peak, 9000 ft., July, E. C. Van Dyke; Golden, July; Pingree Park, August); BRITISH COLUMBIA (100 Mi. House, June).

This rare species is the largest and most striking of our *Symphorobius*. It is close to the smaller *bifasciatus* in wing markings and general body structure, but the male genitalia are decidedly different in the two insects, especially in the form of the distal processes on the anal plates.

Navas' *tristis*, from Pecos, New Mexico, is clearly *angustus*. Navas himself stated that this insect resembled *angustus*, but did not mention characteristics distinguishing the two. The wing, as he has

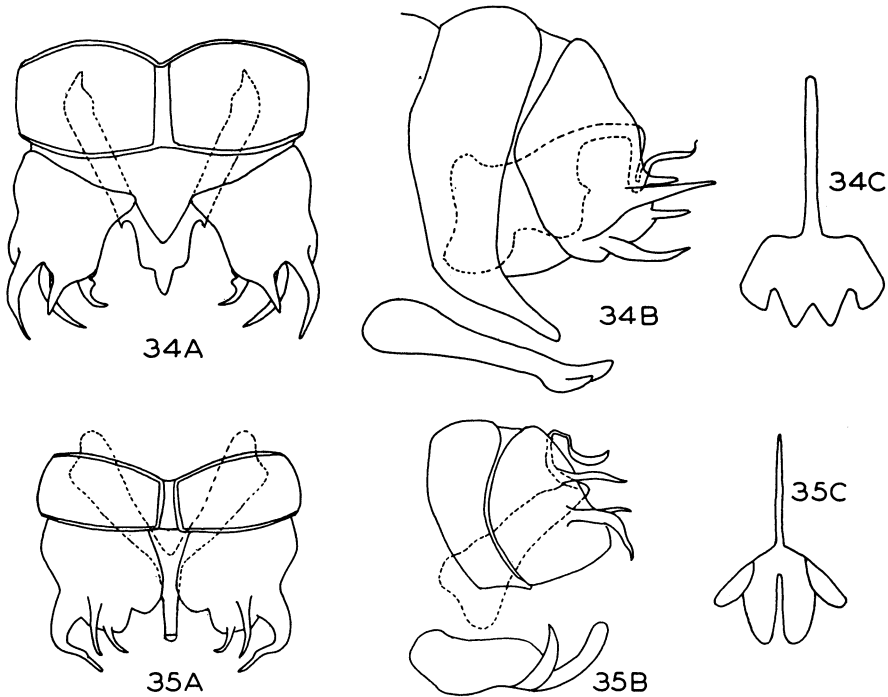


FIGURE 34. *Sympherobius angustus* Banks. A, terminal abdominal segments of male (allotype), dorsal view; B, lateral view; C, parameres of same, dorsal view.

FIGURE 35. *Sympherobius barberi* Banks, A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

drawn it, is broader than that of *angustus*, but his figures are usually incorrectly proportioned. The wing markings, the narrow costal area, and the venation are typical of *angustus*.

*Sympherobius arizonicus* Banks

Plate 2, figure 14

*Sympherobius arizonicus* Banks, 1911, Trans. Amer. Ent. Soc., **37**: 346.

Face dark brown, somewhat reddish, except for a lighter area below antennae; the antennae, thorax and abdomen dark reddish brown. Fore wing: length, 4.5 mm.; width, 2 mm.; costal area narrow, but broader than in *killingtoni*, n. sp.; in the type the wing membrane is so nearly covered with brown maculations that the wing as a whole is nearly uniformly brown, except for numerous, evenly distributed hyaline spots; two lower inner gradate veins not darker than the others; inner gradates normally arranged, the two lower and two upper close together; radial cross-vein absent. Hind wing: slightly brownish. The male is unknown.

*Holotype* (♀): Prescott, Arizona (Osler); in the Museum of Comparative Zoology.

This strikingly marked species I have not been able to recognize in any of the collections of *Sympherobius* which have been sent to me. It is possible that the type is only a very heavily marked specimen of the species which I have described below as *killingtoni*, but none of the numerous individuals of the latter which I have seen even approach the type of *arizonicus* in wing markings.

*Sympherobius pictus* (Banks)

Plate 2, figure 13

*Hemerobius pictus* Banks, 1904, Can. Ent., **36**: 62.

*Sympherobius pictus* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 41.

Face light or medium brown; vertex dark brown; antennae grey; thorax and abdomen dark brown. Fore wing: length, 5 mm.; width, 2 mm.; broadly oval; costal area narrow, as in *arizonicus*; membrane hyaline; distal half of wing conspicuously bordered by a series of extensive light brown maculations, not quite contiguous; four conspicuous dark brown bands extend transversely over the middle part of the wing, one at the level of the outer gradates, one at the level of the two upper

inner gradates, one at the level of the two lower inner gradates, and one at the level of the forking of MP; radial cross-vein absent; inner gradates normally arranged, the two upper and the two lower ones close together; because of the oval shape of the wing, the inner gradate veins seem nearer to the base of the wing than they do in *arizonicus* or *killingtoni*. The male is unknown.

*Types*: Two females (cotypes) from "south western" Colorado (Oslar) are in the Museum of

*Sympherobius barberi* (Banks)

Figure 35; plate 1, figure 9

*Hemerobius barberi* Banks, 1903, Proc. Ent. Soc. Wash., **5**: 241.

*Sympherobius barberi* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 42.

Face light reddish to light yellowish brown; vertex with some dark brown over eyes; pronotum

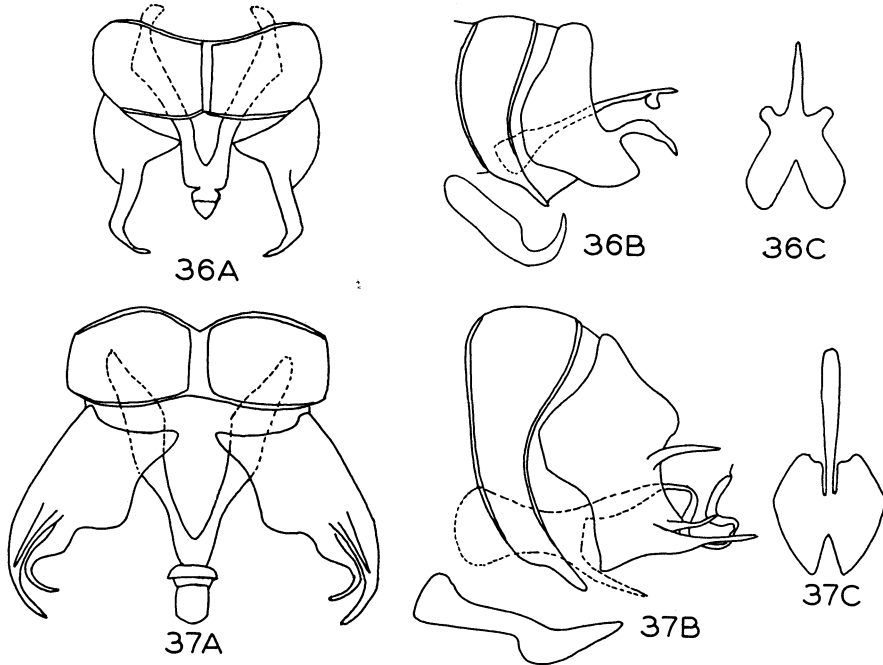


FIGURE 36. *Sympherobius perparvus* (McLach.). A, terminal abdominal segments of male, dorsal view; B, same, lateral view; C, parameres, dorsal view.

FIGURE 37. *Sympherobius distinctus*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

Comparative Zoology; one of these has been now labelled the lectotype.

In addition to the types, I have seen only one other specimen of *pictus*, that also being a female; it was collected near Saguache, Colorado, August 10, 1937, by R. H. Painter, and is in Dr. R. C. Smith's collection.

The fore wings of this species are marked in a unique manner, so far as our Nearctic species are concerned. There is a slight possibility that this is the same insect as *killingtoni*, n. sp., the three individuals mentioned above being in this case abnormally marked. However, I have seen no specimens of *killingtoni* with markings in any way resembling even faintly those of the types of *pictus*.

with a light brown stripe, bordered by darker brown, this being distinctly spotted; mesonotum usually uniformly reddish brown; abdomen dark or medium brown. Fore wing: length, 4.5 mm.; width, 2 mm.; broadly oval, with a very broad costal space; radial cross-vein absent; membrane hyaline, with numerous irregular light brown maculations; a dark brown patch near the end of Cu1 and at the inner angle of wing; cross-veins not margined usually, rarely very faintly. Anal plates of male with three distal processes, the outer lateral one being strongly curved and in most specimens strongly twisted; the inner process is very short and the dorsal one is only a little longer than this; tenth sternite moderate in size, with somewhat

broader "wings"; parameres as in *californicus*, with a shorter fused portion.

*Types*: two females (cotypes) from Williams, Arizona, July 20 and 21 (H. S. Barber and E. A. Schwarz); in the United States National Museum. Allotype, by present designation: Tucson, Arizona, December 19, 1934 (L. P. Wehrle); in the Museum of Comparative Zoology.

*Distribution*: CALIFORNIA (Ft. Yuma, Imperial Co.; Alpine, San Diego Co.; Cloverdale, Sanomco Co.; Susanville, Larsen Co.; Pleyto, Monterey Co.; Ventura; Campo; Indio; San Jacinto Mts., Redding; Claremont; Santa Paula; Mt. Wilson; Alhambra); OREGON (Coelstin, Jackson Co.); COLORADO (Sloss; Glenwood Springs); ARIZONA (Maricopa, Pinal Co.; Patagonia; Santa Rita Mts.; Cochise Co.; Yarnell; Tucson; Huachuca Mts.); NEW MEXICO (Mesilla); UTAH (Klags Sta., Davis Co.; Pintura); TEXAS (Brownsville; Devil's River; Sutton Co.; Karnes Co.; Calvert; Galveston); OKLAHOMA (Grandfield; Page; Pearson; Oswalt; Big Cedar; Lebanon; Tuskahoma); KANSAS (Manhattan; Wichita); ARKANSAS (Washington Co.); FLORIDA (Cedar Keys; Jacksonville, Tampa); SOUTH CAROLINA (Charleston); VIRGINIA (Falls Church); OHIO (Summit Co.); NORTH CAROLINA (no further data); PENNSYLVANIA (no further data). The adults have been collected during all months of the year, though they seem to be most abundant during the summer months.

This is the commonest southern species of the genus. It is similar to *amiculus* in appearance, but differs in the lack of the radial cross-vein in the fore wing, as well as in many details of genital structure. The inner and dorsal processes of the anal plates are very short. In all specimens of *barberi* which I have seen from the area west of Oklahoma and Kansas, the outer process of the anal plates is distinctly twisted, but in specimens from the more eastern states, this process is hardly twisted at all. There seems, therefore, to be some geographic factor involved here, but I have been unable to detect any other characteristics which are correlated with the one mentioned.

Dr. L. P. Wehrle has sent me a fine series of this species which he has bred in the laboratory; the larvae fed on the mealy bug, *Lantana camara* var. *mista*.

***Symphorobius limbus*, n. sp.**

Figure 38

Face light reddish brown, clypeus darkened; vertex pronotum, mesonotum and abdomen nearly

uniformly reddish brown, only slightly darker laterally than medially; antennae grey-brown. Fore wing: length, 3.4 mm.; width, 1.3 mm.; moderately slender; costal area narrow, as in *angustus*; membrane yellow; inner and outer gradates margined with large brown spots, mostly faint; radial cross-vein absent. Anal plates of male with three processes, the outer very large, stout, and only slightly curved, the inner-ventral one short and very strongly curved, and the dorsal one short and straight; tenth sternite with a prominent ventral process extending posteriorly from each "wing"; parameres with the fused part forming a spatulate head, with a conspicuously fringed margin.

The female is unknown.

*Holotype* (♂): Alpine, Texas. July 1, 1928, (R. H. Beamer); in the University of Kansas Museum.

This small *Symphorobius* resembles *killingtoni* in general habitus, but can be distinguished by the yellow wings. The male genitalia are unusual in having the posterior process on the tenth sternite and especially the fringed border on the parameres, a characteristic which I have not seen in any other members of the genus.

***Symphorobius similis*, n. sp.**

Figure 39

Face yellow; vertex yellow-brown, with some dark brown laterally; pronotum and mesonotum with a median yellow, longitudinal stripe, bordered laterally with dark brown; first antennal segment yellow, others dark brown; abdomen yellow-brown. Fore wing: length, 3.5 mm.; width, 1.8 mm.; moderately slender, much as in *angustus*; costal area narrow as in the latter; membrane smoky, with faint and scattered brown maculations; Cu1 as far as m-cu, Cu2, and most cross-veins strongly margined with dark brown; radial cross-vein present between R4 + 5 and R1 + R<sub>2</sub>, before origin of R2 + 3; inner gradates close together, normally arranged. Anal plates of male with two processes, the outer one stout and strongly curved, the inner one small and nearly parallel with the other; tenth sternite with broad "wings," each bearing a small posterior tooth; parameres small, the fused part forming a spatulate head, with a pair of anterior projections.

The female is unknown.

*Holotype* (♂): Santa Rita Mountains, Arizona, July 17, 1932 (R. H. Beamer); in the University of Kansas Museum.

This small species resembles *bifasciatus* Banks. The wings of *similis* are somewhat broader than

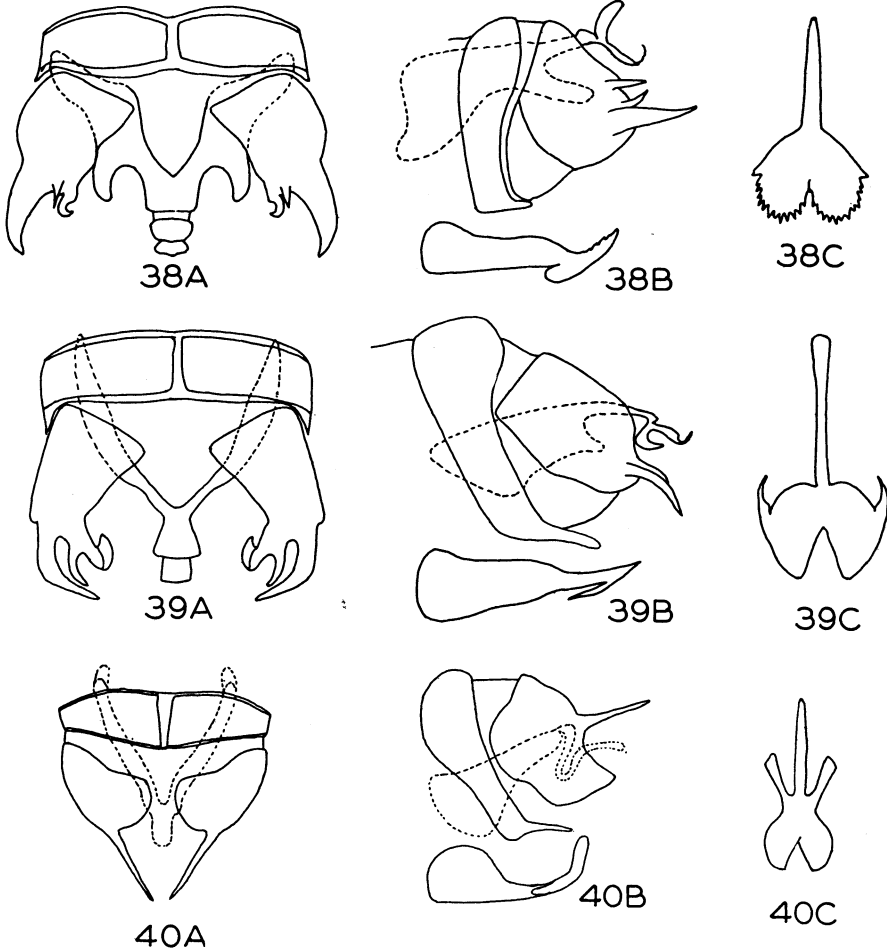


FIGURE 38. *Sympherobius limbus*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

FIGURE 39. *Sympherobius similis*, n. sp. A, terminal abdominal segments of male (holotype), dorsal

view; B, same, lateral view; C, parameres of same, dorsal view.

FIGURE 40. *Sympherobius killingtoni*, n. sp. A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

those of *bifasciatus* and possess brown veins which are very nearly uniformly colored, not interrupted with white, as in *bifasciatus*. The male genitalia are very different from those of the latter, having only two unforked processes on the anal plates.

*Sympherobius perparvus* (McLachlan)

Figure 36; plate 2, figure 15

*Hemerobius perparvus* McLachlan, 1869, Ent. Mo. Mag., 6: 22.

*Sympherobius perparvus* Banks, 1905, Trans. Amer. Ent. Soc., 32: 41.

*Sympherobius sparsus* Banks, 1911, Trans. Amer. Ent. Soc., 37: 346.

Face pale brown, often slightly reddish; vertex usually somewhat darker brown; pronotum and mesonotum brown or dark brown, variegated; antennae dark grey-brown; abdomen brown, often dark brown. Fore wing: length, 4 mm.; width, 1.5 mm.; slender; costal margin narrow; membrane hyaline; maculations grey, usually rather large but widely scattered; gradate veins and longitudinal veins not margined; as a result of the slenderness of the wing the branches of Rs are much longer than in the other Nearctic species of *Sympherobius*; radial cross-vein absent; inner gradate veins widely separated, forming a fairly even series. Anal plates of male with an elongate but very slender posterior projection ventrally;

tenth sternite rather small, the "wings" not greatly expanded; parameres small, the fused part broad as viewed from the side, the separated parts forming two spatulate plates, strongly curved, as viewed laterally.

*Types*: Three specimens (2♀, 1♂) from Bosque Co., Texas (G. W. Belfrage); in the British Museum.

*Distribution*: CALIFORNIA (Bishop; Indio; Little Lake, Inyo Co.); ARIZONA (Patagonia; Wilcox; Washington Mts., near Nogales); NEW MEXICO (Mesilla; Vaughn); COLORADO (Boulder, London); TEXAS (Bosque Co.; Jackson Co.; Potter Co.); OKLAHOMA (Lugert; Roff; Oswalt); KANSAS (Manhattan; Wichita; Stafford Co.; St. Frances; Ellsworth; Dickerson Co.); SASKATCHEWAN (Saskatoon, July 26, K. M. King). The adults have been collected from May through September.

This is the smallest and palest of the Nearctic Sympherobius. It differs from all others in the elongate fore wing and the widely separated gradate veins. The male genitalia are closest to those of *killingtoni*, n. sp., both species having the single process on the anal plates. In *perparvus*, however, this process is strongly curved, whereas it is perfectly straight in *killingtoni*.

Banks' *sparsus* was based upon a female from Kansas (type in the Museum of Comparative Zoology) which unquestionably is *perparvus*; the widely spaced inner gradates were mentioned by Banks in his description. Although I have not been able to examine the types of *perparvus* at the British Museum, the McLachlan collection having been received there shortly after my visit to the museum in 1938, Mr. D. E. Kimmins kindly compared specimens which I sent to him with the types. All of the latter possess the venational and other wing characteristics of the species described here as *perparvus*.

#### **Sympherobius distinctus**, n. sp.

Figure 37

Face very dark red-brown; vertex, pronotum, mesonotum somewhat lighter; metanotum apparently with a median yellow stripe; abdomen dark brown. Fore wing: length 6.5 mm.; width, 2.5 mm.; broad, but costal space narrow; veins uniformly dark brown, not spotted; membrane of wing mostly hyaline, but irregular brownish maculations are very abundant and are very diffuse along the posterior margin; gradate veins not margined; inner gradate veins normally arranged, the

upper two and the lower two close together; radial cross-vein absent. Anal plates of male with three terminal processes, the inner one being broad basally and very strongly curved distally; tenth sternite small, but distinctive, possessing a long posterior process on each of the "wings"; parameres with the spatulate head of other Sympherobius, but lacking the twisted lobation present in other Nearctic species.

*Holotype* (♂): Pingree Park, Colorado; August 18, 1926 (R. C. Smith); in the Museum of Comparative Zoology.

This is a very unusually marked species. The uniformly brown wings of *distinctus* are found elsewhere only in *gracilis*, *occidentalis* and *umbratus*, all of which have differently arranged markings, the maculations coinciding with the cells of the wing. *Distinctus* is probably closer to *arizonicus* than to any other members of the genus, at least so far as wing structure is concerned; but it has larger hyaline areas on the wing and the veins are uniformly brown. The male genitalia are unique in having the long posterior process on the "wings" of the tenth sternite.

#### **Sympherobius killingtoni**, n. sp.

Figure 40; plate 2, figure 11

Face from light to dark brown; vertex dark brown; antennae grey; pronotum and mesonotum dark brown, often reddish; abdomen dark brown. Fore wing: length (average), 4.5 mm.; width, 2 mm.; moderately broad, but with narrow costal space; wing membrane hyaline, maculations usually greyish brown or light brown and evenly distributed; inner gradate veins normally arranged, not widely separated, the two upper ones and the two lower ones close together and dark brown; radial cross-vein absent; cross-veins usually margined, and in many specimens the inner gradates (especially the lower two) are widely and heavily margined with dark brown. Anal plates of male with a single distal process, this being straight, not curved as in *perparvus*; ninth tergite with a slender posterior projection ventrally, as in *perparvus*; tenth sternite with broad "wings"; parameres similar to those of *perparvus*, but with a smaller, spatulate head, and long oblique processes extending anteriorly.

*Holotype* (♂): Eureka, Utah, August 13 (T. Spaulding); in the Museum of Comparative Zoology. Allotype, same locality data, August 15; in the Museum of Comparative Zoology.

*Paratypes*: 1♂, Mesilla, New Mexico; 2♂, Eureka, Utah, August 13 (Spaulding); 1♂, same,

August 14; 1♂, Williams, Arizona, May 28; 1♂, Globe, Arizona, August 10 (Parker); 1♂, Tucson, Arizona, June 7, 1934 (A. A. Nichol); 3♂, 1♀, Tooele, Utah, August 29, 1937 (L. L. Hansen); 1♂, Logan, Utah, August 29, 1937 (L. L. Hansen); all in the Museum of Comparative Zoology.—1♀, Logan, Utah, July 6, 1937 (H. F. Knowlton); 1♀, Trout Creek, Utah, July 25, 1937 (H. B. Stafford); 1♀, Las Vegas, New Mexico, August 4 (H. S. Barber); 1♀, Kamos, Utah, June 24, 1936 (F. C. Harmston); 1♂, Williams, Arizona (H. S. Barber); 1♂, Dallas, Texas, March 6, 1909 (F. S. Tucker); 1♀, Tooele, Utah, August 29, 1937 (L. L. Hansen); all in the United States National Museum.—2♀, Independence, California, June 13, 1929 (R. L. Usinger); 1♂, 1♀, El Paso, Texas, March 25, 1937 (J. O. Martin); 1♀, Maricopa, Pinal Co., Arizona, October 17, 1927 (J. A. Kusche); all in the California Academy of Sciences.—1♀, Flagstaff, Arizona, July 30, 1928 (D. J. and J. N. Knull); in the Ohio State University Museum.—1♀, Torrance Co., New Mexico, July, 1925 (C. H. Martin); in the University of Kansas Museum.

*Distribution:* CALIFORNIA (Independence, Needles, Bishop); ARIZONA (Flagstaff, Washington Mts., Tucson, Florence, Maricopa, Globe); UTAH (Eureka, Richfield, Logan, Tooele, Kamos); IDAHO (Hansen, Hubbs, Butte); NEW MEXICO (Las Vegas); TEXAS (El Paso, Dallas). The adults have been collected from March through October.

This species has been confused with *perparvus* in the past. It differs from the latter in having broader and more heavily marked wings and in having the inner gradate veins normally arranged, i.e., the two upper and two lower gradates of the fore wing are close together, as in all Nearctic Sympherobius except *perparvus*. The male genitalia are close to those of *perparvus*, but the process of the anal plates is straight, not curved as in the latter. I had at first thought that *killingtoni* might be *arizonicus* Banks, the type of which is a unique female; but the wing markings of this type are so very different from that which I have seen in the long series of *killingtoni* that the possibility of such an identity seems extremely slight. There is a similar remote chance that *killingtoni* is *pictus* Banks, known only from the two female types and one additional female, but here again the wing markings of the known specimens of *pictus* are strikingly different from those of all the *killingtoni* which I have seen.

This insect has been named for Dr. F. J. Killington, of Southampton, England, whose recent "Monograph of the British Neuroptera" is unquestionably destined to become one of the classics of entomological literature.

#### Genus *Megalomus* Rambur

*Megalomus* Rambur, 1842, Hist. Nat. Ins. Neuropt.: 418; Killington, 1937, Monogr. Brit. Neuropt., 2: 131.

Fore wing: usually broadly oval, costal space very wide and abruptly broadened at base; recurrent humeral vein present; costal veinlets forked; four or more branches of Rs (very rarely three)

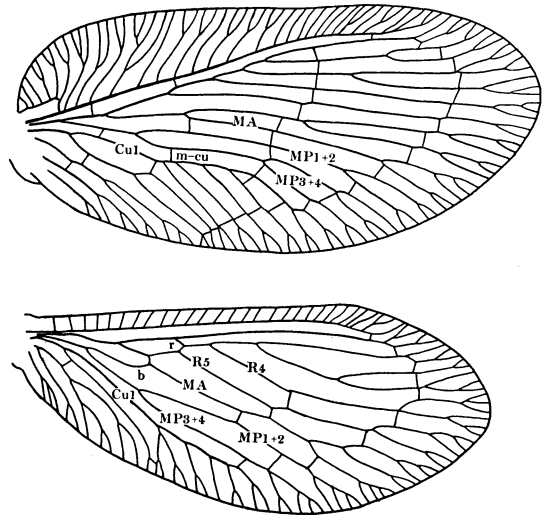


FIGURE 41. Wing venation of *Megalomus moestus* Banks. Lettering as in figure 1.

usually arising from stem  $R1 + Rs$  (not including MA); basal piece of MA either absent, or present at the very base of the wing; a cross-vein present between MA and  $MP1 + 2$ , considerably beyond the origin of the latter; two series of gradate veins, the outer forming a curved line (usually) which is for the most part parallel with the outer margin of the wing; more than ten gradate veins usually present in the outer series.

Hind wing: MA coalesced with Rs for a very short distance or connected with it by a cross-vein (usually); cross-vein between  $R1$  and  $R_s$  close to the point of separation of MA from  $R_s$ , usually slightly distal to it;  $R_s$  with three or four main forks, very rarely two; basal piece of MA usually curved; furcation of MP at the level of or distal to separation of MA from  $R_s$ ; two series of gradate veins, five or more in the outer series,

Anal plates of male subtriangular, with lobes or projections; tenth sternite with extensive wings, bearing prominent processes; aedeagus with two paired plates; parameres fused anteriorly. Anal plates of female small, rounded; ninth sternite divided, with a papiliform process on each plate.

Genotype: *Megalomus tortricoides* Rambur.

The life history of the Nearctic *Megalomus* is unknown. In the European species, according to Killington, the eggs have a sculptured chorion; the larva has a broader head than in *Hemerobius*, the third segment of the antennae is slender and hardly longer than the first, and the jaws are short and stout.

The venation in this genus is excessively variable. In most species the number of branches of the radial sector in the fore wing is greater than that in other genera; but in a few species the individual variation is so great that this difference cannot be regarded as generically rigid. Similarly, the point of furcation of MP in the hind wing, although furnishing diagnostic characteristics for other genera, is highly variable in *Megalomus*. The only venational feature which I have found sufficiently constant in *Megalomus* to be used in the generic key is the position of the basal cross-vein between R1 and Rs in the hind wing, with respect to the origin of R5 (or R4 + 5), and even this fails in some specimens.

Because of its instability the wing venation does not provide satisfactory specific characteristics and this is also true of the wing markings. The shape of the wing, however, is stable enough within the species for this purpose. The male genitalia, which incidentally are markedly different in *Megalomus* from those of other Hemerobiid genera except *Boriomyia*, furnish excellent specific characteristics in most cases.

The genus *Megalomus* has a wide distribution, occurring in Europe, Asia, northern Africa, South America, Central America and North America. It is a small genus, however, and only four species have been found in the Nearctic region. These may be distinguished by the following key:

1. Costal area of fore wing gradually broadened at base ..... *minor* Banks (p. 242)  
 Costal area of fore wing abruptly broadened at base ..... 2
2. Fore wing broadly subtriangular; apex pointed and much nearer to the anterior margin than to the central line of the wing  
     *angulatus*, n. sp. (p. 242)  
 Fore wing broadly oval; apex rounded and about at the central line of the wing ..... 3

3. Cross-veins between Cu1 in the fore wing in line with the outer gradates, the whole series forming a curved line parallel with the outer margin ..... *moestus* Banks (p. 240)  
 Cross-veins between the branches of Cu1 in the fore wing in line with the inner gradates, the whole series forming a straight line across the wing ..... *uniformis* Banks (p. 241)

#### *Megalomus moestus* Banks

Figures 41, 42; plate 2, figure 17

- Megalomus moestus* Banks, 1895, Trans. Amer. Ent. Soc., 22: 314; Banks, 1905, *ibid.*, 32: 43.  
*Megalomus latus* Banks, 1903, Proc. Ent. Soc. Wash., 5: 240; 1905, *ibid.*, 32: 43.

Face varying from light to dark brown, sometimes reddish brown; glabrous; antennae greyish yellow; vertex, pronotum and mesothorax medium and dark brown, somewhat variegated; legs greyish-yellow; abdomen dark brown. Fore wing: length, 7-10 mm.; width, 3.8-5 mm.; broadly and nearly symmetrically oval; costal area very broad, as in all species of the genus, but not so abruptly widened basally as in *uniformis*; Rs with from 5-7 branches leading from R1 + Rs; inner gradate veins arranged in either a straight or broken line; outer gradate veins between the branches of Cu1 forming a continuous line with the outer gradates above; membrane either hyaline or slightly brownish; inner gradate veins strongly margined, forming an oblique streak across the wing, though its extent is variable; usually the membrane on the proximal side of the inner gradates is much darker than that on the distal side; outer gradates of radial sectors usually margined, but the degree of margination very variable; inner angle of wing and region of gradate veins in cubitus marked with dark brown; several irregular and faint, brown maculations are usually present over wing membrane in addition to the marginations of veins; costal area usually spotted with eight or more dark brown maculations. Anal plates of male typical of the genus; tenth sternite with flattened lateral "wings" and a narrow bridge; epimeres fully as long as phallus, strongly curved ventrally as seen in lateral view; phallobase with a small median protuberance posteriorly; plates of aedeagus elongate.

*Holotype*: Sante Fé, New Mexico, July (T. D. A. Cockerell); in the Museum of Comparative Zoology. Since this specimen has the abdomen missing, its sex is unknown.

*Distribution*: NEW MEXICO (Santa Fe, Hot Springs, Pecos, Bedah, Las Vegas); ARIZONA



(Biboquwari Mts., Huachuca Mts., Palmerlee, Globe, Chiricahua Mts.); CALIFORNIA (Claremont, Yosemite Valley); UTAH (Logan, Provo, Vineyard, Salt Lake City, Stockton, Eureka); COLORADO (Estes Park, Georgetown, Boulder, Colorado Springs, Golden, Manitou); TEXAS (El Paso Co.; Ft. Davis, 5000 ft., Jeff Davis Co.); WYOMING (Laramie). The adults have been collected from June through September.

This is the largest of our *Megalomus*. It is unusually variable in venation and in color markings on the wings, especially in the extent of the dark brown around the inner gradate veins.

*Megalomus uniformis* Banks

*Megalomus uniformis* Banks, 1935, Psyche, 42: 56.

Entire body, including antennae and legs, pale brown. Fore wing: length, 6 mm.; width, 3.2 mm.; membrane pale yellow, with only faint traces of light brown maculations; both series of gradate veins margined with light brown; costal area very broad, even more so than in *moestus* and more abruptly widened at base than in *moestus*; the wing as a whole is broader than that of *moestus* and is very nearly symmetrically oval; the apex is very broadly rounded; the gradate veins of the

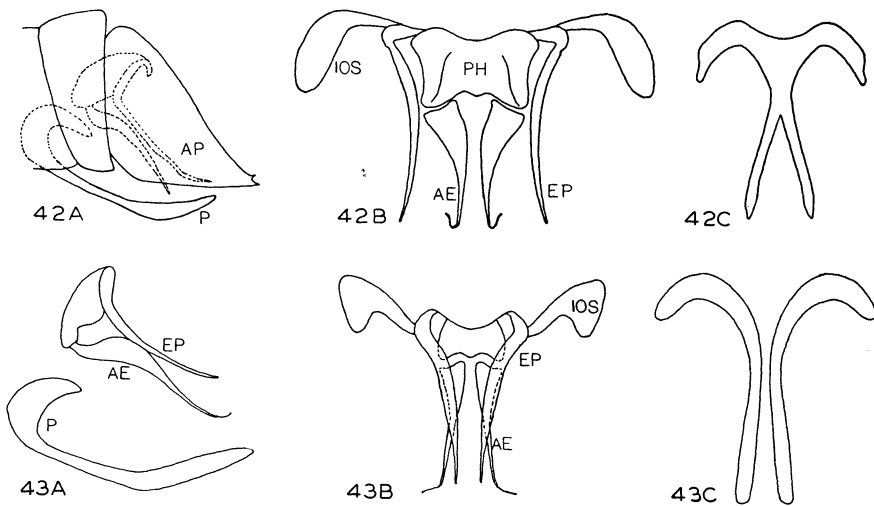


FIGURE 42. *Megalomus moestus* Banks. A, terminal abdominal segments of male; B, same, lateral view; C, parameres of same, dorsal view. PH, phallobase; EP, epimeres; other lettering as in figure 2.

FIGURE 43. *Megalomus angulatus*, n. sp. A, tenth sternite and parameres of male (paratype), lateral view; B, tenth sternite of same, dorsal view; C, parameres of same, dorsal view. Lettering as in figure 42.

Banks' *latus* was based on three specimens, now in the United States National Museum; the holotype, from Williams, Arizona, is a female; one paratype, from Las Vegas Hot Springs, New Mexico, is a female (August 6) and the other, from the same locality (August 13) has the abdomen missing. *Latus* was separated from *moestus* on the extent of the wing markings around the gradate veins. From an examination of the numerous specimens of *moestus* which have passed through my hands, however, I am convinced that the differences indicated for the two species do not hold; there are all gradations in the extent of the markings, and the male genitalia are the same throughout, even in details.

cupitus form a continuous line with the inner gradate veins, not with the outer series as in *moestus*. Hind wing: hyaline, without maculations. The male is unknown. The anal plates of the female are so very similar to those of *moestus* that I can detect no differences.

*Holotype* (♀): Brownsville, Texas; June (F. H. Snow); in the Museum of Comparative Zoology.

This species is known only by the holotype. It may be essentially a Mexican species which enters into the United States only in the region around Brownsville. We can base our conclusions only on the wing structure, but there seems little doubt that this species is distinct from *moestus*. Although the unusual arrangement of

the cross-veins in the cubital region may be individual rather than specific, it is very improbable that the unique wing and body coloring, as well as the shape of the costal area, falls into this category.

***Megalomus angulatus*, n. sp.**

Figure 43; plate 2, figure 18

Face light to medium brown, vertex a little darker; pronotum and mesonotum and abdomen medium to dark brown; legs pale yellow; first two antennal segments light brown, the rest dark brown. Fore wing: 6.5–7 mm.; width, 2.7–3 mm.; broadly subtriangular; apex pointed, much closer to anterior border than to mid-line of wing; costal area nearly as broad as in *moestus*; wing membrane hyaline or nearly so; maculations grey-brown; gradate veins margined with dark brown, forming two conspicuous oblique streaks across the wing; membrane with numerous small, greyish brown maculations, best developed distally, where they form an irregular reticulation and a faint streak from the very apex of the wing to the outer gradate series; cross-veins between the branches of Cu forming a part of the outer gradate series; apical and posterior borders of wing margined with dark brown; outer gradate veins between branches of Rs arranged in nearly a straight line, not curved as in *moestus*. Hind wing: hyaline, with the apex and posterior margin slightly grey-brown. Anal plates of male triangular; tenth sternite like that of *moestus*, but with smaller "wings"; plates of aedeagus slender; epimeres nearly straight in lateral view, not strongly curved as in *moestus*; parameres simple, as in *moestus*, but completely separated. The anal plates of the female are like those of *moestus*.

*Holotype* (♂): Ithaca, New York, September 3, 1939 (J. S. Franciemont); in the entomological collection of Cornell University. Allotype: Same locality data, August 3, 1939; in the same collection.

*Paratypes*: 1♂, Niagara Glen, Ontario, June 8, 1926 (G. S. Walley); in the Canadian National Collection, Ottawa.—1♀, Ithaca, New York, June 13, 1915; 1♀, Milford, New Hampshire, June 11; both in the Museum of Comparative Zoology.—1♂, Naples, Maine, August 20, 1934 (R. H. Beamer); in the University of Kansas Museum.

This striking species is close to *moestus* in general form, but differs in having a subtriangular fore wing, which is most unusual for a *Megalomus*, and also by the wing markings, which are not of

the pattern ordinarily found in the genus. Differences are also evident in the male genitalia. The chief interest of the species lies in the fact that it is the first record of the genus east of the Rocky Mountain region.

In addition to the above mentioned individuals, I have seen four specimens apparently identical with the types in all respects: ♂, Pima Co., Arizona, July 29, 1927 (R. H. Beamer); ♀, Baboquivari, Arizona, July 19, 1934 (R. H. Beamer); and 2♀, near Sabinas Hidalgo, Nuevo Leon, Mexico, June 7, 1932 (Hobart Smith). Since these specimens were collected at places remote from the holotype locality, I have not designated them paratypes. The distribution indicated by these four specimens and the types is a most unusual one, but I have been utterly unable to discern any differences between the eastern and western lots. It may be that the species will eventually turn up in the Rocky Mountain region, in which case the distribution would not be unlike that of many other insects.

***Megalomus minor* Banks**

Figure 44

*Megalomus minor* Banks, 1905, Invert. Pacifica, **1**: 90; 1905, Trans. Amer. Ent. Soc., **32**: 43.<sup>14</sup>

Head, antennae, legs yellow; vertex with a thin and rather indistinct median dark stripe; thorax and abdomen dark brown. Fore wing: length, 5 mm.; width, 2.5 mm.; costal area broad, but only gradually widened at the base, not abruptly, as in the other species of the genus; wing membrane hyaline, slightly yellowish; light brown maculations around the inner and outer gradate veins; a patch of dark brown near the outer gradate veins of the cubitus; Rs in the type with only four branches arising from the stem R1 + R<sub>2</sub>. Anal plates of male as in *moestus*; tenth sternite with broader wings than in the latter; epimeres as long as the aedeagus; plates of aedeagus apparently firmly attached to phallobase; parameres very complex, as seen in dorsal view, with an anterior, triangular basal piece, and two posterior arms, with an oblique tooth-like projection between the base and the arms.

*Types*: Three cotypes were mentioned by Banks, two from San Marcos, Nicaragua, and one from Ormsby Co., Nevada (G. F. Baker). The latter specimen, a male, is in the Museum of Compar-

<sup>14</sup> This species was described as new in both of the papers listed, but the *Invertebrata Pacifica* was actually published first.

ive Zoology and is here designated the lectotype. One of the Nicaragua specimens, a female, is also in the Museum of Comparative Zoology, but I have not been able to find the second specimen from that locality. Although the occurrence of this species in Nicaragua and Nevada seems rather unlikely, I have been unable to discover any differences in the specimens at hand. The examination of a male from San Marcos will definitely settle the question.

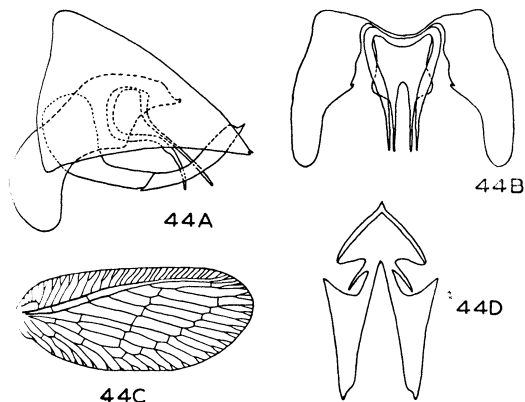


FIGURE 44. *Megalomus minor* Banks. A, terminal abdominal segments of male (holotype), lateral view; B, tenth sternite of same, dorsal view; C, fore wing; D, parameres, dorsal view. Lettering as in figure 42.

This species is unusual for a *Megalomus* in many respects. The wing venation, as pointed out by Banks, is more open than is normal in the genus. The parameres, moreover, are not at all like those of *moestus* or *angulatus*, but instead are very similar to those in *Boriomyia*. On the other hand, there are several characteristics of *minor* which are perfectly typical of *Megalomus*, such as the form of the tenth sternite and the three main forks of Rs in the hind wing, as well as the position of the radial cross-vein in the hind wing with respect to the origin of R5. These several points of similarity with the species of *Megalomus* more than balance the difference in the form of the parameres.

#### Genus *Boriomyia* Banks

*Boriomyia* Banks, 1904, Proc. Ent. Soc. Wash., **6**: 209 (*nec* Banks, 1905); Killington, 1937, Monogr. Brit. Neuropt., **2**: 256.

*Allotomyia* Banks, 1930, Psyche, **37**: 224.<sup>15</sup>

Fore wing: broadly oval; costal area very broad; recurrent humeral vein present; costal

veins forked; three or four branches of Rs arising from stem R1 + Rs (not including MA); basal piece of MA absent or at very base of wing; two series of gradate veins; more than eight veins in outer series; Cu1 forked only once between m-cu and outer gradate series.

Hind wing: Rs having slight contact with MA; Rs diverging slightly towards R1 after its origin and connected to it by a short basal cross-vein, which is far basal to the origin of R4 + 5; Rs with two main forks; basal piece of MA usually sigmoidal; furcation of MP either at level of separation of Rs from MA or slightly distal to it; two series of gradate veins, more than four in the outer series.

Anal plates slenderly triangular, without projections or distal processes; tenth sternite with extensive wings bearing long processes arising distally and extending ventrally; aedeagus with paired plates; parameres fused anteriorly, with excised outer margins. Anal plates of female small, rounded; ninth sternite small, divided, concealed within eighth; each plate of ninth sternite bearing a raised, semi-spheroid area, with radiating spines, similar to the papiliform processes in *Megalomus*, but not quite so large.

Genotype: *Hemerobius fidelis* Banks.

The immature stages of the species of this genus are entirely unknown.

The affinities of this genus have been uncertain in the past and I believe they have been misunderstood. The genotype species, together with *speciosa*, was for a time placed by Banks in the same genus as *disjuncta* and its relatives. Killington also apparently regarded it as closely allied to *Kimminsia*. However, a study of the male and female genitalia of *fidelis* and *speciosa* shows that these insects are really very closely related to *Megalomus*, not to *Kimminsia* or *Hemerobius*. The anal plates and the tenth sternite are surprisingly similar in *Megalomus* and *Boriomyia*, the chief difference in the male genitalia being in the form of the parameres. In this connection the genital structure of *Megalomus minor* Banks is particularly interesting, since the parameres of that species are more like those of *fidelis* and *speciosa* than they are of other *Megalomus*. The ninth sternite of the female abdomen in *Boriomyia* is divided like that in *Megalomus*, and likewise possesses the semi-spheroid area with radiating spines, characteristics which do not occur, so far as I am aware, in any other Hemerobiid genera. Furthermore, it is difficult to find vena-

<sup>15</sup> See page 215.

tional differences between the genera which hold for all species of each. It has been thought in the past that *Megalomus* could be distinguished from *Boriomyia* and other genera by the greater number of branches of the radial sector; but an examination of a large series of specimens of *Megalomus* shows that a four-branched radial sector occurs commonly in some species of the genus. In view of the fact that this type of radial sector is also found in *Boriomyia* (as well as in some other genera of Hemerobiidae) the number of branches of Rs can hardly serve as a reliable characteristic of *Megalomus*. The only venational differences between *Megalomus* and *Boriomyia* which I have found to hold almost without exception is the

Fore wing with two transverse brown bands, one along the inner gradates, the other along the outer ..... *fidelis* Banks (p. 244)  
 Fore wing with very conspicuous dark brown spots around the distal cross-veins of Cu1, the inner and outer gradates and a few other cross-veins  
*speciosa* Banks (p. 245)

*Boriomyia fidelis* (Banks)

Figures 45, 46

*Hemerobius fidelis* Banks, 1897, Trans. Amer. Ent. Soc., **24**: 27.

*Boriomyia fidelis* Banks, 1904, Proc. Ent. Soc. Wash., **6**: 209; 1905, Trans. Amer. Ent. Soc., **32**: 36.

*Allotomyia fidelis* Banks, 1930, Psyche, **37**: 224.

Face yellow to brown, in northern specimens very dark brown just below antennae; antennae pale yellow to dark brown, almost black in northern specimens; pronotum and mesonotum medium brown to dark brown; metanotum and abdomen dark brown; legs pale yellow. Fore wing: length (average), 4-7 mm.; width, 1.8-3.2 mm.; membrane hyaline; markings light brown (dark brown in northern specimens) forming two transverse bands, one in the region of the inner gradates and the other in the region of the outer gradates of Rs only; in the more heavily marked specimens there is a large area of brown in the region of the gradate cross-veins of the cubitus; a heavy spot of dark brown at m-cu cross-vein. Hind wing: membrane hyaline, but anterior third of wing proximal of pterostigma is smoky. Anal plates of male elongate; tenth sternite with broad "wings" and a pair of prominent acute processes extending posteriorly; aedeagus with plates coalesced basally, forming a pair of divergent broad arms; parameres large, with a broad median plate, and two lateral plates, the latter having a prominent tooth near the middle.

*Holotype* (♀): Gowanda, New York, June 25 (E. P. Van Duzee); in the Museum of Comparative Zoology. Allotype, by present designation: Raleigh, North Carolina, May 24, 1932 (C. S. Brimley).

*Distribution*: NORTH CAROLINA (Raleigh, Tryon, Benson, Rock Point); SOUTH CAROLINA (Tigerville); VIRGINIA (Fairfax Co.); MARYLAND (Plummer's Island; Beltsville); WEST VIRGINIA (White Sulpher Springs, Greenbier Co.); PENNSYLVANIA (Jeanette, Pittsburgh, Natrona); DISTRICT OF COLUMBIA (Washington); NEW JERSEY (Lakehurst); MASSA-

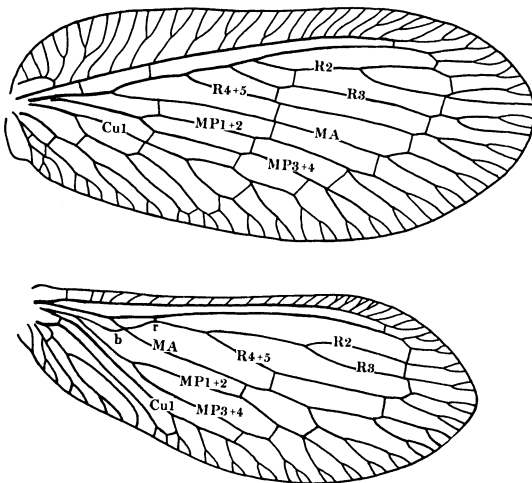


FIGURE 45. Wing venation of *Boriomyia fidelis* (Banks). Lettering as in figure 1.

position of the basal radial cross-vein in the hind wing. In *Megalomus* this cross-vein is very nearly at the point of origin of R5 (or R4 + 5) or even distal to it; in *Boriomyia* the cross-vein is far removed (proximal) from the origin of R4 + 5 (or R5). It is probable, however, that additional species of *Boriomyia*, especially from other regions, will show that this characteristic is variable in the genus to such an extent that it cannot be used as a generic distinction. If that does turn out to be the case, it will presumably be necessary to synonymize *Boriomyia* with *Megalomus*.

The genus *Boriomyia* is at present known only from the Nearctic region, where it is represented by the two following species:<sup>16</sup>

<sup>16</sup> *Boriomyia* (*Allotomyia*) *borealis* Banks is a synonym of *Wesmaelius longifrons* (Walker).

CHUSETTS (Lexington); NEW HAMPSHIRE (Franconia; White Mts.); ONTARIO (Bobcaygeon, July 10, J. McDunnough); BRITISH COLUMBIA (Rolla, July 21, 1927, P. N. Vroom); TEXAS (Terlingua, May 3, 1925); MISSISSIPPI (Shuqualak); ILLINOIS (Elizabethtown, May; Thebes, July). The adults have been collected from May through September. The records are widely scattered, but they indicate that *fidelis* occurs throughout the eastern United States and Canada, from latitude 35° to 45°, and west to longitude 83°. The occurrence of the species in British Columbia

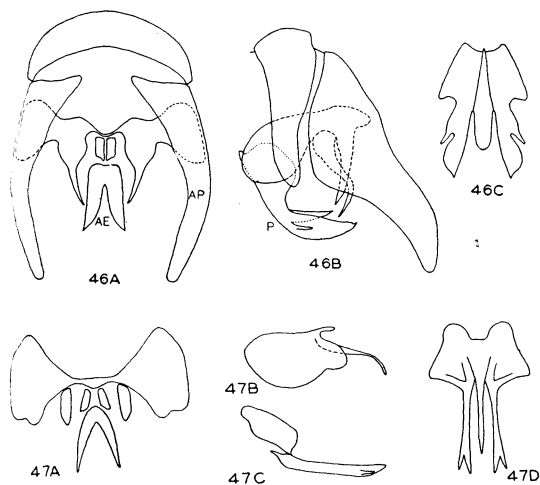


FIGURE 46. *Boriomyia fidelis* (Banks). A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view. Lettering as in figure 42.

FIGURE 47. *Boriomyia speciosa* (Banks). A, tenth sternite of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, lateral view; D, same, dorsal view.

is most surprising; I have seen only the one specimen (from Rolla), but that is a male and exhibits no differences in structure of any nature from the eastern specimens.

The female holotype of *fidelis* is unlike all the other specimens which I have seen in possessing a cross-vein between the lower branch of Rs and R1; I can interpret the presence of this cross-vein in the type only as an abnormality.

*Fidelis* is readily distinguished from the other two species of the genus; from *minor* by the abruptly broadened costal margin, and from *speciosa* by the presence of the two wide transverse bands on the fore wing.

### *Boriomyia speciosa* (Banks)

Figure 47

*Hemerobius speciosus* Banks, 1904, Can. Ent., **36**: 62.

*Boriomyia speciosa* Banks, 1904, Proc. Ent. Soc. Wash., **6**: 209; 1905, Trans. Amer. Ent. Soc., **32**: 37.

*Allotomyia speciosa* Banks, 1930, Psyche, **37**: 224.

Head medium to dark brown; thorax and abdomen very dark brown; antennae and legs yellow. Fore wing: length, 7 mm.; width, 3 mm.; costal area broad, as in *fidelis*; membrane hyaline; markings very dark brown, consisting of spots along the radius at the origin of the several branches of Rs, along the inner gradate veins, along the apex, and at the cross-veins of Cu1. Hind wing: as in *fidelis*, with apex and part of anterior border brown. Anal plates as in *fidelis*; tenth sternite with wider and shorter posterior processes than in *fidelis*; plates of aedeagus slender; parameres very different from those of *fidelis*, having a long, slender, median process extending posteriorly, and a pair of slender, lateral processes forked distally.

*Holotype* (♀): Plummer's Island, Maryland, September 9; in the Museum of Comparative Zoology. Allotype, by present designation: Falls Church, Virginia, August 2 (N. Banks); in the Museum of Comparative Zoology.

In addition to the types, I have seen only three other specimens: a female from near Plummer's Island, September 15 (W. L. McAtee), and two from Sanibel Is., Florida, May 13, 1916.

*Speciosa* resembles *fidelis* in general habitus, but it is readily distinguished from it by the dark spots on the fore wings, in contrast to the lighter, transverse bands in *fidelis*. The male genitalia are in general similar to those of *fidelis*, but the parameres have a very different shape. The terminal abdominal segments of the females of the two species are apparently identical.

### Genus *Micromus* Rambur

*Micromus* Rambur, 1842, Hist. Nat. Ins. Neuropt. 416; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 44; Killington, 1936, Monogr. Brit. Neuropt., **1**: 250.

*Eumicromus* Nakahara, 1915, Annot. Zool., **9**: 36; Killington, 1936, Monogr. Brit. Neuropt., **1**: 257.  
*Stenomicromus* Kruger, 1922, Stett. Ent. Zeit., **83**: 171.

*Pseudomicromus* Kruger, 1922, *ibid.*: 172.

*Paramicromus* Kruger, 1922, *ibid.*: 172.

Fore wing: broadly or slenderly oval; costal area narrow at base; recurrent humeral vein present; costal veinlets forked; three or more branches of Rs arising from stem  $R1 + Rs$  (not including MA); basal piece of MA absent; cross-vein between MA and  $MP1 + 2$  shortly after origin of the latter; two series of gradate veins, five cross-veins or more in the outer series.

Hind wing: Rs usually connected to MA by a cross-vein or (rarely) in actual contact with MA; Rs connected to  $R1$  by a cross-vein usually after the separation of MA from Rs (or the connecting cross-vein); furcation of MP at about the level of separation of MA from Rs (or the connecting cross-vein); basal piece of MA usually very conspicuous; two series of gradate veins, five or more in the outer series.

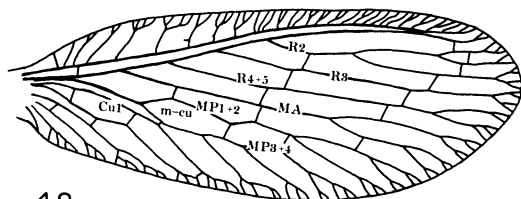
Anal plates of male suboval, with a posterior process arising from the lower margin; aedeagus with two plates, somewhat divergent; parameres fused proximally. Anal plates of female rounded; eighth sternite without sclerotized plates.

Genotype: *Hemerobius variegatus* Fabricius.

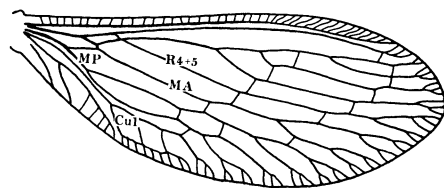
The egg has a smooth chorion, except for some pitting anteriorly. The larva is like that of *Hemerobius*, but has more slender jaws. The life history of three Nearctic species is known: *posticus* Walker (Smith, 1923); *subanticus* Walker (Smith, 1934);<sup>17</sup> and *angulatus* Stephens (Aubrook, 1935).

Several attempts have been made to divide this genus. *Eumicromus* (genotype *M. numerosus* Navas, Asia) was established by Nakahara (1915) for certain species previously included in *Micromus*. Although Killington has accepted this genus in his monograph, the proposed distinctions between *Micromus* and *Eumicromus* do not hold satisfactorily for the Nearctic species. *Eumicromus* was originally separated from *Micromus* by Nakahara on two differences: in *Eumicromus* Rs of the fore wing has from 4 to 8 branches and M and Cu of the hind wing are partially coalesced; in *Micromus* Rs of the fore wing has 3 or 4 branches and M and Cu of the hind wing are free. It is significant to note that the number of branches of Rs in the fore wing overlaps in the two genera, four being common to certain species of both. On the basis of the structure of M and Cu in the hind wing, which seems to be fairly constant in all species, all of the Nearctic species formerly in *Micromus* belong to

*Eumicromus*, although certain of these are closer in other respects to *variegatus*, the genotype of *Micromus*, than to the other species. Killington indicated no additional differences between the two genera except the shape of the wings, those of *Micromus* being narrow and elongate, and those of *Eumicromus* being broadly oval. However, two Nearctic species, *subanticus* and *variolosus*, although belonging to *Eumicromus* on the basis of the structure of M and Cu in the hind wing, have the narrow and elongate wings as in *variegatus*. It



48



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FIGURE 48. Wing venation of *Micromus posticus* (Walker). Lettering as in figure 1.

FIGURE 49. Venation of fore wing of *Micromus variolosus* Hagen. Lettering as in figure 1.

is my conviction, therefore, especially since no unusual genital differences exist between the two groups, that *Eumicromus* is not a valid genus.

The Nearctic species of *Micromus* may be readily recognized on wing characteristics, such as the arrangement of the inner gradate veins of the fore wing and the point of furcation of  $Cu1a$  in the fore wing. The number of branches of Rs, which has previously been used as a difference between *montanus* and the other Nearctic species, does not hold in a sufficiently high percentage of specimens to be useful taxonomically. The male genitalia show very good specific differences, most of them being discernible without dissection. The terminal ab-

<sup>17</sup>Smith determined the species as *variolosus*, which does not, however, occur in Kansas (at least in the eastern part of the state), where the insects were obtained.

dominal segments of the female are very much alike in all species.

*Micromus* has a wide and nearly cosmopolitan distribution. The five Nearctic species have an extensive range within the region, some being mainly northern and others mostly southern. One species, *angulatus* Stephens, is holarctic. The Nearctic species may be distinguished as follows:

KEY TO THE NEARCTIC SPECIES OF *MICROMUS*

1. Inner gradate veins of fore wing much more than their lengths apart .....2  
    Inner gradate veins at most only their lengths apart .....3
2. Thorax and vertex of head very dark brown; wing markings dark brown, almost black  
    *variolosus* Hagen (p. 251)  
    Thorax and vertex of head medium brown or light brown; wing markings light brown  
    *subanticus* Walker (p. 250)
3. Inner gradate vein of fore wing between MA and MP1 + 2 basal to the one above it, the gradates forming a regular series  
    *angulatus* Stephens (p. 247)  
    Inner gradate vein of fore wing between MA and MP1 + 2 distal to the one above it, the gradate series being irregular at this point .....4
4. Cula of fore wing forked deeply, at least to half the distance from the hind margin to the cross-vein joining it to MP3 + 4 or to the point of coalescence of M3 + 4 and Cu1a  
    *montanus* Hagen (p. 249)  
    Cu1a forked or twiggged very nearly at the wing margin .....*posticus* Walker (p. 248)

*Micromus angulatus* (Stephens)

Figure 50; plate 2, figure 19

*Hemerobius angulatus* Stephens, 1836, Illus. Brit. Ent., Mand., 6: 106.<sup>18</sup>

*Micromus angulatus* Hagen, 1889, Proc. Bost. Soc. Nat. Hist., 23: 280; Banks, 1905, Trans. Amer. Ent. Soc., 32: 45.

*Micromus jonas* Needham, 1905, Bull. N. Y. State Mus., 86: 15.

Face uniformly light brown; antennae pale brown; vertex brown, with some rugose sculpturing on posterior half; pronotum nearly uniformly brown, there being some dark brown laterally; mesonotum uniformly brown; abdomen dark brown. Fore wing: length (average), 7 mm.; width, 3 mm.; broadly oval, apex rounded; membrane yellow-

brown to light brown; veins and maculations brown; maculations forming an irregular network; gradate veins margined; general effect of markings on wings is three obliquely transverse stripes and one or two short longitudinal ones distally; Rs with from 4 to 6 branches; the inner gradate veins form a straight line, the one between MA and MP1 + 2 being in line (slightly basal) with the one above it; points of contact of inner gradate veins with the longitudinal veins close together. Hind wing: MP3 + 4 not coalesced with Cu1; membrane hyaline. Anal plates of male more or less rounded as seen from the side, with a pair of straight, long posterior processes arising from the ventral surface; tenth sternite large, with two prominent, flattened anterior lobes; plates of aedeagus divergent, slightly curved distally; parameres coalesced anteriorly, forming a pair of curved, contiguous arms posteriorly.

*Holotype* (♀): in the British Museum; no collecting data are known, but the specimen was probably taken near London.

*Distribution*: QUEBEC (September–October); ONTARIO (May, July–October); MAINE (Machias, August 10); VERMONT (Woodstock, August 11); NEW HAMPSHIRE (White Mts.); NEW YORK (Fulton Co.; Cranberry Lake; Ithaca; Old Forge; Hillside, September 22); MICHIGAN (Chebaygan Co., July 27); WISCONSIN (Wittemberg, August 27; Brule, August 19); MINNESOTA (Twin Harbors, May, July–August); COLORADO (Selkirk Mts.); SOUTH DAKOTA (Custer Co.); MANITOBA (Stony Mts., October 8, 1911; Swan River, August 2); SASKATCHEWAN (Saskatoon, September 13); ALBERTA (Calgary); BRITISH COLUMBIA (Vernon, September 29; Point Grey, October 30; Agassiz, July 29); YUKON (Dawson, August 29). The species also occurs in Europe, from Finland and Siberia to Spain and Palestine (according to Killington). The most southern record known to me in the Nearctic region is in Colorado, and although no additional locality data are available for that specimen, it was probably taken at a high altitude.

The wings of this species are distinctly marked and have obvious venational peculiarities, such as the arrangement of the gradate veins. The genitalia are closest to those of *posticus*, but there are many obvious differences, such as in the shape of the aedeagus, as shown in the figures.

*M. jonas* Needham, based upon wings found in the stomach of a bullfrog, is unquestionably a

<sup>18</sup>The European synonymy is not included here, since it has been listed in Killington's recent monograph of the British Neuroptera (1936).

synonym of *angulatus*. The author gives no definite characteristics for separating the two species, but merely states that the wings alone will distinguish it. His figures of the wings, however, reveal no differences of a specific nature. The radial sector of the fore wing illustrated has only three branches, instead of four, as is usually the case; but I have seen several specimens of *angulatus* with three branches in one wing and four branches in the opposite wing.

pointed; wing membrane hyaline, but nearly covered with faint, greyish brown, irregular maculations; gradate veins lightly margined with brown, forming two very thin oblique transverse stripes; usually three or four branches of Rs; Cu1a with a very shallow distal fork or twigged at the margin; inner gradate vein between MA and MP1 + 2 distal to the one above, the gradate series being broken at this point; inner gradate veins less than their lengths apart. Hind wing: MP3 + 4 not

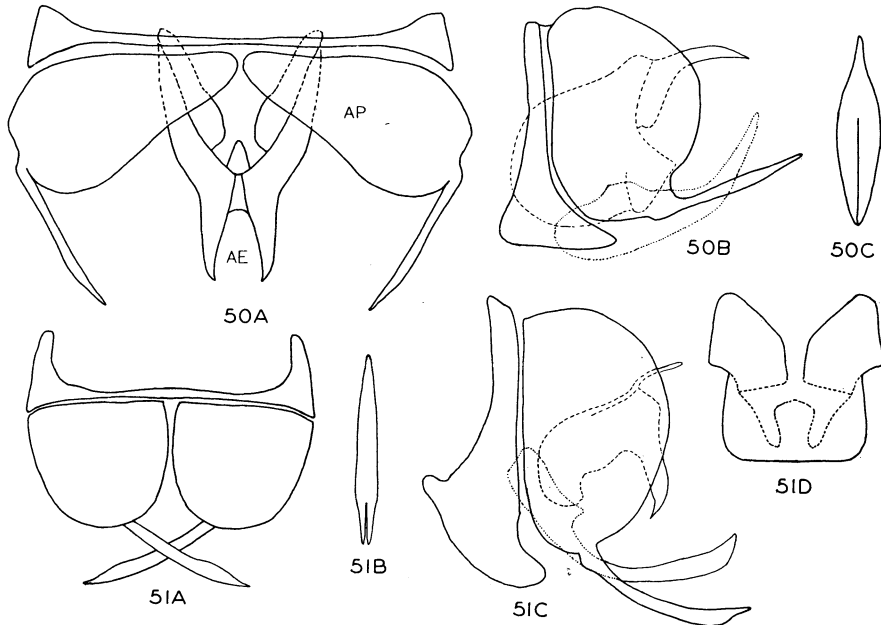


FIGURE 50. *Micromus angulatus* Steph. A, terminal abdominal segments of male, dorsal view; B, same, lateral view; C, parameres of same, dorsal view. Lettering as in figure 2.

FIGURE 51. *Micromus posticus* (Walker). A, terminal abdominal segments of male, dorsal view; B, parameres of same, dorsal view; C, terminal segments of male, lateral view; D, tenth sternite of same, dorsal view.

*Micromus posticus* (Walker)

Figure 51

*Hemerobius posticus* Walker, 1853, List. Spec. Neuropt. Ins. Brit. Mus.: 283.

*Micromus posticus* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 45.

*Micromus insipidus* Hagen, 1861, Syn. Neuropt. N. A.: 199; Hagen, 1886, Proc. Bost. Soc. Nat. Hist., **23**: 285.

*Micromus sobrius* Hagen, 1861, *ibid.*: 199.

Head, thorax and abdomen nearly uniformly brown, with some irregular darker areas on thorax; antennae and legs lighter brown. Fore wing: length, 9 mm.; width, 4 mm.; apex slightly

coalesced with Cu1; membrane hyaline, no maculations. Anal plates of male short, almost semi-circular, with a long posterior process arising from the ventral margin; tenth sternite small, "wings" without lateral posterior extensions; aedeagus short, slightly curved, directed ventrally; a very wide median distal process of the tenth sternite extends above the aedeagus; parameres coalesced for nearly their whole length.

*Types*: Two cotypes ( $\delta$ ,  $\text{♀}$ ), from Georgia (Abbot); in the British Museum.

*Distribution*: This species is common over the eastern United States from Massachusetts westward to Minnesota and southward to Florida and Texas; in Canada the species has been found only



in Ontario (Niagara, Norfolk, Vineland). I have seen no specimens from northern New England or the eastern Canadian provinces. A few specimens have been collected in Nebraska (Lincoln, Omaha), Kansas (Montgomery Co.; Riley Co.; Troy; Douglas Co.); Colorado (Pingree Park); North Dakota (Linton), and Arizona (Maricopa Co.).

*Posticus* is the commonest species of the genus in the Nearctic region. It is readily distinguished from *montanus* by the nature of the branching of Cu1, and in general appearance it does not even resemble the other species.

The types of *insipidus* Hagen and *sobrius* Hagen are in the Museum of Comparative Zoology; they are unquestionably *posticus*, as was suggested by McLachlan and as they have been subsequently regarded.

thin gradate stripes and three short and broader distal bands between the outer gradates and the hind margin; five bands of Rs usually present, but specimens with four branches are not rare; inner gradate vein between MA and MP1 + 2 slightly proximal to the one above it, there being a break in the gradate series at this point; first fork of Cu1 much closer to the gradate vein between Cu1 and Cu2 than to the m-cu cross-vein; Cu1a forked more than half way from the wing margin to m-cu. Hind wing: hyaline, no maculations; MP3 + 4 not coalesced with Cu1. Anal plates of male with a very long and strongly arched posterior process, the dorsal surface of the arch being somewhat denticulate; tenth sternite also large, the "wings" giving rise to a pair of prominent posterior lobes; aedeagus long and rather slender; tenth sternite

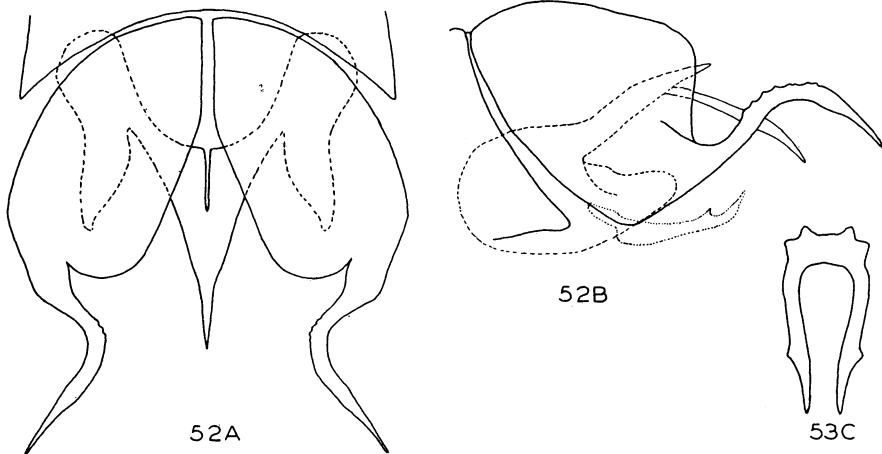


FIGURE 52. *Micromus montanus* Hagen. A, terminal abdominal segments of male (lectotype), dorsal

view; B, same, lateral view; C, parameres of same, dorsal view.

*Micromus montanus* Hagen

Figure 52; plate 2, figure 20

*Micromus montanus* Hagen, 1886, Proc. Bost. Soc. Nat. Hist., **23**: 279; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 45.

Head uniformly light brown; pronotum and mesonotum also light brown, occasionally with a few variable darker areas; antennae and legs light brown; abdomen usually somewhat darker than the rest of the body. Fore wing: length (average), 7-11 mm.; width, 3-5 mm.; broad, slightly pointed; membrane hyaline; veins as a whole light brown and very faint, except where maculations occur; maculations yellow-brown; inner and outer gradate veins dark brown, as also are certain distal branches of Rs; markings consisting of the two

with a short median distal process over the aedeagus; parameres coalesced anteriorly, then divergent, forming a pair of long, pointed and slightly curved arms, with a prominent dorsal subapical tooth.

*Types*: The following cotypes were mentioned in the original description: 1 ♂, 3 ♀, White Mts., New Hampshire, July (Morrison); in the Museum of Comparative Zoology; 1 ♀, same, in the Canadian National collection; 1 ♂, Natick, Massachusetts, in the Museum of Comparative Zoology. The latter is designated the lectotype.

*Distribution*: QUEBEC; NOVA SCOTIA; MAINE; NEW HAMPSHIRE; MASSACHUSETTS; NEW YORK (Fulton Co., Greene Co.); CONNECTICUT (Salisbury); TENNESSEE

(Newfound Gap, Smoky Mts., 5000 ft., August 20); NORTH DAKOTA (Metagoshe); UTAH (Provo, Logan); COLORADO (Golden; Veta Pass; Rocky Mt. Nat'l. Park; Summit Co.); NEVADA (Ormsby Co., July 6); CALIFORNIA (Gold Lake Camp, Plumas Co., July 20, H. G. Dyar); ARIZONA (Graham Mt., July 26, 1933); BRITISH COLUMBIA (Ainsworth; Kokanee Mt.; Brookville; Kaslo; Hedley; Clinton; Hope Mts.); ALBERTA (Nordegg; Waterton Lakes; Banff; Lake Louise); IDAHO (Wallace); WASHINGTON (Northbend, King Co., July 7, 1920, E. C. Van Dyke). Most of the specimens have been collected during June, July and August, but a few were taken in May and September. Although the above records are somewhat spotty, the species apparently ranges across Canada and the northern United States, entering the south only at high altitudes. It seems to be absent from the plains region of United States and Canada.

*Montanus* is the largest species of our *Micromus*. As Hagen pointed out, it is close to the European *paganus* Linn., both having the venational peculiarities mentioned above; the genitalia, however, though of the same general form, differ in various details, as Hagen himself noted. The relationship between these two species is apparently analogous to that between *Hemerobius marginatus* Steph. (European) and *H. costalis* Carp. (Nearctic). From the other Nearctic species of its genus *montanus* is distinguished by the wing markings and especially by the nature of the forking of Cu1.

*Micromus subanticus* (Walker)

Figure 53; plate 2, figure 22

*Hemerobius subanticus* Walker, 1853, List. Spec. Neuropt. Ins. Brit. Mus.: 282.

*Micromus subanticus* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 46.

*Micromus angustus* Hagen, 1886, Proc. Bost. Soc. Nat. Hist., **23**: 287; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 50.

*Micromus nesoticus* Navas, 1914, Bull. Brook. Ent. Soc., **9**: 16, fig. 3.

Head, including vertex, nearly uniformly light or medium brown; thoracic nota medium brown; abdomen dark brown; antennae and legs light brown. Fore wing: length, 7 mm.; width, 2.3 mm.; about three times as long as wide; membrane very light brown, nearly hyaline; veins brownish; Rs usually with three branches; MA and the outer gradates usually dark brown, forming a very thin longi-

tudinal line, bent upwards distally; maculations grey, very faint and confined to the area around the gradate veins and some of the other cross-veins; inner gradate veins very widely separated, more than their length apart; Cu1a usually free from MP, but occasionally coalesced with it for a short distance. Hind wing: hyaline, no maculations; MP not fused with Cu1. Anal plates of male short, terminating in a pair of prominent posterior processes arising from the ventral border; tenth sternite large, the "wings" extended anteriorly and much broadened; plates of aedeagus divergent as seen from the side; parameres fused anteriorly for half their length, separating posteriorly to form a pair of short curved arms.

*Holotype* ( $\delta$ ): St. John's Bluff, East Florida; in the British Museum. Allotype, by present designation: Winter Park, Florida, January 24 (E. M. Davis); in the Museum of Comparative Zoology.

*Distribution*: In the southern part of the United States, below latitude 37°, *subanticus* has been found commonly across the continent from Florida to California; north of this latitude it occurs in the eastern half of the country only, i.e. east of about longitude 97°, where it extends as far north as Massachusetts (lat. 43°). I have seen no specimens from any part of Canada. In the Gulf States and California the adults have been collected during all months of the year; further north they have been taken from June to October.

This species and the following (*variolosus*) differ from our other species of *Micromus* in having slender wings and widely separated inner gradates. *Subanticus* and *variolosus* are very similar to each other, however. There seem to be no constant venational characteristics which serve to distinguish them readily, but this can be done by the body color and wing markings. *Variolosus* is much the darker species, both in body and wing coloring. The male genitalia also show good specific differences, as indicated in the figures.

Hagen's *angustus* was based upon seven specimens of this species from Florida and North Carolina; six types are in the Museum of Comparative Zoology and one is in the Canadian National collection. Hagen himself stated after his description that *angustus* was perhaps *subanticus*, but he separated the two on the number of branches of the radial sector. The branching of the radial sector in *Micromus*, however, is very variable, and furnishes no specific differences.

Navas' *nesoticus* is also this species. This was

based upon an individual from Yaphank, Long Island, New York, and was supposed to differ from *subanticus* by having only "three radial sectors, in place of four." Such venational differences, as already mentioned, are of individual occurrence in *Micromus*.

*Micromus variolosus* Hagen

Figure 54; plate 2, figure 21

*Micromus variolosus* Hagen, 1886, Proc. Bost. Soc. Nat. Hist., **23**: 284; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 46.

Head with face light brown, rarely dark brown in center; vertex, thorax and abdomen very dark

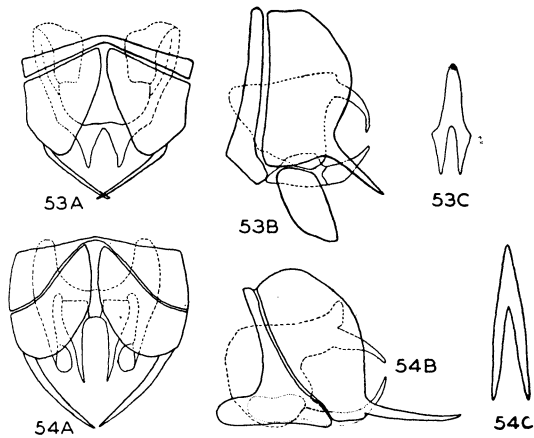


FIGURE 53. *Micromus subanticus* (Walker). A, terminal abdominal segments of male, dorsal view; B, same, lateral view; C, parameres of same.

FIGURE 54. *Micromus variolosus* Hagen. A, terminal abdominal segments of male (allotype), dorsal view; B, same, lateral view; C, parameres of same, dorsal view.

brown, almost black. Fore wing: length (average), 7 mm.; width, 2.2 mm.; shape as in *subanticus*; membrane hyaline; markings brown, much darker than in *subanticus*; veins dark brown, mostly interrupted; maculations most prominent along the posterior border and distal third of the wing; outer gradate veins heavily margined, forming a short but distinct oblique streak which is easily visible; inner gradate veins widely separated, as in *subanticus*; Rs usually with three branches. Hind wing: membrane hyaline, no maculations; MP2 + 3 not fused with Cu1. Anal plates of male short, with long posterior ventral process; tenth sternite large, the "wings" giving rise to a pair of long posterior extensions; plates of aedeagus paral-

lel in dorsal view, almost straight from the side; a short distal process present over the aedeagus; parameres coalesced for less than half their length, forming two strongly curved posterior arms.

*Holotype* (♀): Denver, Colorado; in the Museum of Comparative Zoology. Allotype, by present designation: Rainbow Natural Bridge, Utah, July 5 (C. T. Brues); in the Museum of Comparative Zoology.

*Distribution*: BRITISH COLUMBIA (Hedley, Lilloet); WASHINGTON (Pullman, Toppenish); IDAHO (Hubbs Butte); OREGON (Biggs; Pendleton; Klamath Co., 6000 ft.); WYOMING (near Lusk); UTAH (Provo, Logan, Eureka, Weber Canyon, Tooele, Rainbow, Heber, St. George, Bryce Canyon); NEVADA (Reno; Humbolt; Dixie Nat. Forest); CALIFORNIA (Oroville, Colton, Needles, Indio, San Jacinto Mts. San Gabriel Mts., Riverside, Inyo Co.); NEW MEXICO (Pecos, Las Cruces, Mesa Verda, Otero Co., Torrance Co.); ARIZONA (Williams, Flagstaff, Washington Mts., Nogales, Tucson, Chirahua Mts., Santa Rita Mts., Prescott, Congress Junction); COLORADO (Mt. Manitou, Salida, Maybel, Tabernash, Florissant, Boulder, Denver, Saguache, Platte Canyon, Colorado Springs). Most of the specimens have been collected from May through August, but in California adults have been found during March and December. It is interesting that in spite of the close resemblance of *variolosus* and *subanticus*, the two species have very different ranges, and that only in three states (California, Arizona, and New Mexico), so far as our present records are concerned, do the ranges of the two species coincide.

As noted in the key, this species is readily separated from the former by the much darker wing and body coloration.

Genus *Psectra* Hagen

*Psectra* Hagen, 1866, Stett. Ent. Zeit., **27**: 376; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 44; Killington, 1936, Monogr. Brit. Neuropt., **1**: 245.

Fore wing: elongate oval; costal area broadened above furcation of MP, but not abruptly narrowed basally, as in *Micromus*; recurrent humeral vein absent; few costal veinlets forked; Rs with two branches, R2 + 3 arising near the apex of wing, R4 + 5 coalesced proximally with MA; basal piece of MA present, remote from base; one series of gradate veins. Hind wing: either fully formed or vestigial. When fully developed, the hind wing is similar in size and shape to the fore wing; MA coalesced with Rs for a considerable distance; no

gradate series. Anal plates of male small; ninth tergite narrow, with the lower margin prolonged into a curved tooth posteriorly; apparently no plates of the aedeagus are present; parameres fused. Anal plates of female small; ninth sternite large, rounded; eighth sternite without a sclerotized plate.

Genotype: *Hemerobius dipterus* Burmeister.

This aberrant genus contains only the genotype species. Its affinities are very uncertain, though it is doubtless closely related to *Nyrma Navas*, from Asia Minor. Its life history is entirely unknown.

*Psectra diptera* (Burmeister)

Figure 55; plate 3, figure 23

*Hemerobius dipterus* Burmeister, 1839, Handb. der Ent., **2**: 973.

*Psectra diptera* Hagen, 1866, Stett. Ent. Zeit., **27**: 376; Hagen, 1886, Ent. Amer., **2**: 21; McLachlan, 1868, Trans. Ent. Soc. Lond., **1868**: 170; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 44; Killington, 1936, Monogr. Brit. Neuropt., **1**: 247.

*Hemerobius delicatulus* Fitch, 1856, 1st and 2nd Rept. Ins. N. Y.: 96.

*Psectra buenoi* Navas, 1909, Ann. Soc. Sci. Brux., **33**: 218.

Head dark reddish brown, often black; antennae dark brown; thorax and abdomen dark brown, nearly black. Fore wing: length (average), 6 mm.; width, 3 mm.; membrane hyaline or pale yellow; gradates and other cross-veins margined with grey-brown; a few similar spots are scattered over the wing. Hind wing: when present, with markings similar to those of fore wing, but paler. Anal plates of male with the inner margin prolonged distally, forming a process which is armed apically with black bristles; ninth tergite with the lateral processes curved; tenth sternite in form of a curved, strap-like plate; parameres with the distal part strongly curved ventrally. Ninth sternite of female abdomen very short, rounded; eighth sternite with the dorsal margin prolonged anteriorly slightly into a short lobe.

*Holotype* (♂): near Leipzig, Saxony, Germany; in the Museum at Halle. The type has vestigial hind wings.

*Distribution*: This insect occurs over the north-eastern United States, as far west as Michigan, and as far south as Virginia and West Virginia; it has been collected rarely in Ontario (Normandale, Mer Bleue). The adults have been taken from June through September. *Diptera* also occurs in

Europe and Siberia, but it is not at all common anywhere. I have seen only 44 Nearctic specimens and Killington was able to locate records of but six from the British Isles.

This unusual Neuropteran has attracted a great deal of attention, especially in Europe, because of the occurrence of two winged individuals.<sup>19</sup> The lack of extensive series has caused some uncertainty as to whether or not the dipterous condition is restricted to one sex. Killington was led to believe that this dimorphism was not sexual at all and his conclusions are fully substantiated by the more extensive Nearctic material. Of the 44 specimens which I have seen 30 are females and 14 are males; 9 females and 9 males are dipterous.

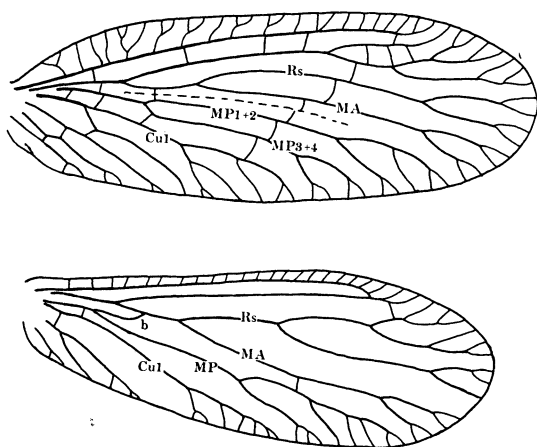


FIGURE 55. Wing venation of *Psectra diptera* (Burm.). Lettering as in figure 1.

It may be, as these figures suggest, that a greater proportion of males than females are dipterous, but it is clear that both sexes may have the vestigial hind wings.

The terminal abdominal structures (both sexes) of the Nearctic specimens are identical with those of the European individuals, which have been figured by Killington (1936, p. 248, fig. 64) and by Tjeder (1936, p. 99, fig. 1).

The synonymy of this species is clear. The two types of *delicatulus* Fitch are in the Museum of Comparative Zoology; they were examined by Hagen, who pronounced this species identical with *dipterus* (1886). *Ps. buenoi* Navas was based upon a 4-winged individual, the author not being

<sup>19</sup> The most important papers on *Psectra diptera* not listed above are by Mjoberg (1909), Morton (1936), Killington and Kimmins (1932), Killington (1929), Kimmins (1935), Tjeder (1936).

aware that such specimens of *dipterus* had been recorded.

#### Family SISYRIDAE

Antennae setaceous or nearly so, multisegmented, about half as long as the fore wing; basal segment enlarged; prothorax wider than long, but less so than in the Hemerobiidae; lateral margins not lobed; legs cursorial, coxae free, fore coxae very long; abdomen cylindrical; tenth tergite small in both sexes, with few trichobothria. Wings subequal, oval. Fore wing: costal space narrow, costal veinlets usually unbranched; recurrent humeral vein absent; Sc and R fused distally; Rs arising from R near the base of wing; MA coalesced with Rs for a short interval; free piece of MA usually absent; Rs with from one to three branches (not including MA). Hind wing: costal area very narrow, veinlets unbranched; MA coalesced with Rs for a long distance, the point of separation being near the middle of the wing.

The life history of some of the Sisyrids is fairly well known. The first important contribution to our knowledge of their biology was made by Needham (1901), who described the larva and pupa of the Nearctic species, *Sisyra vicaria* Walker (*umbriata* Needham) and *Climacia areolaris* Hagen (*dictyona* Needham). The following year Anthony published an excellent account of the morphology of the larva and pupa of *Sisyra vicaria* and more recently Old (1933) made a brief biological study of the larva and pupa of this species and *C. areolaris*. The most extensive study on the immature stages has been made by Withycombe (1923, 1925) on two British species of *Sisyra*.

The eggs of the Sisyridae are elongate-spheroid and are like those of Hemerobius except that the chorion is smoother. They are laid in clusters on leaves or twigs, etc., over fresh water, and are covered with silk. Incubation lasts about two weeks. On hatching from the egg the larva, according to Withycombe, drops into the water, forces its way through the surface film, and then floats along under water. Eventually, after reaching a sponge, it presses its mandibles into the body of the sponge and feeds on the body fluids. The first instar larva is very different from the two later ones; the jaws are short and stout, the antennae are 5-segmented, and tracheal gills are absent. In the second and third instars the mandibles are elongate and slender, almost bristle-like; the antennae are long and consist of about 15 segments and the first seven abdominal segments bear paired, leg-like tracheal

gills ventrally. The larvae of the British species require the entire summer for development. When it is nearly ready to pupate, the larva leaves the water and crawls up a tree or similar object, where it spins a cocoon. This consists of two layers of silk, the outer one with a loose, wide mesh, and the inner one with a much denser texture. The British species hibernate in the prepupal stage, the pupa being formed in spring or early summer. The adults issue shortly thereafter.

So far as I am aware no insect parasites of the Sisyrids have been recorded specifically, though Old states that some of the pupae of *Sisyra* and *Climacia* which he obtained in Michigan contained hymenopterous parasites. Killington attributes the high mortality of the prepupae to infection by a fungus; on one occasion he found more than a thousand pupae so attacked.

The family Sisyridae has a wide distribution; it has been recorded from Europe, India, part of Asia, Africa, Australia, and North and South America. The two Nearctic genera of the family may be distinguished as follows:

- Rs of fore and hind wings with one main fork, which is below the pterostigma; fore wing with dark brown and yellow markings . . . *Climacia* (p. 254)  
 Rs of fore and hind wings with two main forks, both far proximal to the pterostigma; fore wing uniformly brown . . . . . *Sisyra* (p. 253)

#### Genus *Sisyra* Burmeister

- Sisyra* Burmeister, 1839, Handb. Ent., 2 (3): 975;  
 Banks, 1905, Trans. Amer. Ent. Soc., 32: 25;  
 Killington, 1936, Monogr. Brit. Neuropt., 1: 228.

Fore wing: broadly oval; costal area narrow at base, slightly widened beyond; subcostal area broad, with a basal cross-vein; R4 + 5 arising near the middle of the wing, R2 and R3 separating a short distance beyond; two or rarely three cross-veins between R1 and Rs; one between MA and Rs, and one between MA and MP1 + 2; MP forked just beyond separation of MA from Rs; no gradate series, the cross-veins being irregularly arranged.

Hind wing: Rs coalescing with MA for a longer interval than in the fore wing, separating from it at about the mid-wing and diverging towards R1; two main forks of Rs, both proximal of the pterostigma; MP forking just proximad of separation of MA from Rs; no gradate veins.

Terminal segment of labial palpi greatly enlarged; prothorax short; face very short, truncate. Tenth tergite of male very small, broader than

long, entire; ninth tergite divided into two small, lateral plates, situated just anterior of and slightly below the tenth tergite; tenth sternite forming a broad, weakly sclerotized proximal plate, and a pair of short, heavily sclerotized claspers; hypandrium internal, like that of Hemerobiidae; parameres small, not fused. Tenth tergite of female small, broader than long; eighth divided, short, but greatly extended ventrally; ninth tergite divided into a pair of large, ventro-lateral plates, to which is articulated the modified ninth sternite.

Genotype: *Hemerobius fuscatus* Fabr.

The genus *Sisyra* has as wide a range as the family to which it belongs; but only one species occurs in the Nearctic region.

brown. Fore wing: length (average), 6 mm.; width, 2.5 mm.; membrane uniformly light to dark brown, no wing markings. Hind wing: paler brown than the fore. Tenth sternite of male abdomen with large basal plate, claspers small, heavily sclerotized, the distal part conical and slightly curved. Ninth tergite of female abdomen very large, with the dorsal border nearly straight.

*Types*: two specimens (cotypes) from Georgia; in the British Museum of Natural History.

*Distribution*: NOVA SCOTIA (Anapolis Royal); QUEBEC; ONTARIO (Biscotasing; Go Home Bay); NEW YORK; MASSACHUSETTS; CONNECTICUT; PENNSYLVANIA (Ohio Pyle); MARYLAND (High Island); DISTRICT OF

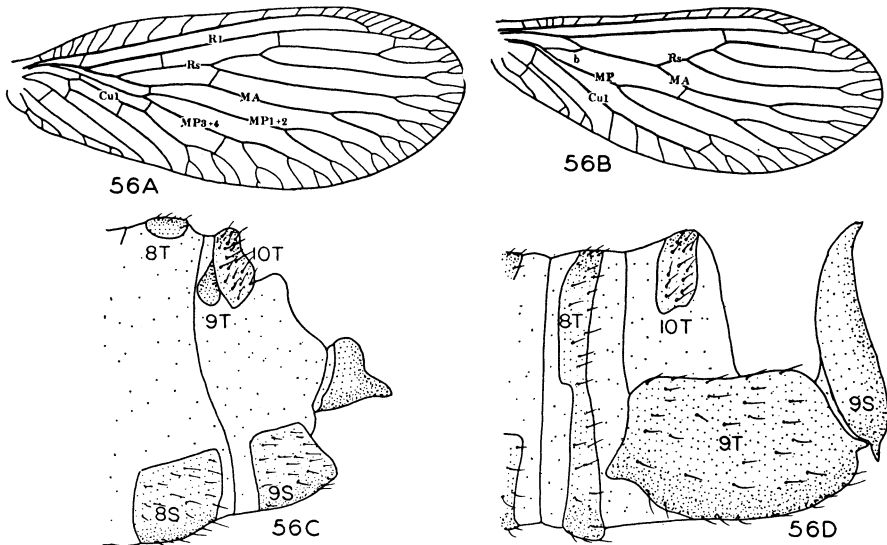


FIGURE 56. *Sisyra vicaria* Walker. A, fore wing; B, hind wing; C, terminal abdominal segments of male, lateral view; D, terminal abdominal segments

of female, lateral view; 8T, 9T, 10T, abdominal tergites; 8S, 9S, 10S, abdominal sternites. Lettering of veins as in figure 1.

### *Sisyra vicaria* Walker

#### Figure 56

*Sisyra vicaria* Walker, 1853, List Spec. Neuropt.

Ins. Brit. Mus., **2**: 297; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 25.

*Sisyra umbrata* Needham, 1901, Bull. N. Y. State Mus., **47**: 555; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 25.

*Sisyra lampra* Navas, 1914, Bull. Brook. Ent. Soc., **9**: 60.

Head varying from yellow to brown; antennae light or dark brown, second segment very dark brown; legs yellow or very light brown; thorax yellowish brown to medium brown; abdomen

COLUMBIA; NORTH CAROLINA (Raleigh); GEORGIA; FLORIDA; ILLINOIS; MICHIGAN (Isle Royal; Detroit; Douglass Lake; Cheboygan Co.); WISCONSIN (Trout River); OREGON (Gold Hill, Jackson Co.); BRITISH COLUMBIA (Lillooet, Agassiz, Kaslo); TEXAS (Colorado Co.). The adults have been collected from June through August. The foregoing records are decidedly discontinuous; the species probably occurs over all of the eastern states as far west as the Mississippi River; and across southern Canada into the north-western states.

This is a very readily identified species. Needham's *umbrata* is beyond doubt a synonym of *vicaria*, as it has been regarded by Banks. When

he described *umbrata*, Needham knew *vicaria* only by Walker's brief and unsatisfactory description; it is not surprising therefore that he found *umbrata* abundant in the field and in collections, though he could locate no specimens of *vicaria*, as he understood it. I have compared the two cotypes of *umbrata* in the Museum of Comparative Zoology with specimens of *vicaria* and have been unable to find any specific differences. Navas' *lampra*, based upon a single specimen from Lakehurst, New Jersey, is also *vicaria*. No figure accompanied the description of this insect but there is nothing included in Navas' description which indicates specific difference.

#### Genus *Climacia* McLachlan

*Climacia* McLachlan, 1869, Ent. Mo. Mag., **6**: 21; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 26.

Fore wing: slenderly oval; costal area very narrow, scarcely widened above the origin of Rs; costal veinlets widely spaced; subcostal area broad, with a cross-vein basally; R4 + 5 and R2 + 3 separating below the pterostigma; two or rarely three cross-veins between R1 and Rs; two between Rs and MA, and two between MA and MP1 + 2; MP forked at about the level of separation of MA from Rs; two short series of gradates.

Hind wing: Rs coalescing with MA for a considerable distance; furcation of M below origin of Rs, MA joining Rs much further distad than in *Sisyra*; R4 + 5 and R2 + 3 separating below the pterostigma; MP forked to level of point of separation of Rs from MA; usually one cross-vein between R1 and Rs, before pterostigma, two between MA and MP; the outer gradate series weakly formed.

Last segment of labial palpi only slightly enlarged; prothorax somewhat longer than in *Sisyra*; face much longer. Tenth tergite of male divided into two lateral plates; ninth tergite entire, short, and very broad; tenth sternite external, forming a pair of slender, lateral plates; ninth sternite small, entire; parameres partially fused, complex. Tenth tergite of female abdomen small, broader than long; eighth tergite consisting of two ventro-lateral plates; ninth tergite also composed of two ventro-lateral plates, somewhat larger than those of *Sisyra*; ninth sternite modified as in the latter genus and articulated to the ninth tergite.

Genotype: *Micromus areolaris* Hagen.

The immature stages of the species of this genus are similar to those of *Sisyra*.

*Climacia* is apparently restricted to the New World, but has been found in both North and South America. There is only one Nearctic species.

#### *Climacia areolaris* (Hagen)

Figures 57, 58; plate 3, figure 24

*Micromus areolaris* Hagen, 1861, Synop. Neuropt. N. A.: 199.

*Climacia areolaris* McLachlan, 1869, Ent. Mo. Mag., **6**: 21; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 26.

*Climacia dictyona* Needham, 1901, Bull. N. Y. State Mus., **47**: 558; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 26.

Head nearly uniformly yellow to light brown; antennae dark brown; thorax yellow to medium

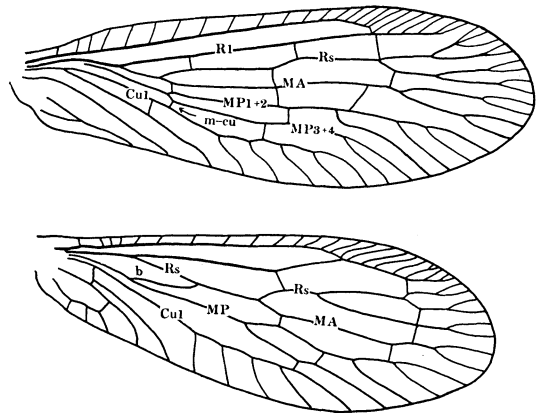


FIGURE 57. Wing venation of *Climacia areolaris* (Hagen). Lettering as in figure 1.

brown above, darker laterally; legs light yellow; abdomen dark brown. Fore wing: length (average), 5 mm.; width, 2 mm.; membrane yellow, at least slightly; markings light to dark brown; a brown patch present between Rs and the costal margin just before Rs, the pterostigma; another is present at the base between R1 and Sc; these two patches are often joined by a somewhat fainter brown streak; distal part of pterostigma usually with a very small dark brown spot; distal third of wing, exclusive of pterostigmal area is yellow-brown; just proximal to this the membrane is hyaline or nearly so; and proximal to this, is another yellow-brown area extending almost to the base; most all longitudinal and cross-veins are darker brown than the membrane. Hind wing: hyaline or nearly so; two brown spots, one at the distal end and the other at the proximal end of the pterostigma; veins only slightly darker than the mem-

brane. Tenth tergite of male with the ventral border widened, prolonged distally; plates of tenth sternite almost strip-like, covered with coarse papillae, resembling fine teeth; ninth sternite with a pair of curved processes extending posteriorly on the inner surface; parameres forming a median plate, with a dorsal median lobe, that diverges abruptly from the plate. Ninth tergite of female very large with the dorsal margin prolonged anteriorly; tenth sternite much modified and articulated to ninth tergite.

*Type*: A single type of this species, from Florida (Osten-Sacken) was mentioned by Hagen. This specimen is not in the Museum of Comparative Zoology, where it should be; it was probably one

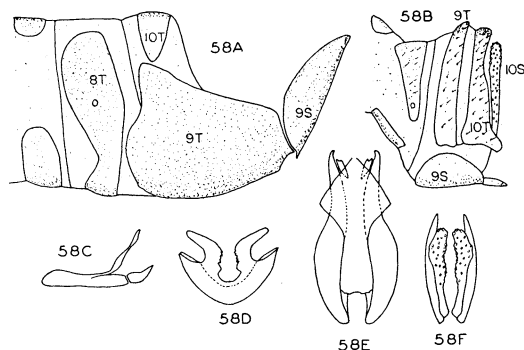


FIGURE 58. *Climacia areolaris* (Hagen). A, terminal abdominal segments of female (allotype), lateral view; B, terminal abdominal segments of male (neoholotype); C, parameres of same, lateral view; D, ninth sternite of same, posterior view; E, parameres of same, lateral view; F, tenth tergite and tenth sternite, posterior view. Lettering as in figure 56.

of the several specimens destroyed when Hagen's collection was shipped from Europe to this country. The following male in the Museum of Comparative Zoology is therefore designated the neoholotype: Grant, Oklahoma, July 1, 1937 (Standish and Kaiser); in the Museum of Comparative Zoology. Allotype, by present designation: same collecting data; in the Museum of Comparative Zoology.

*Distribution*: QUEBEC; ONTARIO (Ottawa, Go Home Bay, Biscotasing); MAINE; NEW HAMPSHIRE; VERMONT; MASSACHUSETTS; CONNECTICUT; NEW YORK; PENNSYLVANIA; NEW JERSEY; MARYLAND; GEORGIA (Okefenoke Swamp); NORTH CAROLINA (Aberdeen); NEW MEXICO (Eddy Co.); VIRGINIA; TEXAS (Bosque Co.; Sutton Co.; Victoria); LOUISIANA (Shreveport); FLORIDA; OKLAHOMA; MIS-

SISSIPPI (Natchez); ILLINOIS; MICHIGAN (E. Lansing, Silver City, Douglass Lake, Burt Lake); OHIO (Put-in-Bay). This species probably occurs over all eastern United States as far west as the beginning of the plains region; it has extended beyond this area only at a few localities. It apparently does not reach the northwestern states or western Canada. The adults have been collected from June to October.

This striking and locally common insect is readily identified. As Banks has pointed out, Needham's *dictyona* is based upon individual characteristics only, such as size and the number of branches of Rs and the cubitus. I have examined the three cotypes of *dictyona* in the Museum of Comparative Zoology and have been unable to distinguish specific differences.

#### Family BERTHIDAE

Antennae moniliform, multisegmented, first segment enlarged; antennae shorter than fore wing; ocelli absent; prothorax usually at least as long as wide, the lateral margins not lobed; legs cursorial; coxae well developed and free, the fore coxae especially long; abdomen slender, cylindrical; tenth tergite of male entire; aedeagus with a slender median sclerotized plate; ninth sternite well developed, external. Tenth tergite of female large, entire with a pair of conspicuous ventral processes extending anteriorly; ninth sternite small but usually strongly sclerotized.

Wings subequal; scales often present on veins of either or both fore and hind wings. Fore wing: costal area broader than that of hind wing, with forked veinlets; recurrent humeral veinlet usually absent;<sup>20</sup> Sc terminating on either R1 distally or the wing margin and joined to R1 by a cross-vein; Rs with four or more branches (not including MA), all arising from a single stem; MA coalesced with RS for a short distance proximally; a single series of gradate veins. Hind wing: costal area narrow, with unbranched veinlets; Rs and MA as in the fore wing; a single series of gradate veins; basal free piece of MA arranged as a cross-vein, not longitudinal as in most other Neuroptera.

The life history and general biology of the Berothids are almost entirely unknown. Tillyard, however, has described the egg and first instar larva of the Australian *Spermophorella disseminata* Till. and *S. maculatissima* Till. The elongate spheroidal

<sup>20</sup> The recurrent humeral vein is present only in the aberrant *Naizeme patagonica* Navas, which may not be a Berothid.



eggs of these insects were laid in patches of 20 to 50 pieces and were stalked, as in the Chrysopidae. During oviposition the process of the tenth tergite was used as a lever to the end of the abdomen. The larvae, which hatched in about ten days, were long and slender, and crawled with the motion of a geometrid caterpillar, using the anal claspers in walking. The head was longer than that of the Hemerobiid larvae, the antennae were 4-segmented and the mandibles very nearly straight. The larvae did not survive in captivity beyond the first instar, presumably because of the lack of proper food. Tillyard was of the opinion that the larvae of these species inhabited the crevices of rocks and preyed on the lepidopterous larvae that fed on the lichens and moss. The larvae of the Nearctic Berothids are probably very similar to those of *Spermophorella*, since the adults are not greatly different. Smith (1923) obtained a single infertile egg from one of the Nearctic species (probably *Lomamyia banksi*, n. sp.); it was deposited directly upon the substratum, not stalked, but in all probability the manner of oviposition was abnormal.

The generic classification of the Berothidae in general is in a very confusing state.<sup>21</sup> Esben-Petersen pointed out in 1918 that the Berothidae "want a thorough revision." Krüger's unillustrated "monograph" of this family published a few years later (1922a) served only to make the confusion more nearly complete. Navas (1929) has published a better account of the Berothidae, but many of his concepts are based upon unique specimens or very small series and are consequently faulty. Thus, his attempt to separate the genera into two categories on the basis of the number of branches of the radial sector (5 or less, 6 or more) is not at all practicable because the number fluctuates in individuals beyond these limits. In order to determine the generic position of the Nearctic species, I have found it necessary to make a study of the Berothidae in general of all geographical regions. The results of this survey will be published elsewhere, since they are too irrelevant to the pres-

ent revision for inclusion here. It is my conviction, however, that the genus *Lomamyia*, established by Banks (1904a) for the Nearctic species, is distinct from *Berotha* and therefore is a valid genus. Its relationship with other genera need not concern us here, since *Lomamyia* was the third genus of the family to be described and the other two (*Isoscelipteron* and *Dasypteryx*) are well established synonyms of *Berotha*.

*Lomamyia* differs from *Berotha* in having only three gradate veins in the hind wing, the lowest one being in line with the other two, i.e., slightly proximal to the one above it; also in having the gradate vein between MP1 + 2 and MP3 + 4 in the fore wing close to the one above it, usually not more than its own length away. In *Berotha* there are four or more gradate veins in the hind wing, the lowest being far proximal to the others; and the gradate vein between MP1 + 2 and MP3 + 4 in the fore wing is far proximal of the one above, usually at least five times its own length away. There seem to be no more than specific differences in genital structure exhibited by the members of these two genera; apparently the genera of Berothidae cannot be satisfactorily based upon genital structure, as in the case of the Hemerobiidae, for I have found the genitalia to be essentially the same in the Asian, Australian and Nearctic species of the family.

There are two striking characteristics of the Berothidae which deserve comment here: 1) In most species the outer margin of the fore wing is more or less incised below the apex. Krüger has used the presence or absence of this incision as the basis of the division of the family into subfamilies; but the extent of this incision is variable in all species and in certain ones the amount of variation is such that in a high percentage of specimens it is not possible to decide whether the incision is present or not (e.g., *longicollis* Walker). 2) A more interesting feature is the presence of scales on the wings and thorax of the females of certain species. McLachlan first called attention to these, on the wings of *B. fulva* Costa and of one Nearctic species.<sup>22</sup> Tillyard subsequently described these in full on the wing veins of *Spermophorella disseminata* Till. and *S. maculatissima* Till., but having interpreted incorrectly McLachlan's account, he made the presence of the scales on the veins the basis of the genus *Spermophorella*. The scales are also shown in the photograph of *Berotha neuro-*

<sup>21</sup> One of the reasons for this is that the sexes have usually been confused in the past. In the Berothids it is the females instead of the males that have prominent external genital structures. Tillyard (1916) was the first to establish the fact that such specimens were females, for he was able to observe oviposition in *Spermophorella*; previous authors, as McLachlan, Hagen, Banks, etc., had assumed them to be males. Krüger (1922a) and Esben-Petersen (1917, 1918), both having overlooked Tillyard's paper, did likewise.

<sup>22</sup> McLachlan (1864) identified the species as *flavicornis* Walker, but this lacks the scales.

*punctata* Esben-Petersen (New South Wales), though no mention of them is made in the text. Of the Nearctic species more than half have scales present on the wings of the female. It is apparent, therefore, that these scales are of general occurrence among the Berothids and not restricted to a few species. Curiously enough, though the scales are on the upper side of the hind wing, they are present only on the lower side of the fore wing. Similar scales may also occur on the thorax and the legs of the females, as in *L. squamosa*, n. sp.

The Berothids have an unusual distribution: Australia, New Zealand, Africa, Japan, Hindustan, Ceylon, Formosa, Java, Borneo, eastern China (Shanghai), southeast Europe, Asia Minor, Argentina, United States and western Canada. The family probably has a much more extensive distribution than that at present known.

#### Genus *Lomamyia* Banks

*Lomamyia* Banks, 1904, Proc. Ent. Soc. Wash., **6**: 209; Navas, 1929, Mem. Acad. Cienc. Exact., Zaragoza, **2**: 25.

Fore wing: subtriangular, often elongate; costal area very narrow at base, usually much broadened above furcation of M, and narrowed near the middle of the wing; pterostigma present; two or rarely three cross-veins between R1 and Rs; usually five, rarely four or six, gradate veins, the one between MP1 + 2 and MP3 + 4 not more than its length from the one above it; MP3 + 4 is usually forked only to or slightly beyond the gradate vein between the branches of MP; Cu1 usually forked to outer cross-vein between Cu1 and MP3 + 4.

Hind wing: venation similar to that of fore wing; only three gradate veins, the lowest one only slightly proximal to that above it.

Prothorax much longer than broad; anal plate (tenth tergite) of male narrowed medially, with a long sclerotized process extending anteriorly from the lateral wings; aedeagus with a series of long bristles distally. Anal plate of female unspecialized; ninth sternite complex, with several sclerotized, short processes; eighth sternite with a pair of sclerotized processes extending forwards towards the seventh sternite.

Genotype: *Hemerobius flavicornis* Walker.

The characteristics on which the species of this genus may be classified differ greatly in the two sexes. The females are usually readily distinguished by the nature and distribution of the scales on the wings and thorax. In a few species (e.g., *flavicornis*) such scales are entirely wanting; in

others they are present on the wings only (*occidentalis* Banks); and in still others they are in both wings and thorax. In using these characteristics, however, one must bear in mind that specimens in poor condition may have had the scales rubbed off wings and body. The process on the tenth tergite of the female varies considerably in length within the species and is of no use in specific taxonomy. The ninth tergite, however, is very different in most species, but it is very complex and needs careful orientation in the making of comparisons. The sclerotized rods of the eighth sternite also show marked difference in many species. The males are not so readily determined as the females. There being no secondary characteristics comparable with the scales, it is necessary to use venational and

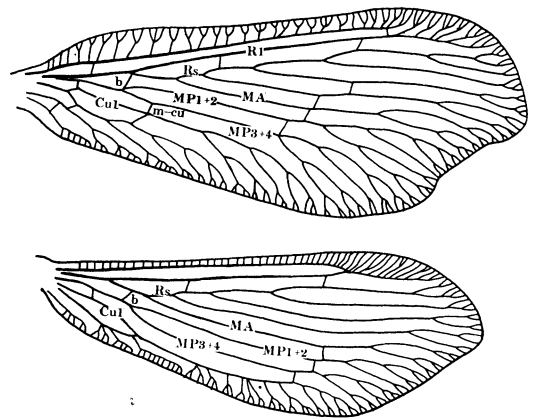


FIGURE 59. Wing venation of *Lomamyia flavicornis* (Walker). Lettering as in figure 1.

other features of the wings. Of particular interest is the presence of three cross-veins between R1 and Rs in two species (*squamosa* and *longicollis*). This is a characteristic which is also shared by Berotha and I was at first inclined to regard it as a basis for generic separation. However, since there are no other wing or body characteristics associated with the number of these cross-veins, I have treated the difference in number as specific only. The male genitalia, although having the sclerotized parts internal, provide excellent taxonomic characteristics, especially the aedeagus.

The genus *Lomamyia* is apparently restricted to the Nearctic region. Although many of our species have a wide distribution in this region, all are uncommon. Of the ten species which are known, I have been able to see only about 150 specimens. It is probable that many Nearctic species remain undescribed.

The males and females of this genus have been given separate keys, because of the ease with which the females may be determined by use of the secondary sexual characteristics.

## KEY TO THE MALES OF NEARCTIC LOMAMYIA

1. Three radial cross-veins present, one directly below the pterostigma .....2  
Two radial cross-veins present, none below the pterostigma .....3
2. Apical border of fore wing deeply incised  
*squamosa*, n. sp. (p. 266)  
Apical border of fore wing entire or nearly so  
*longicollis* Walker (p. 267)
3. Four to six dark brown spots on costal area; costal area moderately broad .....4  
Spots on costal area very weak or absent; costal area very narrow .....*hamata* Walker (p. 265)
4. Gradate veins of fore wing strongly margined, forming a distinct streak across the wing  
*texana* Banks (p. 264)  
Gradate veins at most weakly margined .....5
5. Anterior margin of wing not concave, nearly straight .....*occidentalis* Banks (p. 263)  
Anterior margin of fore wing distinctly concave ..6
6. Fore wing very broad .....7  
Fore wing narrow or at most only normally broad .....8
7. Fore wing nearly uniformly yellow-brown, no maculations except on costal area; cross-veins not margined .....*fulva*, n. sp. (p. 264)<sup>23</sup>  
Fore wing nearly hyaline; numerous maculations present; gradate veins lightly margined  
*latipennis*, n. sp. (p. 262)
8. Fore wing very slender; apex strongly falcate  
*tenuis*, n. sp. (p. 261)  
Fore wing moderately broad; apex not falcate ...9
9. Face usually light yellow; aedeagus nearly straight  
*flavicornis* Walker (p. 259)  
Face usually brown or reddish brown; aedeagus strongly curved anteriorly  
*banksi*, n. sp. (p. 260)

KEY TO THE FEMALES OF NEARCTIC LOMAMYIA<sup>24</sup>

1. Scales present on fore coxae or at least a few veins of lower surface of fore wing .....2  
Scales absent from coxae and fore wings .....8
2. Scales absent from fore coxae .....3  
Scales present on fore coxae .....4
3. Fore wing slender, costal margin nearly straight, not concave .....*occidentalis* Banks (p. 263)  
Fore wing very broad, costal margin concave  
*latipennis*, n. sp. (p. 262)

<sup>23</sup> The male of *fulva*, n. sp., is not known, but I have included the species in this key on the basis of the wing shape and markings, which do not differ in the sexes of *Lomamyia*.

<sup>24</sup> The female of *tenuis*, n. sp., is unknown.

4. Scales present on fore coxae only, absent from rest of thorax .....5  
Scales present on fore coxae and also other parts of thorax .....6
5. Costal area with four to six dark brown spots; gradate veins margined with dark brown; costal area broad .....*banksi*, n. sp. (p. 260)  
Costal area with very faint spots or entirely without them; gradate veins not margined; costal area very narrow .....*hamata* Walker (p. 265)
6. Scales on thorax confined to fore coxae and pleura of mesothorax; two radial cross-veins in fore wing .....7  
Scales on fore coxae and pleural region of both meso- and metathorax; three radial cross-veins in fore wing .....*squamosa*, n. sp. (p. 266)
7. Fore wing slender, gradate veins heavily margined  
*texana* Banks (p. 264)  
Fore wing very broad, gradate veins not margined  
*fulva*, n. sp. (p. 264)
8. Two radial cross-veins in fore wing; none below the pterostigma .....*flavicornis* Walker (p. 259)  
Three radial cross-veins in fore wing, one below the pterostigma .....*longicollis* Walker (p. 267)

*Lomamyia flavicornis* (Walker)

Figures 59, 60; plate 3, figure 26

*Hemerobius flavicornis* Walker, 1853, List Spec. Neuropt. Brit. Mus.: 278.

*Micromus flavicornis* Hagen, 1861, Synop. Neuropt. N. A.: 198.

*Lomamyia flavicornis* Banks, 1905, Trans. Amer. Ent. Soc., **32**: 27.

*Lomamyia nearctica* Navas, 1913, Ent. Zeit., **27**: 19.

♂. Face and antennae yellow; vertex yellow, usually with several reddish brown spots; pronotum and mesonotum from yellow-brown to brown, usually with dark reddish brown spots at the base of the hairs; abdomen brown; legs pale yellow, very hairy, the tibiae spotted with dots of reddish brown; vertex, thorax, with long hairs, some brown, but mostly white. Fore wing: length (average), 9 mm.; width, 3 mm.; membrane hyaline; apex of the wing deeply incised; apex of the wing usually clouded with light grey-brown, sometimes extending as far as the gradate veins; costal area with four to six conspicuous dark brown patches; wings with long, brown and white hairs, the latter especially numerous; cross-veins with numerous very long, black hairs, especially well developed on the gradate veins; pterostigma usually reddish, at least in part; distal forks of branches of Rs and M usually marked with a small dark brown patch. Hind wing: hyaline, with dark brown maculations at the

pterostigmal cross-veins and the gradate veins. Tenth abdominal tergite with two broad lateral plates, each giving rise to a long, anterior process and a short posterior process; the bridge between the two plates is extended posteriorly into a smoothly rounded lobe; sclerotized part of aedeagus forming a median strap-like structure, broadened anteriorly and terminating posteriorly in several very fine filaments; the anterior end of the aedeagus is only slightly curved, very nearly straight in lateral view.

♀. Like the male in size, coloration, without specialized hairs or scales on either wings or body.

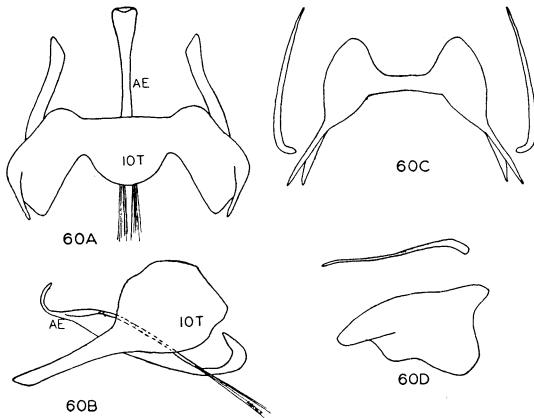


FIGURE 60. *Lomamyia flavicornis* (Walker). A, ninth sternite of male, dorsal view; B, same, lateral view; C, eighth sternite and lateral rods of seventh sternite of female, dorsal view; D, same, lateral view. AE, aedeagus; 10T, tenth tergite.

Eighth sternite strongly sclerotized; viewed ventrally there are two pairs of narrow posterior processes; the two lateral plates of the sternite are connected by a narrow sclerotized band; sclerotized rods of seventh sternite rather short.

*Types*: Two type specimens of this insect were mentioned by Walker: a, from "North America"; and b, from "Georgia" (Abbot); both are in the British Museum. The first specimen lacks the abdomen, but the wings are in good condition; they are heavily marked and agree with those of many specimens of the insect which has been identified as *flavicornis* by Banks and others in the past. This specimen is here designated the lectotype of *flavicornis*. The second specimen, b, is a different species; it apparently is the representative of variety "B" which Walker mentioned in his description. This is a female with scales on the fore coxae and is the species described below as *banksi*.

*Distribution*: FLORIDA (Winter Park, April 30, E. M. Davis; Tampa, E. P. Van Duzee); ALABAMA (Jackson, April 19, W. D. Pierce); GEORGIA (no further data); NORTH CAROLINA (Raleigh; Southern Pines; Tryon); VIRGINIA (Dead Run, Fairfax Co., August 6; Vienna, August); KENTUCKY (no further data); LOUISIANA (Caddo Park); MARYLAND (Glen Echo); NEW JERSEY (Prosperstown); NEW YORK (Long Island); PENNSYLVANIA (Roxboro). Most of the specimens which I have seen lack complete collecting data; the meagre information available indicates that adults appear in early summer (April, May) and in the fall (August).

This species resembles *banksi* closely and has been confused with it in the past. The females of the two are readily distinguished, that of *flavicornis* lacking the scales on the fore coxae which are present in *banksi*. The males, however, are very difficult to separate without examination of the genitalia. Most specimens of *flavicornis* have broader wings than are usually found in *banksi*, but there seem to be no constant differences in wing markings. The aedeagus is strikingly different in the two, that of *flavicornis* being almost straight whereas that of *banksi* is strongly reflexed.

*Nearctica* Navas is almost certainly this species. The type locality of the unique male on which the species was based is Long Island, where both *flavicornis* and *banksi*, n. sp., have been collected. Navas' figure shows a much broader wing than I have seen in any specimens of *banksi*, though such wings do occur in many specimens of *flavicornis*. Navas himself synonymized his species with *flavicornis* in 1929.

#### *Lomamyia banksi*, n. sp.

##### Figure 61

♂. Face and antennae yellow; vertex greyish brown, with some dark reddish spots usually present; pronotum and mesonotum either yellow with reddish spots or medium reddish brown with faint spots; long black or dark brown hairs on vertex, thorax and legs, white hairs not usually conspicuous; legs pale, spotted with reddish brown and bearing long dark hairs. Fore wing: length (average), 10 mm.; width, 4.2 mm.; anterior margin concave, outer margin incised, much as in *flavicornis*; four to six dark reddish brown spots on costal area; membrane hyaline, maculations brownish, somewhat diffuse distally; gradate veins either with or without marginations; cross-veins with tufts of long black hairs; wing covered with dark

brown hairs, white hairs usually not so abundant; two radial cross-veins. Hind wing: hyaline, with maculations at pterostigmal cross-vein and gradate veins. Tenth abdominal tergite with a pair of long anterior processes ventrally, and a pair of shorter anterior processes dorsally; lateral plates connected by a narrow sclerotized bridge; aedeagus long, the anterior part sigmoidally curved.

♀. Similar to the male in size and coloration; fore coxae with the anterior surface covered by a patch of appressed, black scales; rest of thorax and the wings without scales. Eighth abdominal sternite strongly sclerotized; a pair of short but distinct processes extending posteriorly and a pair of broader and flatter lobes on the anterior end, directed ventrally; sclerotized rods of seventh sternite very long and heavy.

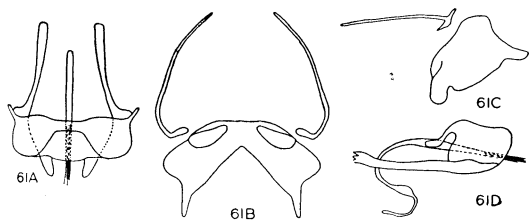


FIGURE 61. *Lomamyia banksi*, n. sp. A, tenth sternite of male (holotype), dorsal view; B, eighth sternite and lateral rods of seventh sternite of female (allotype), dorsal view; C, same, lateral view; D, tenth sternite of male (holotype), lateral view.

*Holotype* (♂): Clemson College, South Carolina; April 30, 1932 (D. Duncan). *Allotype*: same locality and collector, May 28, 1931. Both are in the Museum of Comparative Zoology.

*Paratypes*: 1♂, Falls Church, Virginia, September 3 (N. Banks); 1♀, Monticello, Florida, June 11, 1935 (G. Fairchild); 1♀, Nelson Co., Virginia, July 25, 1923 (W. Robinson); 1♀, Clemson College, July 23, 1936 (F. Sherman); 1♀, Manhattan, Kansas, October 5, 1934 (R. C. Smith); 1♀, Dobson, near Clarksville, Illinois, July 25, 1936 (Mohr); 1♀, Falls Church, Virginia, August 11 (N. Banks); all in the Museum of Comparative Zoology.—1♂, Wyandanch, Long Island, New York, July 15, 1917 (F. W. Schott); 1♀, Thomasville, Alabama, March 20, 1910 (W. D. Pierce); 1♀, Washington, D. C., July 26 (W. V. Warner); all in the United States National Museum.—1♀, Clemson College, South Carolina, May 9, 1932 (D. Duncan) in the Clemson College collection. 1♀, Manhattan, Kansas, October 5, 1934 (R. C. Smith); in the R. C. Smith collection.—1♀, Pike,

Illinois, June 28, 1934 (Delong and Ross); 1♂, Anna, Illinois, June 27, 1909; both in the Illinois Natural History Survey collection.

*Distribution*: VIRGINIA (Falls Church; Nelson Co.); NORTH CAROLINA (no other data); SOUTH CAROLINA (Clemson College); FLORIDA (Monticello, Hilliard); ALABAMA (Jackson, Thomasville); MISSISSIPPI (Fulton, Hamilton); MISSOURI (no other data); DISTRICT OF COLUMBIA; NEW YORK (Long Island); KANSAS (Manhattan); ARIZONA (Santa Rita Mts.); ILLINOIS (Dobson, Pike, Anna, Jeff); MICHIGAN (Douglass Lake). The adults have been collected from May through July.

This species has been identified as *flavicornis* in the past. The females of *banksi* differ in possessing the patch of scales on the fore coxae; the males usually have somewhat narrower wings than those of *flavicornis*, and always have a sigmoidal aedeagus instead of a straight one, as in the latter.

#### *Lomamyia tenuis*, n. sp.

Figure 62

♂. Face and antennae yellow; vertex yellow with several distinct, dark brown or black spots, and a diffuse brown area medially; pronotum and mesonotum yellow and light brown, variegated;

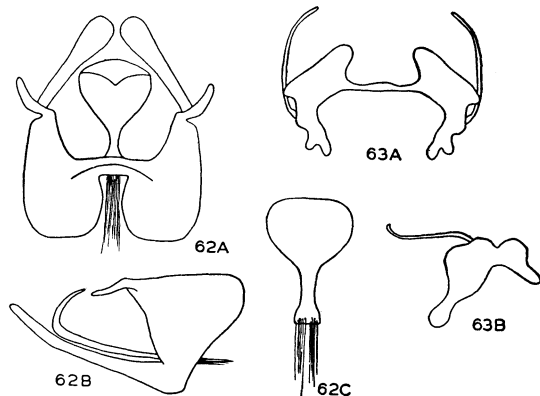


FIGURE 62. *Lomamyia tenuis*, n. sp. A, tenth sternite of male (holotype), dorsal view; B, same, ventral view; C, aedeagus, dorsal view.

FIGURE 63. *Lomamyia fulva*, n. sp. A, eighth sternite and lateral rods of seventh sternite of female (holotype), dorsal view; B, same, lateral view.

legs pale with several dark brown spots; vertex, thorax and legs with brown and white hairs; abdomen brown. Fore wing: length, 10 mm.; width, 3.8 mm.; very slender; costal area normally broad basally, but usually narrowed distally, the costal

border being markedly concave; outer margin very deeply incised, the incision being posterior of the apex, forming a falcate tip; membrane hyaline; costal area with four (or more) dark brown spots; two radial cross-veins; maculations medium brown, in the form of small spots close together distally and posteriorly; gradate veins margined with brown. Tenth tergite with a pair of long ventral processes directed anteriorly and much flattened at their anterior end; a pair of shorter but conspicuous processes also directed anteriorly; the lateral plates connected by a narrow bridge; aedeagus greatly widened distally, more than in *texana*. Female unknown.

*Holotype* ( $\delta$ ): Torrance Co., New Mexico, July, 1925 (C. H. Martin); in the Museum of Comparative Zoology (donated by R. C. Smith).

This species, which resembles *texana* more than any other member of the genus, is distinguished from it by the more tenuous wing, the falcate apex, the less marked gradates, and the remarkably broad aedeagus.

***Lomamyia latipennis*, n. sp.**

Figure 64

$\delta$ . Face and antennae light reddish brown; vertex similarly colored, with several small reddish spots and a dark reddish brown area medially; pronotum light reddish brown, somewhat variegated, darker medially; mesonotum light reddish brown, darker medially and laterally; vertex, pronotum and mesonotum with long dark brown hairs; legs pale spotted with dark reddish brown and with long grey-brown hairs; abdomen dark brown. Fore wing: length (average), 11 mm.; width, 5 mm.; costal area broad basally and only gradually narrowed, with 4-6 dark reddish brown spots; outer margin deeply incised; membrane hyaline, maculations light brown, darker and more diffuse distally, the membrane sometimes appearing nearly uniformly light brown; pterostigma reddish; two radial cross-veins; cross-veins not heavily margined; wing with dark brown hairs and a few black hairs at cross-veins. Hind wing: hyaline; pterostigmal cross-vein heavily margined, gradates not margined. Tenth sternite with a pair of long straight ventral processes, directed anteriorly; no posterior processes; aedeagus short and nearly straight, with a prominent tuft of black spines or stout hairs arising from the ventral surface of the aedeagus near the posterior end.

$\text{♀}$ . Similar to the male in size and coloration. The fore and hind wings of the allotype bear only

a few black scales, the others apparently having been rubbed off; the  $\text{♀}$  paratype has the scales of the fore wings on the proximal parts of MA and both branches of MP, as well as on the very basal part of Rs; and in the hind wings along Rs and MA in the region of the divergence of these veins. No scales are present on the coxae or rest of the thorax. The eighth sternite of the female abdomen is very broad and heavily sclerotized; a pair of lateral lobes extend posteriorly; two smaller lobes extend dorsally and laterally, and a pair of very large, flattened and broad processes are directed ventrally; rods of the seventh sternite are very weakly sclerotized.

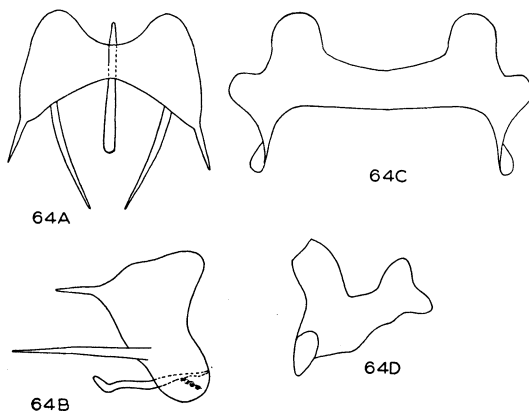


FIGURE 64. *Lomamyia latipennis*, n. sp. A, tenth sternite of male (holotype), dorsal view; B, same, lateral view; C, eighth sternite of female (allotype), dorsal view; D, same, lateral view.

*Holotype* ( $\delta$ ): Phoenix Lake, Marin Co., California, July 4, 1927 (H. H. Kiefer). Allotype: Mt. Tamalpais, Marin Co., California, May 23, 1909 (E. C. Van Dyke). Both are in the California Academy of Sciences.

*Paratypes*: 1  $\delta$ , Cayton, Shasta Co., California, July 13, 1918 (E. P. Van Duzee); 1  $\text{♀}$ , Coleville, Mono Co., California, May 28, 1939 (M. A. Cazier); both in the Museum of Comparative Zoology.—1  $\delta$ , Confidence, California, August 4 (J. N. Knull); in the Ohio State University collection.

This large *Lomamyia* is known to me only from California and Arizona. In addition to the types I have seen five other specimens:  $\delta$ , Cazadero, California, September 3 (E. P. Van Duzee); 2  $\delta$ , Boulder Creek, California, July 18, 1933 (R. H. Beamer);  $\delta$ , Mt. Tamalpais, California, August 15, 1938 (L. W. Hopper); and 1  $\text{♀}$ , Yarnell, Arizona, July 29, 1933 (R. H. Beamer). The male of

this insect resembles that of *flavicornis* superficially, but is at once distinguished by the much broader wings. The female is more like that of *occidentalis* Banks, in that both have scales on the wings but not on the coxae; the chief difference is found in the broad wings and concave anterior wing margin of *latipennis*. The male of *latipennis* is unique in possessing the tuft of black spines on the aedeagus; these are conspicuous enough to be seen without dissection of the abdomen. The female allotype has apparently had most of the scales rubbed from the wings; a few are visible at irregular intervals, however, which is enough to show that they actually were present. The female paratype, which has precisely the same genital structure as the allotype, has the scales more nearly completely attached.

*Lomamyia occidentalis* (Banks)

Figure 65

*Berotha occidentalis* Banks, 1905, *Invert. Pacifica*, 1: 89.<sup>25</sup>

*Lomamyia occidentalis* Banks, 1905, *Trans. Amer. Ent. Soc.*, 32: 48.

♂. Face and antennae yellow; vertex yellow, with several spots of reddish brown; pronotum yellow, but with numerous reddish spots; mesonotum with a large dark reddish brown patch anteriorly, divided by a thin yellow stripe; rest of mesonotum yellow with several large and small reddish brown spots; abdomen medium brown; legs pale with red spots; vertex, thorax, abdomen and legs with long brown and white hairs, the latter especially conspicuous. Fore wing: length (type), 9–12 mm.; width (type), 4–5 mm.; costal area wide basally and not markedly narrowed beyond, so that the costal margin is very nearly straight; four to six dark reddish brown spots along the costal area; pterostigma reddish; two radial cross-veins; membrane hyaline, with numerous small, light brown maculations, giving the wing a definitely spotted appearance; distally the maculations are larger and more diffuse; gradate series not margined; the wing with long brown and white hairs, and tufts of long black hairs on the cross-veins. Tenth sternite with a pair of long, straight ventral processes, directed anteriorly and flattened distally; dorsal part of sternite with a pair of shorter processes also extending anteriorly; no

posterior processes; aedeagus broad anteriorly, with the tip curved dorsally; posterior filaments in a single cluster.

♀. Similar to the male in size and coloration, but with scales as follows: in the fore wing, slender, subcylindrical scales on the lower branches of Rs, on MA and MP1 + 2. In the hind wing similar scales on the stem of Rs, but apparently not on its branches. Legs and thorax without scales. Eighth sternite of abdomen strongly sclerotized, with a pair of flat processes extending posteriorly and two rounded lateral lobes extending anteriorly; the two lateral plates connected by a thin bridge, with a slight median bulge; rods of seventh sternite very long and curved.

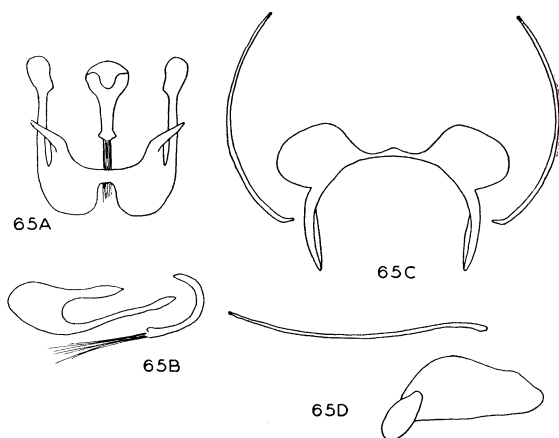


FIGURE 65. *Lomamyia occidentalis* (Banks). A, tenth sternite of male (allotype), dorsal view; B, same, lateral view; C, eighth abdominal sternite and rods of seventh segment of female (holotype), dorsal view; D, same, lateral view.

*Types*: two cotypes of this insect were mentioned by Banks, one (♀) from Ormsby Co., Nevada (C. F. Baker), and the other from Phoenix, Arizona. The former is the only one which I have been able to locate; it is in the Museum of Comparative Zoology and is here designated the lectotype. Allotype, by present designation: Clayton, California; July 20, 1935 (R. H. Beamer); in the University of Kansas Museum.

In addition to the types I have seen only two other specimens: ♀, San Diego, California, August 3, 1913 (E. P. Van Duzee); and ♂, Lytton, British Columbia, August 2, 1931.

This species is characterized by the spotted fore wings and the nearly straight costal margin, as well as by the presence of scales on the wings of the female. There is only a slight resemblance to

<sup>25</sup>This species was listed by Banks in 1903 (*Proc. Ent. Soc. Wash.*, 5: 240), but was not described until 1905. The specimens mentioned in the 1903 paper were not those eventually taken as types.

*latipennis* and *fulva*. The male genitalia are closest to those of *texana*, but differ in several respects, such as having broader processes on the tenth sternite.

***Lomamyia fulva*, n. sp.**

Figure 63

♀. Face and antennae yellow; vertex yellow, with numerous small, dark red spots; pronotum also mostly yellow, with some darker brown medially, which is continued on the meso- and meta-nota; all thoracic nota with small red spots; legs pale with a few red spots; vertex and thorax above with long grey-brown and dark brown hairs; legs with long light grey hairs; fore coxae and mesopleura with appressed black scales. Fore wing: length, 13 mm.; width, 6 mm.; very broad, as in *latipennis*; apex strongly incised; costal area moderately narrow, the margin concave; four to six brown spots along the costal area near the margin; wing membrane uniformly light yellow-brown; no maculations on the wing except for those on the costal margin and one at a cross-vein between Sc and R1; gradates not margined; black subcylindrical scales on MA, branches of MP and the proximal part of Cu, as well as the base of Rs; two radial cross-veins. Hind wing: membrane hyaline, with the pterostigmal cross-vein margined with dark brown; gradates not margined; black scales near the separation of MA from Rs. The eighth sternite heavily sclerotized, the two prominent, anterior lateral lobes directed slightly towards the middle of the segment; the posterior lateral processes are furcate distally; the bridge between the two lateral plates is very slender; rods of seventh sternite heavily sclerotized and moderately long.

Male unknown.

*Holotype* (♀): San Jacinto Mts., California, July 21, 1929 (R. H. Beamer); in the Museum of Comparative Zoology.

The female of this insect resembles that of *latipennis*, from which it differs by the presence of the black scales on the fore coxae and mesopleura. The male will probably be easily recognized by the wing coloring, especially the lack of marginations on the gradates.

*Lomamyia texana* (Banks)

Figure 66; plate 3, figure 25

*Bertha texana* Banks, 1897, Trans. Amer. Ent. Soc., 24: 24.

*Lomamyia texana* Banks, 1905, *ibid.*, 32: 27.

♂. Face and antennae yellow; vertex yellow with several conspicuous dark reddish brown spots;

pronotum and mesonotum medium brown, with similar reddish brown spots; abdomen dark brown; vertex, pronotum and mesonotum with a mixture of greyish brown and pure white hairs, the latter being very numerous; legs pale, spotted with reddish brown and bearing white hairs. Fore wing: length (average), 11 mm.; width, 4 mm.; slender, with the apex deeply incised; membrane hyaline; four to six dark reddish spots along costal border; pterostigma usually reddish; nearly all cells of the wing with a varying amount of light yellow brown, of greater density and extent in the distal part of the wing; gradate veins strongly margined with

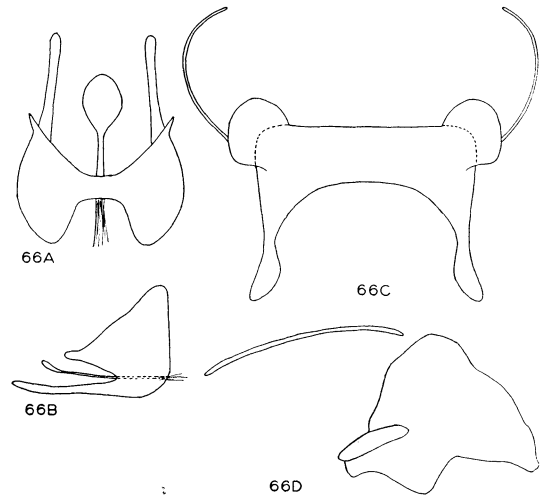


FIGURE 66. *Lomamyia texana* (Banks). A, tenth sternite of male (lectotype), dorsal view; B, same, ventral view; C, eighth abdominal sternite and rods of seventh sternite of female (allotype), ventral view; D, same, lateral view.

dark brown, forming an oblique streak across the wing; long hairs on the wing as in *flavicornis*, but white ones especially conspicuous; gradate veins with tufts of black hairs; two radial cross-veins. Hind wing: hyaline, the pterostigmal and gradate veins margined with brown. Tenth tergite with a pair of conspicuous anterior processes and a pair of short anterior lobes above; lateral plates of tergite connected by a narrow strip, lacking the prominent median posterior lobe of *flavicornis*; aedeagus short and straight, the anterior end being very broad and spatulate.

♀. Similar to the male in size and coloration, but with scales as follows: fore coxae with closely appressed black or dark brown scales; pleural region of mesothorax similarly scaled; fore wing with black or dark brown scales on the under surface of



the two lower branches of Rs and on MA. Scales apparently absent from hind wing. The eighth sternite broad, heavily sclerotized, with a pair of lateral, posterior processes, and a conspicuous pair of rounded anterior lobes; sclerotized rods of preceding segment about as long as in *flavicornis* but somewhat more curved.

*Types*: Two males (cotypes) from Texas were mentioned by Banks and both are in the Museum of Comparative Zoology. One of these lacks the abdomen; the other is here designated the lectotype. Allotype, by present designation: Globe, Arizona, July 17, 1933 (Parker); in the Museum of Comparative Zoology.

*Distribution*: TEXAS (Comfort; Davis Mts., August 22, 1936, J. N. Knull); ARIZONA (Santa Rita Mts., May 31, E. E. Schwarz; Oracle, July 15, E. A. Schwarz; Globe, July 17; Oak Creek Canyon, August 15, 1938, J. N. Knull; Huachuca Mts., August 22, 1935, R. H. Beamer); UTAH (Bellevue, June 22, Spaulding; Parowan Canyon, Iron Co., July 16, 1919, Spaulding).

This species can usually be readily recognized by the dark oblique streak formed along the gradate veins. The female is further characterized by the possession of the patches of scales on the fore coxae and mesopleura. Several specimens of these females which I have seen had a waxy secretion covering the scales, which suggests that the scales may be associated with glands.

*Lomamyia hamata* (Walker)

Figure 67

*Hemerobius hamata* Walker, 1853, List Spec. Neuropt. Ins. Brit. Mus.: 278.

*Micromus hamatus* Hagen, 1861, Synop. Neuropt. N. A.: 199.

*Lomamyia hamata* Banks, 1905, Trans. Amer. Ent. Soc., 32: 48.

*Lomamyia hubbardi* Banks, 1924, Bull. Mus. Comp. Zool., 65: 430.

♂. Face and antennae yellow; vertex and thoracic nota also yellow, with scattered red spots; sides of prothorax and mesothorax reddish; vertex and pronotum without white hairs; abdomen yellow or light brown; legs pale yellow, spotted with red. Fore wing: length, 10 mm.; width, 4 mm.; costal space less than normally broad at base and much narrowed distally; pterostigma reddish; outer border of wing deeply incised, the apex being falcate; membrane yellow-brown, with some scattered faint brown maculations and with more conspicuous red maculations along the hind and apical

margins; spots along the costal area absent or if present very faint and much reduced in size; two radial cross-veins; gradate veins not margined and apparently without tufts of hairs; the wing is covered with long, yellow-brown hairs. Hind wing: subhyaline, with the pterostigmal cross-vein heavily margined with dark brown. Tenth tergite of abdomen with a pair of long slender anterior processes ventrally and a pair of short anterior ones dorsally; lateral plates connected by a broad bridge; aedeagus very nearly straight and with only a slight thickening of the anterior part.

♀. Similar to the male in size and coloration; fore coxae with a patch of closely appressed black scales; fore wing with at least a few scattered black

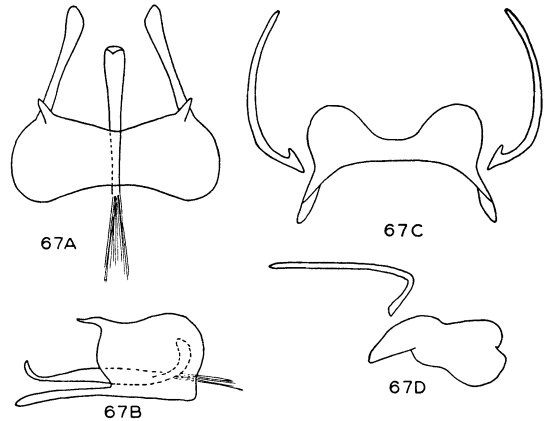


FIGURE 67. *Lomamyia hamata* (Walker). A, tenth sternite of male, dorsal view; B, same, ventral view; C, eighth abdominal sternite and rods of seventh sternite of female (allotype), dorsal view; D, same, lateral view.

slender scales in the lower two branches of Rs and MA; hind wing apparently without scales. The eighth sternite with a pair of prominent lateral processes, somewhat twisted, extending posteriorly, and two lateral rounded lobes anteriorly, the two lobes being connected by a narrow bridge; sclerotized rods of seventh segment long and strongly curved.

*Holotype* (♂): "North America"; in the British Museum of Natural History. Allotype, by present designation: Tampa, Florida, May 2, 1918 (E. P. Van Duzee); in the California Academy of Sciences.

This distinctive species is known to me only by two specimens in addition to the type. One of these, the type of *hubbardi* Banks, is from Cedar Keys, Florida, April 5, 1878 (Hubbard and Schwarz); and the other is the allotype, from Tampa, Florida.

The male type of *hamata* lacks the abdomen, but the sex is clear from the absence of the scales on the coxae and wings. The fore wings of this insect are distinctive in having the spots along the costal margin absent or very weak, and in having a very narrow costal area. The type of *hubbardi* Banks, also a male, is identical with Walker's type in wing structure and coloration, and I am convinced that the species are the same, even though nothing is known of the genital structure of Walker's specimen. At the time when he described *hubbardi*, Banks was under the impression that *hamata* was a synonym of *flavicornis*. The female described above as the allotype agrees with the male from Cedar Keys, except for the scales on the wings and thorax.

with brown and with only a few long black hairs; pterostigma reddish. Hind wing: hyaline, pterostigmal cross-vein strongly margined, gradate veins without marginations. Tenth tergite of abdomen with a pair of long ventral processes extending anteriorly and a short pair more dorsal, also directed anteriorly; a pair of prominent ventral processes extending posteriorly; aedeagus nearly straight, only slightly broadened anteriorly.

♀. Similar to the male except for the presence of black scales which are distributed as follows: fore coxae and most of fore femora; sides of pronotum; pleura of meso- and metathorax, and coxae and basal part of femora of meso- and metathorax. Also on fore and hind wing along the proximal parts of Sc, Rs, M, Cu. The eighth sternite of

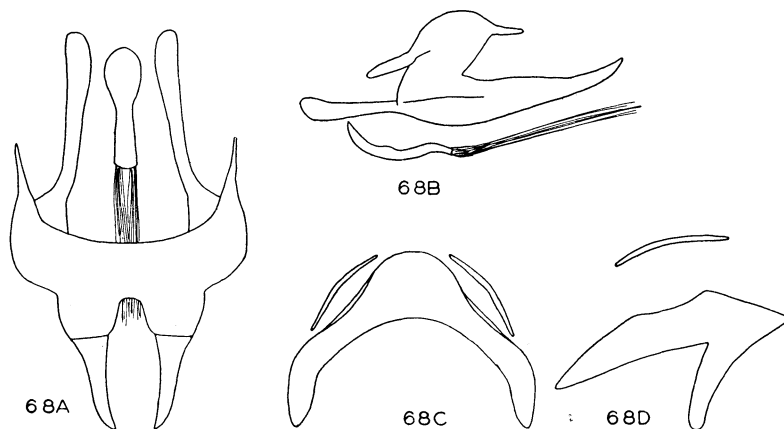


FIGURE 68. *Lomamyia squamosa*, n. sp. A, tenth abdominal sternite of male (holotype), dorsal view; B, same, lateral view; C, eighth abdominal sternite

and rods of seventh sternite of female (allotype), dorsal view; D, same, lateral view.

***Lomamyia squamosa*, n. sp.**

Figure 68

♂. Face and antennae yellow; vertex yellow, with small reddish spots at the very top; pronotum yellow with brown spots and a light reddish brown area medially; mesonotum yellow posteriorly, reddish brown anteriorly; vertex and thorax with pale yellow hairs; legs pale yellow, with red spots and yellow hairs. Fore wing: length (average), 9 mm.; width, 3.2 mm.; costal space broadened basally, narrowed near the middle of wing; outer margin smoothly and deeply incised, the apex falcate; membrane hyaline, with numerous light brown maculations, these being more or less diffuse in the distal half of wing; three radial cross-veins, one below the pterostigma; wing with dark brown or black hairs; gradate veins only slightly margined

abdomen heavily sclerotized; seen in lateral view this forms an inverted "V"; seen from below, there is a median, posterior lobe, and two lateral arms, extending posteriorly; rods of seventh sternite much reduced.

*Holotype* (♂): Brownsville, Texas, June 11-16, 1933 (P. J. Darlington, Jr.); in the Museum of Comparative Zoology. Allotype: Sabinal, Texas, March 6, 1910 (F. C. Pratt); in the Museum of Comparative Zoology.

*Paratypes*: 1♀, Brownsville, Texas, June; 1♀, same, June 10 (H. S. Barber); both in the United States National Museum.—1♂, Brownsville, June (Snow); in the Museum of Comparative Zoology.

*Distribution*: This species is known to me only from Texas. In addition to the types I have seen specimens from Hildago Co., Cypress Mills, McAllen, and Devil's River (May 6). The insect ap-

pears to be not uncommon at Brownsville, from which I have seen six individuals.

This unusual *Lomamyia* is characterized by having a greater development of scales on the wings and thorax of the female than any of our other species of the genus. The male can at once be recognized by the presence of three radial cross-veins in the fore wing, one being below the pterostigma. *Longicollis* is the only other Nearctic *Lomamyia* which possesses the three radial cross-veins, and that species has the apical margin of the fore wing almost entire, not deeply incised, as in *squamosa*. Both male and female genitalia are unusual, though following the general pattern found in other species.

*Lomamyia longicollis* (Walker)

*Hemerobius longicollis* Walker, 1853, List Spec. Neuropt. Ins. Brit. Mus.: 281.

♂. Face and antennae yellow-brown; antennae a little stouter than in other specimens of the genus; vertex, pronotum and mesonotum brown, with some very dark brown or black hairs and many white ones; legs pale, spotted with dark brown and bearing many long white hairs; abdomen brown. Fore wing: length, 9 mm.; width, 4 mm.; apical margin not truly incised, at most slightly concave; costal margin nearly straight; costal area broad; pterostigma faintly reddish brown; four to six dark reddish brown spots along the costal border; membrane subhyaline, with numerous faint brown maculations which give the wing a brownish color, especially apically; veins dark, with little or no spotting; brown hairs on wing; three radial cross-veins, one below the pterostigma; gradate veins with tufts of black hairs, but not margined. Hind wing: no maculations or marginations of cross-veins. The structure of the male genitalia is not known; the only two males of this species which I have seen are the Walker types.

♀. Similar to the male; no scales on wings or thorax. The eighth sternite very small and so weakly sclerotized that it shows no definite shape, as it does in other species; there is no sclerotized plate. The rods of the seventh segment are very small.

*Types*: Two males (cotypes) from Georgia (Abbot); in the British Museum. Allotype, by present designation: Prattsburg, Georgia, July 25, 1930 (R. H. Beamer); in the Museum of Comparative Zoology (donated by R. C. Smith).

*Distribution*: In addition to the types I have seen but two specimens: ♀, from Ocean Springs, Mississippi; ♀, from Warren, North Carolina.

This species has been the cause of much uncertainty in the past. The lack of a definitely excised apical margin has made the generic position of the insect obscure. Walker's assignment of the insect to *Hemerobius* was of little significance, since the genus was then very loosely and broadly used. Hagen, on the basis of McLachlan's description, thought that the species was allied to the Sisyrid *Climacia areolaris* (Hagen). Banks in his revision of the Nearctic Hemerobiidae (1905) did not attempt to assign the species to any genus; subsequently, however, he obtained a specimen from Mississippi (Ocean Springs) and provisionally determined it as *longicollis*. My examination of the types in the British Museum shows that his identification was correct.

Although *longicollis* lacks the incised apical wing margin, an indication of it is present. The species is unusual for the lack, also, of the heavily sclerotized eighth abdominal sternite of the female, although there is a slight indication of this plate.

Family POLYSTOECHOTIDAE

Antennae setaceous or nearly so, short, less than half the length of the fore wing, first segment much enlarged; ocelli absent; prothorax much broader than long, not lobed laterally; legs cursorial, all coxae well developed and free; abdomen large. Tenth tergite of male entire, with well developed trichobothria laterally; ninth tergite narrow, the ventral margin extended slightly posteriorly; tenth sternite forming part of the internal armature; ninth sternite small. Tenth tergite of female entire, large; ninth narrow above, but extended so far ventrally as to almost envelop the segment; eighth sternite small.

Wings subequal; costal area at least slightly broadened above the separation of Rs from R1; Sc apparently terminating on costal margin; no true pterostigma present; Rs originating close to the base of the wing and giving rise to nine to fourteen branches, all of which fork several times; MA apparently coalesced with Rs, though there is no indication of the free basal part of MA; Cu1 forked close to the base of the wing. Hind wing: costal space narrower than that of fore wing; cross-veins unbranched; MA coalesced for a short interval with Rs at the base; free proximal part of MA distinct; Rs with from seven to thirteen branches; Cu1 forked close to base of wing.

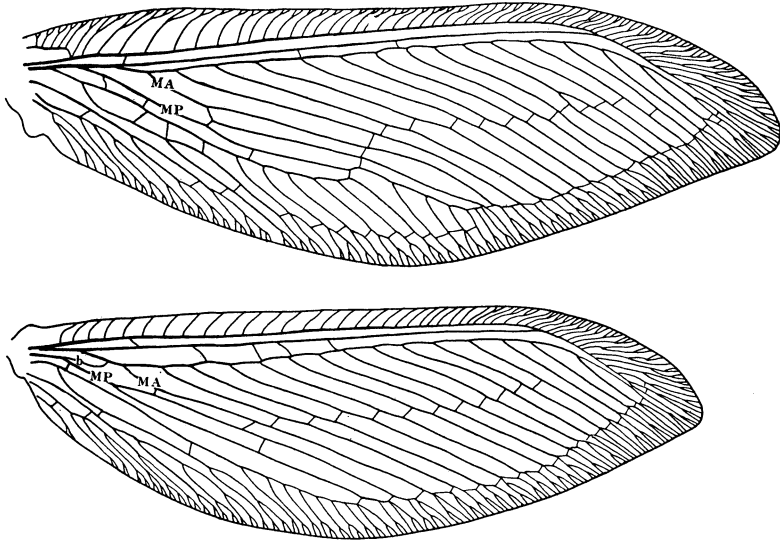


FIGURE 69. Wing venation of *Polystoechotes punctatus* (Fabr.). Lettering as in figure 1.

This family, which is confined to the New World, has in the past included only two genera, *Polystoechotes* Burm. and *Fontecilla* Navas (Chile);<sup>26</sup> a third genus is described in the present paper. Almost nothing is known of the immature stages of the *Polystoechotids*.

The two Nearctic genera now in the family may be distinguished as follows:

1. Costal area narrow at base, only slightly broadened beyond; abdomen slender

*Polystoechotes* Burm. (p. 268)

- Costal area abruptly broadened at base, and very wide beyond; abdomen very stout

*Platystoechotes*, n. gen. (p. 270)

#### Genus *Polystoechotes* Burmeister

*Polystoechotes* Burmeister, 1839, Handb. Ent., 2 (3): 982; Banks, 1905, Trans. Amer. Ent. Soc., 32: 28.

Fore wing: slender, pointed; costal area narrow at base and very slightly widened beyond; recurrent humeral vein present; costal veinlets forked; Rs with from eleven to fourteen branches; MA connected by a cross-vein to MP1 + 2 shortly after origin of the latter; two series of gradate veins, the outer with twenty-five to thirty cross-

veins, the series close to the hind margin and nearly parallel to it; inner gradates with twelve to sixteen cross-veins. Hind wing: Rs having distinct contact with Rs; eleven to fourteen branches of Rs; MP forked at about the level of separation of MA from Rs; MP1 + 2 connected by a cross-vein to MA, shortly after the origin of Rs; two series of gradates, eighteen to twenty-three in the outer and ten to thirteen in the inner.

Eyes of moderate size; thorax narrow; abdomen very slender. Tenth tergite of male very large; ninth sternite with a long distal lobe; internal armature consisting of three complex, sclerotized plates; eighth sternite very long. Tenth tergite of female large; ninth narrow, but greatly extended ventrally; eighth sternite small but heavily sclerotized.

Genotype: *Semblis punctata* Fabricius.

The relationship of this genus with other Neuroptera is not at all clear. The genital structure, furthermore, is so unusual that I have been unable to homologize the parts with those of other genera in the order. *Polystoechotes* has been found in Chile (*P. gazullai* Navas), Panama, Mexico, and the Nearctic Region.

*Polystoechotes punctatus* (Fabr.)

Figures 69, 70; plate 3, figure 27

*Semblis punctata* Fabricius, 1793, Ent. Syst., 2: 73.

*Hemerobius nebulosa* Fabricius, 1798, Ent. Syst. Suppl.: 202.

<sup>26</sup> *Oliarces clara* Banks, from California, has been referred by Lameere (1936) to the *Polystoechotidae*, but a study of the type, which is the only known representative of the insect, has convinced me that this is not justifiable.

*Hemerobius irroratus* Say (nec Stephens), 1824, Long's Exped., 2: 306; Fitch, 1856, 1st and 2nd Rept. Ins. N. Y.: 92.

*Polystoechotes strictus* Burmeister, 1839, Handb. Ent., 2: 982; Walker, 1853, List Spec. Neuropt. Ins. Brit. Mus.: 231.

*Osmylus validus* Walker, 1853, *ibid.*: 233.

*Hemerobius vittatus* Say, 1824, Long's Exped., 2: 307; Fitch, 1856, 1st and 2nd Rept. Inst. N. Y.: 93.

*Polystoechotes punctatus* Hagen, 1861, Syn. Neuropt. N. A.: 206; Banks, 1905, Trans. Amer. Ent. Soc., 32: 28.

♂. Lower face yellow or light brown; upper part, just below antennae dark reddish brown, sometimes nearly black; between vertex and antennae a thin transverse yellow band; vertex dark reddish brown or black, often variegated; vertex with conspicuous black and white hairs; antennae medium to dark brown; pronotum dark brown, with a small yellow irregular spot laterally; pronotum and mesonotum with black and white hairs, especially the latter; mesonotum brown, with some indication of reddish brown; metanotum and abdomen dark brown; legs light grey-brown, with light orange hairs; tip of tibiae and tarsal segments dark brown. Fore wing: length 18–34 mm.; width, 6–12 mm.; costal space only moderately broad; apex pointed, membrane hyaline or faintly smoky; costal area with dark brown spots; inner gradates margined; posterior part of wing with four to six large dark brown, irregular spots; also area between R1 and Rs and other parts of wing frequently with dark brown spots, very variable in intensity and size. Hind wing: hyaline; without markings except for a few light spots along outer gradates in the vicinity of Cu and M, ninth sternite with a median distal process; internal armature as shown in figure 70D.

♀. Like the male in color and markings, but usually larger, the fore wing length varying from twenty to forty millimeters. Ninth abdominal sternite strongly sclerotized; seen from below the plate shows a posterior median lobe distally excised; a pair of lateral plates extending dorsally; and between these vertical plates a heavily sclerotized rod extending anteriorly and attached to the ninth sternite by a membrane.

*Type*: Without locality data; in British Museum.

*Distribution*: This is a very widely distributed insect. I have seen specimens from all of the states west of the Rocky Mountains (approx-

mately longitude 105°); and from Georgia, New York, New Hampshire, Maine, Massachusetts, Pennsylvania, Maryland and North Carolina. It is common in British Columbia, Alberta, Ontario, and Quebec. Hagen reported it from Texas and although I have seen no specimens from that state, I have no doubt it does occur there. In the collection of the California Academy of Sciences there

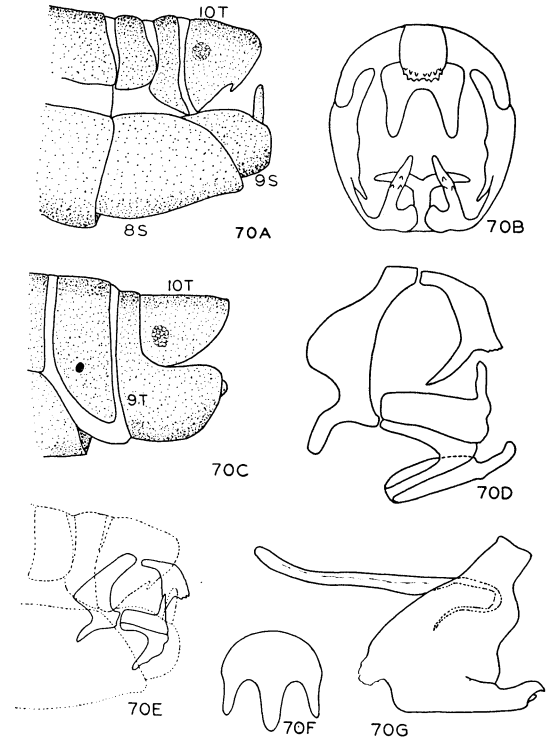


FIGURE 70. *Polystoechotes punctatus* (Fabr.). A, terminal abdominal segments of male, lateral view; B, same and internal armature, posterior view (ninth sternite omitted); C, terminal abdominal segments of female, lateral view; D, internal armature of male, lateral view; E, same, showing position of parts with reference to segmentation; F, ninth sternite of male, ventral view; G, ninth abdominal sternite of female, lateral view.

is a specimen from Lower California; and in the Museum of Comparative Zoology there is a female from Panama (Lino). The most northern record is near Peace River (town), Alberta (lat. 56°). The species is far more common in the western states (especially the northern ones) than it is in the eastern. Of particular interest is the fact that *punctatus* seems to be absent from the prairie states and Manitoba. The adults appear in June and persist until the end of October. They are positively phototropic and during the fall, especially

August, a great many individuals may be collected at lights in the western states.<sup>27</sup> I have seen more than five hundred specimens.

*Punctatus* is remarkable for its variability in size. This, in conjunction with a similar instability in the color pattern of the wing, has been the chief cause of the many synonyms. Fabricius' description of the insect was too incomplete to enable recognition of the species from that alone. Hagen saw the type in the British Museum and of course readily recognized the insect. He was also able to see the types of most other synonymous species, all of which were described before the publication of

and tapering, and had a very large head. The mandibles were straight; the antennae were 8-segmented, the first and second segments much larger than the others; the maxillary palpi were 5-segmented. Welch was of the opinion that the larvae were predaceous and terrestrial; Needham suggested the possibility of their being terrestrial or arboreal; Hagen that they were aquatic; and Banks that they were parasitic on an aquatic insect.<sup>28</sup> Whatever the environmental occurrence of *punctatus* may be, it is obvious that the mature larva, which must be at least an inch in length, has not been found.

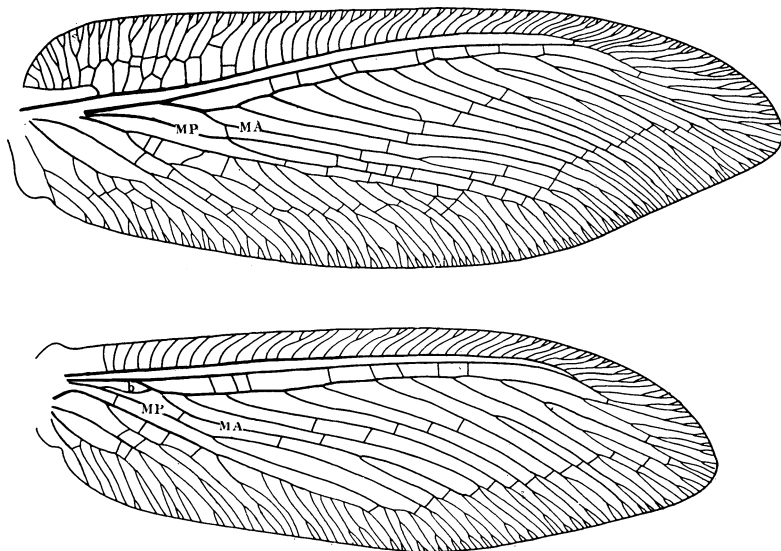


FIGURE 71. Wing venation of *Platystoechotes lineatus*, n. sp. Lettering as in figure 1.

his "Synopsis of the Neuroptera of North America" in 1861.

The most surprising fact about *punctatus* is that in spite of its large size and local abundance, its immature stages are almost unknown. Needham (1901), Hungerford (1931) and Welch (1914) have obtained eggs from captive specimens. The larvae obtained by Welch lived only a few days, presumably because of the lack of proper food. The eggs were laid singly, were oval, white and very granular. They were exceedingly small, being less than a millimeter in length. The incubation period was found by Welch to be ten days. The newly hatched larvae were about 1.5 mm. long, slender

#### Genus *Platystoechotes*, n. gen.

Fore wing: slender, costal area abruptly broadened at base; humeral recurrent vein present; costal veinlets forked, the proximal ones joined by cross-veins; Rs with eight to twelve branches; MA joined to MP by a cross-vein at about the fork of MP; two series of gradate veins, the outer one with 28-35 cross-veins, the series remote from the margin and forming a broad "V"; inner gradate series with 9-11 cross-veins.

Hind wing: Rs having slight contact with MA; Rs with seven to nine branches; MP not forked nearly as far proximally as the separation of MA from Rs; MA connected to MP before furcation

<sup>27</sup> Fyles records (1903) the occurrence of a cloud of these insects above a warehouse in Ontario; the aggregation was so dense that observers mistook it for smoke and called out the fire-engines.

<sup>28</sup> Lestage (1925) and Withycombe (1925) have discussed these possibilities at some length, without coming to a definite conclusion.

of latter; two series of gradates, 11–14 in the outer, 6–8 in the inner.

Eyes small; thorax broad and thick, the head recessed into the prothorax; abdomen very thick. Tenth tergite of male large; ninth tergite of moderate size; tenth sternite forming part of the internal armature; ninth sternite small; eighth large; internal armature consisting of two complex plates. Tenth tergite of female large rounded; ninth tergite narrow but extended ventrally; ninth sternite divided; eighth sternite small and heavily sclerotized.

Genotype: *Platystoechotes lineatus*, n. sp.

This genus is related to *Polystoechotes*. The wings are much like those of *punctatus*, though having a much broader costal area. The wings alone, however, would not justify the erection of a new genus, but the terminal abdominal segments of the male and female of *lineatus* are so different from those of *punctatus* that I have not been able to homologize the parts satisfactorily. It is because of the difference in genital structure that I have considered a new genus necessary.<sup>29</sup>

***Platystoechotes lineatus*, n. sp.**

Figures 71, 72; Plate 3, figure 28

Clypeus yellow; frons reddish brown and yellow, variegated; vertex from light to dark reddish brown, with some yellow usually present just behind the eyes laterally; vertex with long white hairs; antennae yellowish; pronotum reddish to medium brown, with very long grey-brown hairs; meso- and metanotum medium brown, with grey-brown and white hairs; abdomen light reddish brown, with brown hairs. Fore wing: length, 25–28 mm.; width, 8–9 mm.; costal area very broad; cross-veins present between the costal veinlets in the proximal half of the wing; membrane hyaline; costal area with 4–6 large brown spots; numerous smaller spots between R1 and Rs; a wide transverse brown band from the hind margin to R1 at about mid-wing; a thinner but slightly darker stripe follows along the line of the gradates; long hairs are present on all veins, brown ones on the brown

areas and white ones on hyaline areas. Hind wing: hyaline, but with the outer and most of the inner gradates surrounded by a dark brown spot, the gradate veins themselves being white. The terminal abdominal segments as described for the genus; internal armature consisting of a very weakly sclerotized structure in the form of a "C," when seen in side view; in end view the structure is seen to be composed of a dorsal median piece and two lateral divergent arms, supporting ventrally a median posterior process.

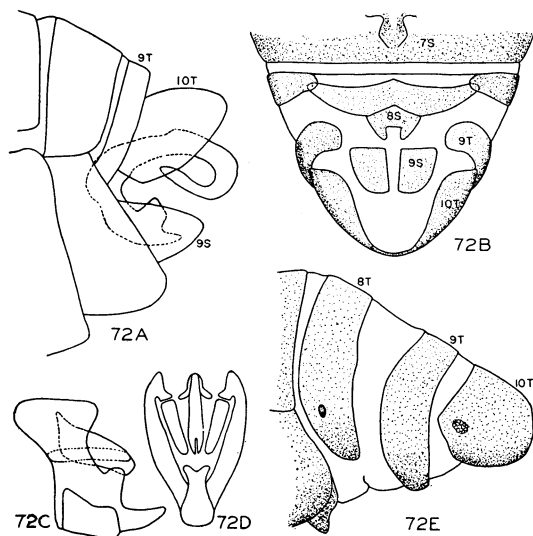


FIGURE 72. *Platystoechotes lineatus*, n. sp. A, terminal abdominal segments of male (holotype), lateral view; B, same of female (allotype), ventral view; C, eighth abdominal sternite of female, lateral view; D, ninth abdominal sternite and internal armature of male, posterior view; E, terminal abdominal segments of female, lateral view.

♀. Similar to the male in color, but usually larger, the fore wing varying from 25–33 mm. Eighth sternite strongly sclerotized ventrally and bearing two vertical, lateral plates; between the latter a short, heavily sclerotized rod; ninth sternite with a conspicuous median depression posteriorly, with a pair of prominent teeth projecting inwards near the posterior end of the depression.

*Holotype* (♂): Wolverton, Sequoia National Park, California, 7000–9000 ft., June 14, 1929 (E. C. Van Dyke); in the California Academy of Sciences. Allotype: same locality, June 13, 1929 (E. C. Van Dyke); in the California Academy of Sciences.

*Paratypes*: 1♂, same locality as holotype, June 19, 1929 (E. C. Van Dyke); 1♀, same, June 24,

<sup>29</sup>Navas' monospecific genus *Fontecilla* (1931), from Chile, has a broad costal area, somewhat like that of *lineatus*, but the wings are falcate apically. Since Navas did not describe the venation of his insect (*F. graphicus* Nav.), no venational comparisons between *Platystoechotes* and *Fontecilla* can be made. The type of *graphicus* was originally in the Navas collection, and I have been unable to ascertain its present location.

1929; 1 ♀, Norval Flats, Lassen Co., California, 5500 ft., June 2, 1920 (J. O. Martin); all in the California Academy of Sciences.—1 ♂, Wolverton, California, June 19, 1929 (E. C. Van Dyke); 1 ♀, Potwisha, Sequoia Nat'l. Park, 2-5000 ft., California; 1 ♂, Giant Forest, Tulare Co., California, July 15, 1928 (C. L. Fox); all in the Museum of Comparative Zoology.—1 ♀, Giant Forest, California, July 28, 1929 (R. H. Beamer); in R. C. Smith collection.—1 ♂, 1 ♀, Glacier Pt., 7214 ft., California, June 13, 1931; in the University of California collection.

This striking insect, which has so far been found only in California, is readily recognized by the wing markings and shape, as well as by the very stout body. It is surprising that such a large and conspicuous insect as this has not previously been described and that it was not collected prior to the past twenty years. It is apparently not rare in Sequoia National Park and vicinity, where, I am informed, it is taken without much difficulty by students at the University of California. The general habitus of this insect is very different from that of *punctatus*; the latter has a slim, elongate abdomen, whereas *lineatus* has an exceedingly stout one. Since this is true of both sexes, the size of the abdomen in the female can hardly be due to the presence of an unusually large number of eggs. It is greatly to be hoped that some attention will be given to the life history of this insect.

#### Family DILARIDAE

Antennae filiform in the female, pectinate in the male; first segment enlarged; functional ocelli absent, but three ocelli-like pilous tubercles are present; prothorax as wide as long, usually broader and bearing several conspicuous tubercles; its lateral margins not lobed; legs cursorial; coxae large and free; abdomen cylindrical and short; tenth tergite of male transverse, with trichobothria; tenth sternite forming part of the internal armature; female with a long ovipositor.

Wings subequal, very hairy, often showing sexual dimorphism. Fore wing: costal space either narrow or broad, but never abruptly widened at base; recurrent humeral vein absent; cross-veins numerous in costal area, mostly unbranched; all branches of Rs arising from a single stem; Rs with from two to five branches arising directly from the stem; MA either coalesced with Rs or coalesced with R and separated from it before origin of Rs; MP either deeply forked or twigged at the margin of

the wing; cross-veins few or many, rarely arranged in gradate series.

Hind wing: costal space narrow, with numerous unbranched cross-veins; MA usually coalesced with Rs, though rarely free; MP usually deeply forked; Rs with from two to five branches; cross-veins few or many, rarely arranged in gradate series.

Nothing is known of the immature stages of the Dilaridae. The suggestion has been made that the larvae are aquatic, but as Hagen pointed out this does not seem likely in view of the long ovipositor. In this connection it is pertinent to note that Dr. W. H. Anderson has recently reared a male of the Nearctic species, *Nallachus americana* (Hagen) from wood debris of a dead tulip tree (*Liriodendron tulipifera* Linn.), near Falls Church, Virginia. The wood had been collected a few weeks before from the tree, which stood near the edge of a wooded area about 300 feet from a small stream. It seems very probable that the pupa of the insect was secreted on or in the dead wood.

This family is an exceptionally interesting one. Although the species exhibit various specializations, such as the pectinate antennae of the male, some possess characteristics which are clearly generalized. In this category, for example, is the free MA which occurs in *Dilar corcyracus* Navas. The existing species of the family are undoubtedly but a small remnant of a much larger group. Navas was led to conclude from a revisional study of the family that several genera exist, rather than Dilar alone, and I believe that most of the six new genera which he described are valid. Although only about thirty species of Dilaridae are known, the family has a wide distribution: Asia, Europe, Africa, and North and South America. Most of the genera, however, are restricted to single continents. Only one genus occurs in the Nearctic region.

#### Genus *Nallachus* Navas

*Nallachus* Navas, 1909, Mem. Real. Acad. Cienc. Artes Barc., 7: 666.

Fore wing: slenderly oval in female, subtriangular in male; costal area very narrow for its entire length; pterostigma weakly formed; at least one cross-vein between R1 and Rs; gradate veins absent or few in number; Rs with two or three branches arising directly from stem Rs; M coalesced with Rs for a considerable distance, and apparently also coalesced with Rs, which arises as an anterior branch of MA near the mid-wing; basal piece of MA usually present at base of wing, often obsolescent; Cu1 deeply forked.



Hind wing: elongate-oval in female; broadly oval in male; costal area narrow; Rs with two branches from stem Rs; one or two cross-veins between R1 and Rs; MA coalesced with Rs for a considerable distance, also apparently with R4 + 5; free part of MA obsolete; MP forked to level of separation of MA from stem Rs.

Antennae of male with from 12–16 segments; of female with from 15–17 segments; prothorax much broader than long; tenth tergite of male divided, forming two lateral plates, with numerous trichobothria; ninth tergite entire, the ventral margin extended posteriorly; eighth tergite entire and very short, but extending nearly to ventral part of segment; ninth sternite small; eighth larger; tenth straight and apparently forming a complex armature, consisting of an anterior transverse plate, with

*Nallachus americanus* (McLachlan)

Figures 73, 74

*Dilar americana* McLachlan, 1881, Ent. Mo. Mag., **18**: 55; Banks, 1905, Trans. Amer. Ent. Soc., **32**: 24.

*Nallachus americanus* Navas, 1909, Mem. Real. Acad. Cienc. Artes Barc., **7**: 669; 1914, Gen. Ins., fasc. **156**: 11.

♂. Head, first antennal segment, prothorax and abdomen reddish brown; ocellar warts light brown; antennae and legs pale yellow. Fore wing: length, 4 mm.; width, 1.8 mm.; membrane either hyaline or slightly greyish; maculations grey, in the form of large, irregular spots, sometimes very diffuse, so that the entire wing is more or less grey; veins with

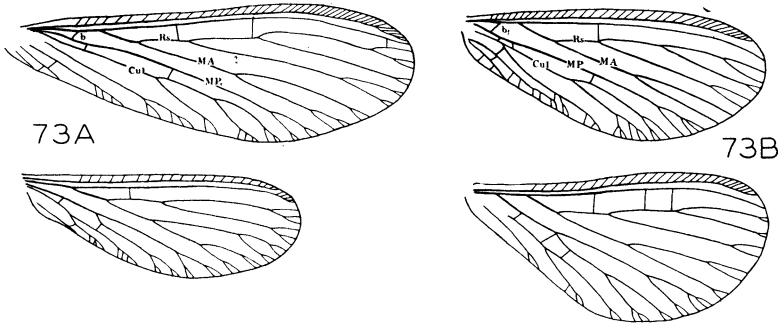


FIGURE 73. Wing venation of *Nallachus americana* (McLachlan). A, female (holotype); B, male (allotype). Lettering as in figure 1.

two pairs of posterior processes, one pair lateral, the other medial; hypandrium small. Female with the ovipositor curved strongly over the abdomen.

Genotype: *Dilar prestoni* McLachlan.

This small genus includes four species: *prestoni* McLach. from Brazil; *loxanus* Navas from Ecuador; *pulchellus* Banks from Cuba and Arizona, and *americanus* McLachlan from Kentucky and Virginia.<sup>30</sup> The two latter species may be separated as follows:

1. Fore wing without a series of gradate cross-veins  
*americanus* McLach. (p. 273)
- Fore wing with a series of gradates  
*pulchellus* Banks (p. 274)

long grey hairs. Hind wing: length, 3 mm.; width, 1.8 mm.; very broadly oval, color as in fore wing. Anal plates (tenth abdominal tergite) with a short, broad tooth arising from the posterior margin near the mid-point; internal armature with the lateral processes longer and straighter than the inner pair; aedeagus only about half as long as latter.

♀. Head, thorax and abdomen pale brown; antennae and legs yellow. Fore wing: length, 5 mm.; width, 2 mm.; elongate oval; membrane hyaline, with numerous grey maculations as in the male. Hind wing: length, 3.5 mm.; width, 1.5 mm.; color as in the fore wing.

*Holotype* (♀): Bee Spring, Kentucky, June, 1874 (Sanborn); in the Museum of Comparative Zoology. Allotype, by present designation: about 4 mi. northeast of Falls Church, Virginia, on the property of R. A. Cushman; the specimen emerged from woody debris of a dead tulip tree, May 25,

<sup>30</sup> There are also undescribed species in the Museum of Comparative Zoology from Paraguay and Puerto Rico.

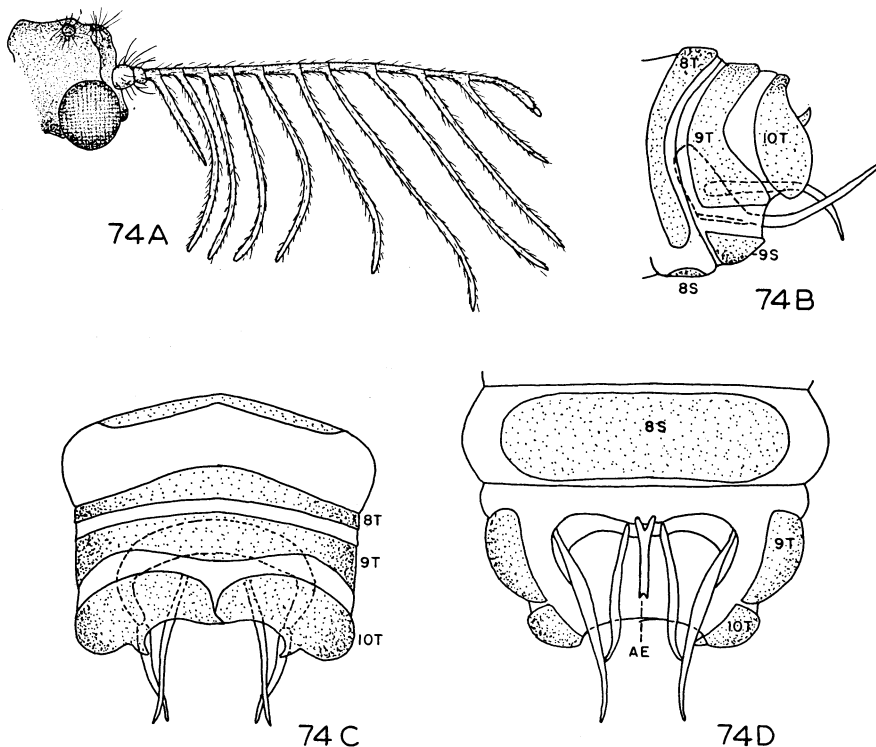


FIGURE 74. *Nallachius americana* (McLachlan), male (allotype). A, head and antenna, lateral view; B, terminal abdominal segments, lateral view; C,

same, dorsal view; D, same, ventral view (ninth sternite omitted). Lettering as in figure 2.

1939 (W. H. Anderson); in the United States National Museum.

I have seen only three specimens of this rare insect in addition to the types mentioned. One of these ( $\delta$ ) was collected at Glen Echo, Maryland, July 16, 1922 (J. R. Malloch) and is in the National Museum. The other two ( $\delta$ ,  $\text{♀}$ ) were collected at Falls Church, Virginia, July 20, on the same tree and within a few minutes of each other (N. Banks); these are in the Museum of Comparative Zoology. In the latter male, from Falls Church, the wings are greyish, without definite spots, the maculations apparently being diffuse. The genitalia of this specimen are identical with those of the allotype. The wing venation probably varies considerably in this insect. The holotype specimen has three branches of Rs arising directly from stem Rs in the fore wings, whereas all other specimens have only two. The male antennae appear to differ markedly in the several genera of Dilarids, but they also show some individual variation. One of the males of *americana* (allotype) has two more antennal segments than are present in the other male.

#### *Nallachius pulchellus* (Banks)

Figure 75

*Dilar* (*Nallachius*) *pulchellus* Banks, 1938, Rev. de Ent., 9: 289; fig. 12.

$\delta$ . Head light reddish brown; first two antennal segments reddish-brown; rest grey-brown; antennae shaped much as in *americana*; ocellar warts as in *americana*, lighter than the rest of the head; thorax and abdomen brown, variegated; pronotal warts as in *americana*; legs pale. Fore wing: length, 3-5.5 mm.; width, 1.5-2.4 mm.; shape as in *americana*; membrane hyaline, with numerous grey maculations, sometimes diffuse, especially distally; costal space narrow; two cross-veins between R1 and Rs; MP3 + 4 not coalesced with Cu1; a series of five gradate veins present. Hind wing: length 2.4-3.5 mm.; width, 1.5-2.4 mm.; maculations as in the fore wing; no gradate series. Anal plates with a short but conspicuous tooth arising from the posterior margin at the top of the plates; a larger process arises from about the same part of the plate but is directed inwards; internal arma-

ture with the lateral processes somewhat longer than the inner pair, and the aedeagus nearly as long as the latter.

♀. Similar to the male in coloring; antennae pale yellow. Fore wing: length, 5.4 mm.; width,

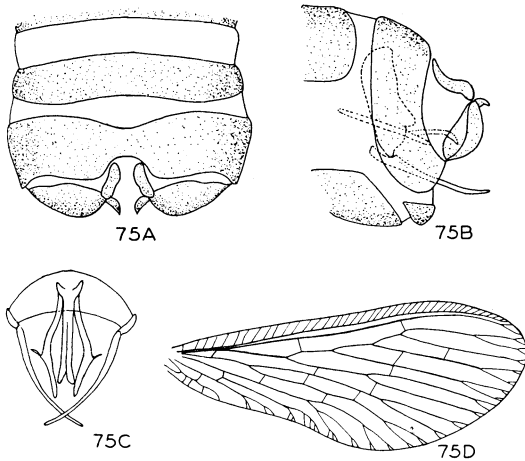


FIGURE 75. *Nallachius pulchellus* (Banks). A, terminal abdominal segments of male (holotype), dorsal view; B, same, lateral view; C, internal armature of male, ventral view; D, fore wing of female (allotype).

2 mm.; slender; maculations and venation as in the male. Hind wing: length, 3.6 mm.; width, 1.8 mm.; maculations and venation as in the male.

*Types*: two cotypes (♂, ♀) from woods near Soledad (Cienfuegos), Cuba, May 4, 1930 (P. J.

Darlington, Jr.); in the Museum of Comparative Zoology.

A single male of this species is contained in the collection of the University of Kansas; it was taken in the Santa Rita Mountains, Arizona, 5000–8000 ft., July (F. H. Snow). At first glance I believed this to be a new species, but after comparing it with the types of *pulchellus*, I was unable to find any differences whatever, in genital or wing structure. It is somewhat larger than the types, but the Dilarids in general are very variable in size. There are several striking differences between this species and *americana*; e.g., the fore wings of the latter lack all cross-veins in the distal half of the wing, except the one between Rs and R1; whereas in *pulchellus*, there is a series of five gradates. The latter characteristic does not, in fact, fit Navas' original definition of *Nallachius*, which was described as lacking the gradates; but since *pulchellus* is not even remotely related to the other named genera, I prefer to modify the definition of *Nallachius* rather than establish a new genus.

The occurrence of this Dilarid in Arizona is of great interest, since the family has not previously been found anywhere in the Nearctic region except near the District of Columbia. That the species also occurs in the West Indies is likewise interesting, but Dr. Darlington tells me that he has observed many instances of close relationship between West Indian Coleoptera and those of northern Mexico and southern Arizona.

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## PLATE 1

Fore wings of *Hemerobius* and *Symphorobius*

The photographs do not indicate relative sizes of the insects

Fig. 1, *Hemerobius humulinus* Linn. Fig. 2, *Hemerobius stigmaterus* Fitch. Fig. 3, *Hemerobius pacificus* Banks. Fig. 4, *Hemerobius bistrigatus* Currie. Fig. 5, *Hemerobius ovalis*, n. sp. Fig. 6, *Hemerobius simulans* Walker. Fig. 7, *Hemerobius dorsatus* Banks. Fig. 8, *Hemerobius costalis*, n. sp. Fig. 9, *Symphorobius barberi* Banks. Fig. 10, *Symphorobius occidentalis* (Fitch).

## PLATE 2

Fore Wings of *Symphorobius*, *Megalomus*, and *Micromus*

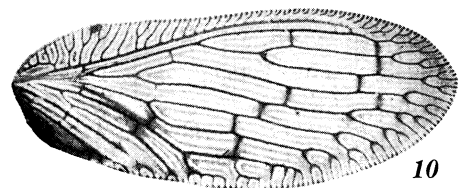
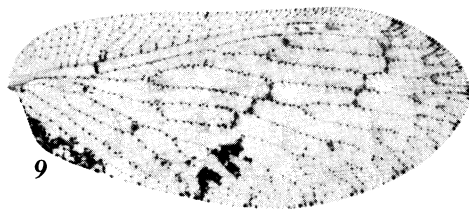
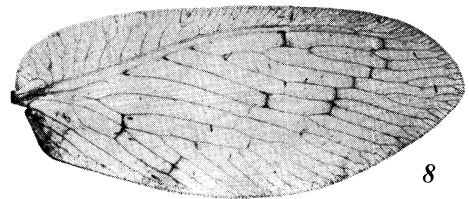
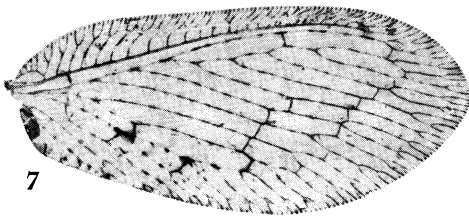
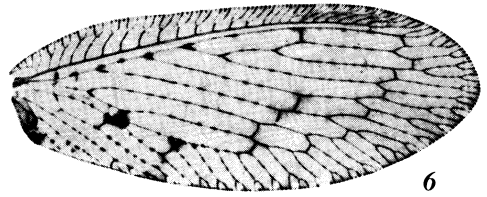
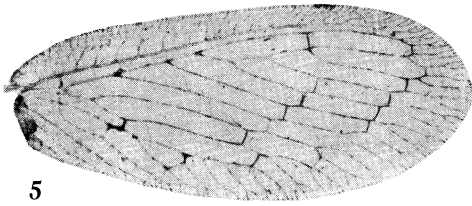
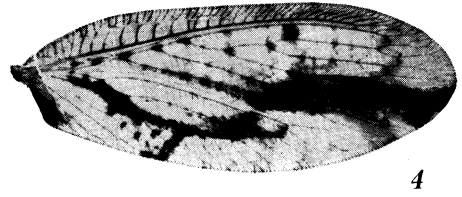
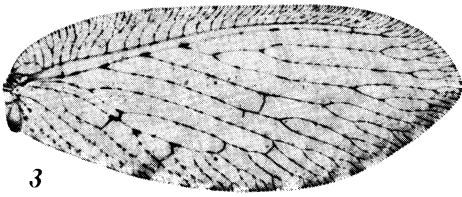
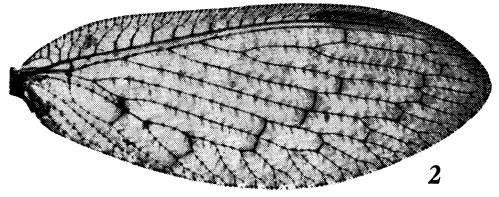
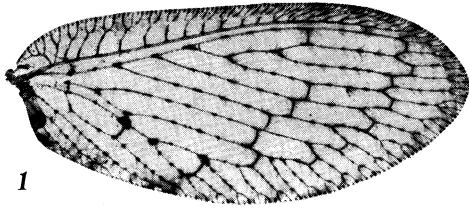
The photographs do not indicate relative sizes of the insects

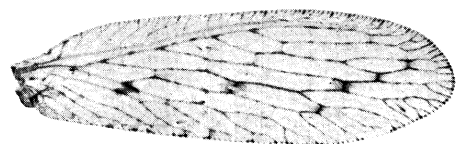
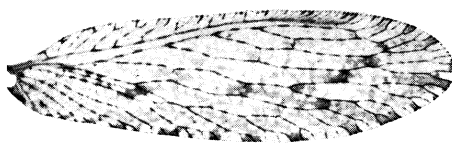
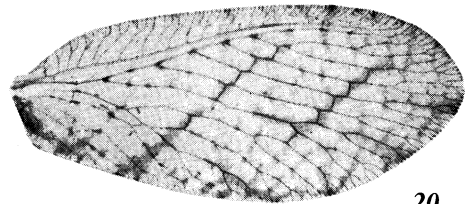
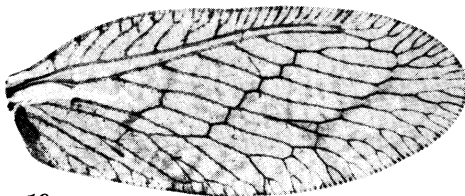
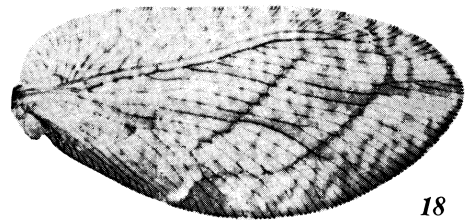
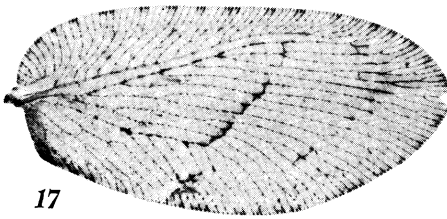
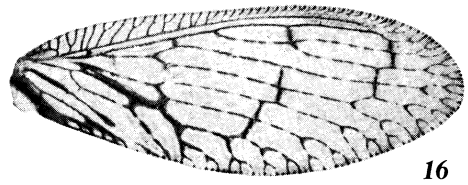
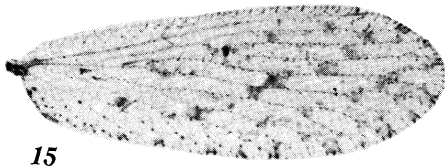
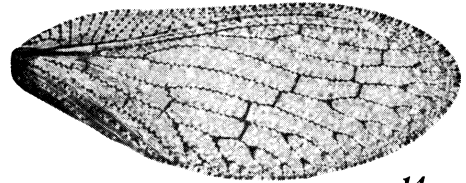
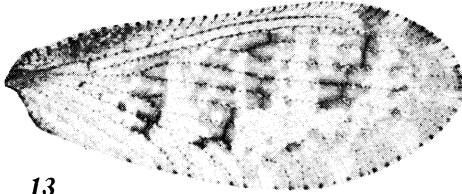
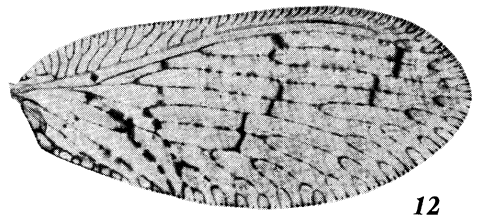
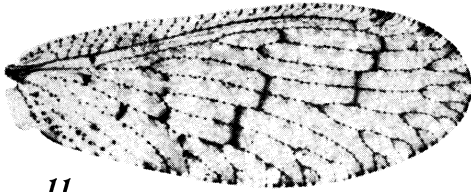
Fig. 11, *Symphorobius killingtoni*, n. sp. Fig. 12, *Symphorobius californicus* Banks. Fig. 13, *Symphorobius pictus* (Banks). Lectotype. Fig. 14, *Symphorobius arizonicus* (Banks). Holotype. Fig. 15, *Symphorobius perparvus* (McLach.). Fig. 16, *Symphorobius angustus* Banks. Fig. 17, *Megalomus moestus* Banks. Fig. 18, *Megalomus angulatus*, n. sp. Holotype. Fig. 19, *Micromus angulatus* Steph. Fig. 20, *Micromus montanus* Hagen. Fig. 21, *Micromus variolosus* Hagen. Fig. 22, *Micromus subanticus* Walker.

## PLATE 3

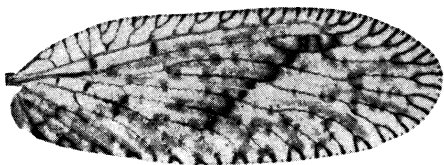
The photographs do not indicate relative sizes of the insects

Fig. 23, Fore wing of *Psectra diptera* (Burm.). Fig. 24, Fore wing of *Climacia areolaris* (Hagen). Fig. 25, Fore wing of *Lomamyia texana* Banks. Fig. 26, Fore wing of *Lomamyia flavicornis* (Walker). Fig. 27, Fore wing of *Polystoechotes punctatus* (Fabr.). Fig. 28, Fore and hind wing of *Platystoechotes lineatus*, n. sp.

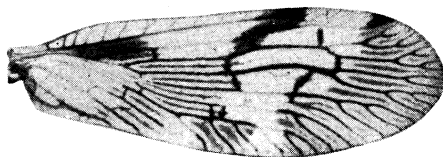




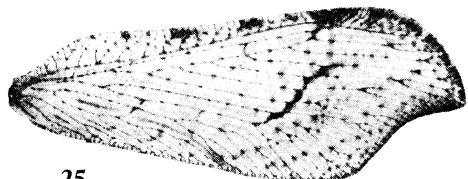




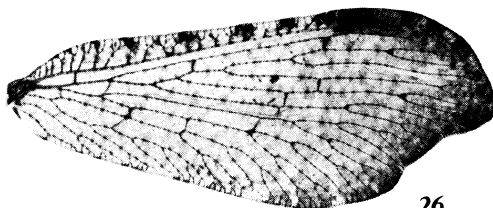
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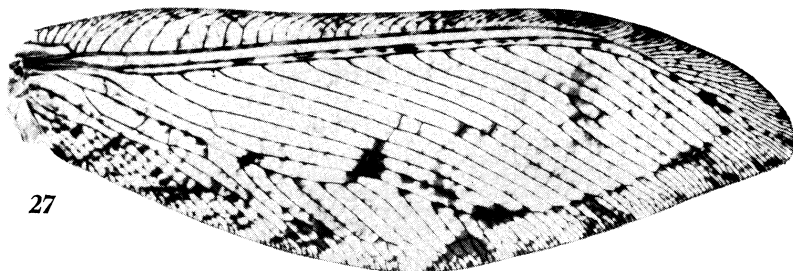
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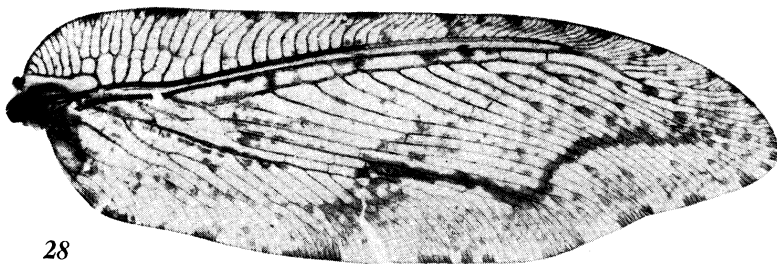
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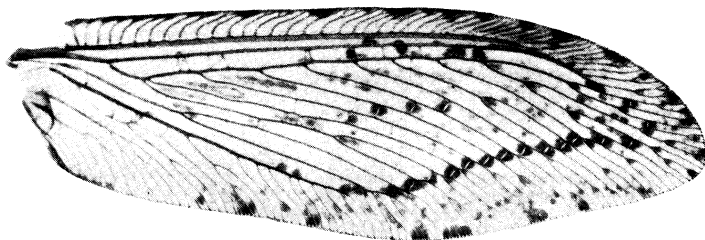
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