ILLINOIS

atural History Survey

BULLETIN

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CONTENTS

This report is printed by authority of the State of Illinois, IRS Ch. 127, Par. 58.12. It is a contribution from the Section of Faunistic Surveys and Insect Identification of the Illinois Natural History Survey.

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Frontispiece.—A hangingfly, **Bittacus pilicornis,** awaiting its prey, which includes mosquitoes and other bottomland insects. (Photo by W. D. Zehr)

The Mecoptera, or Scorpionflies, of Illinois

Donald W. Webb, Norman D. Penny, and John C. Marlin

THE ORDER MECOPTERA (scorpionflies and hangingflies) is of ancient lineage. Fossils of this order are known from as far back as the Permian. Today relatively few species of Mecoptera exist; fewer than 500 are currently recorded for the world. They and their fossil relatives exhibit many primitive characteristics and are considered among the oldest and most primitive holometabolous insects. Eighteen species occur in Illinois. They live in mesic places, especially among dense herbaceous vegetation in lowland woods. One species of *Boreus* occurs only on moss in woods and is a relict of the Arctotertiary forest. This species is found in the southwestern corner of the state.

Twenty-one families of Mecoptera are recognized, a dozen of which are represented only by fossils. Of the nine extant families, the Bittacidae (hangingflies) are the most widespread, occurring on all continents in tropical and warm-temperate regions. The families Notiothaumidae (found only in South America) and Meropeidae (one monotypic genus in Australia and one in North America) are considered the most primitive. Three families, Choristidae, Nannochoristidae, and Apteropanorpidae, are restricted to the southern hemisphere, occurring in Australia, Tasmania, or New Zealand. The remaining three families, Boreidae, Panorpodidae, and Panorpidae, are found in North America and Eurasia.

The five families (Bittacidae, Boreidae, Meropeidae, Panorpodidae, and Panorpidae) occurring in North America contain 80 species. The majority of these species are distributed throughout the eastern United States. Other species occur in Central America, Mexico, and the western coastal states. With the exception of the family Boreidae, no Mecoptera have been recorded north of the 50th parallel in North America.

The center of distribution of Mecoptera in the United States is in the southern Appalachians (Byers 1969), from which area the various species have dispersed themselves northward and westward. Thirty-two species are recorded in the Midwest. Illinois, with its extensive north-to-south length and geological history, provides a wide variety of habitats for most groups of Mecoptera. The glaciated regions of northern Illinois, in particular the Northeast Morainal Division[1], offer suitable habitat for species, such as *Panorpa subfurcata, P. mirabilis,* and *P. galerita,* distributed primarily or wholly in previously glaciated areas. The Coastal Plain Division (Austroriparian Division) at the southern tip of Illinois is attractive to those species, such as *Panorpa nuptialis,* distributed in the coastal plains of the southern Atlantic and Gulf states. The narrow strip of Ozark Division in southwestern Illinois is an extension of the Ozark uplift and provides habitats for species such as *Panorpa braueri.* Similarly, the Shawnee Hills Division of southern Illinois contains habitats similar to those in the southern Appalachians and in Kentucky and Tennessee for such species as *Bittacus punctiger.* The central part of Illinois has areas of deciduous forest along the eastern boundary and prairie and mixed woodland to the west that provide habitats for the other midwestern species.

The objective of this study is to update our knowledge of the distribution and natural history of Mecoptera, particularly in relation to the biogeographic

[1] Terms from "The Natural Divisions of Illinois," Illinois Nature Preserves Commission, 1972.

history of Illinois. Synoptic descriptions, keys, and illustrations have been prepared to provide an insight into this primitive and interesting group of insects.

The emphasis of this study is on the fauna of Illinois, but other species occurring in the Midwest have been included.

Collecting data are listed for those Illinois species known from fewer than ten localities. Records for other species are plotted on distribution maps.

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NATURAL HISTORY

Feeding

In the Bittacidae, adults of *Bittacus* and *Apterobittacus* are predaceous. Hanging by their fore or, occasionally, middle legs from the underside of vegetation, they wait with outstretched hind legs for some unsuspecting prey. When prey is within reach, it is seized by the raptorial tarsi of the hind legs. The prey is brought to the mouth, and the piercing mouthparts enter through the intersegmental membranes. The soft body parts of the victim are withdrawn, and the empty exoskeleton is discarded. *Bittacus* feed on a wide variety of insects. In Illinois *Bittacus apicalis, B. strigosus,* and *B. pilicornis* feed heavily on dolichopodids (Diptera). Setty (1931 and 1940) and Newkirk (1957) listed a wide range of insects that *Bittacus* accept, noting a preference for Diptera and Homoptera.

The time required for feeding varies considerably. Setty (1931) reported the average time as 20 minutes although feeding sometimes lasted as long as 40 or 50 minutes. Newkirk (1957) reported that the feeding of *Bittacus apicalis* may last an hour. He gave a detailed account of *B. apicalis* feeding on aphids:

> The hangingfly regurgitates a dark-brown fluid, which resembles the "tobacco juice" of a grasshopper, and covers a part of the aphid with it. Through this the hangingfly bites, and sucks out the aphid body fluid. Then the hangingfly injects saliva, kneads what is left in the aphid body cavity with its mandibles, draws off the mixture; re-

peats this several times; and discards the empty exoskeleton.

Very young larvae of bittacids are relatively active, but older larvae move very little (Setty 1940) and can be found among ferns and moist leaf litter in humid lowland woods. They feed on dead or dying animal matter, and it is not known if they can catch live prey.

Little is known of the feeding habits of *Boreus*. Withycombe (1922) observed the larvae and Fraser (1943) the adults of *Boreus hyemalis* feeding on moss. Other substances may also be consumed. In Illinois, *Boreus* lives in *Atrichum angustatum* and probably feeds on it.

Nothing is known of the feeding habits of the family Meropeidae.

The feeding habits of the Panorpidae, in particular *Panorpa*, have been variously reported in the literature. Lyonnet (1742) initiated the misconception that *Panorpa* are predaceous when he saw a fly the size of a scorpionfly attack a damselfly and bring it to the ground. Kirby & Spence (1823) repeated Lyonnet's description and asserted that the species involved was *Panorpa communis*. Since then, numerous authors (Brauer 1863; Byers 1963; Campion & Campion 1912; Felt 1895; Lucas 1910; Miyaké 1912; Shiperovitsh 1925; and Syms 1934) have published observations on panorpids' feeding, and none has been found to be predaceous. Panorpids feed primarily on dead or dying insects although Carpenter (1931*b*) reported their feeding on the nectar of flowers, and Miyaké (1912) saw them feeding on the petals of sweet william.

Larvae of *Panorpa* feed principally on dead or dying animal matter, but Felt (1895) reported larger larvae of *Panorpa* attacking and devouring smaller ones.

Mating and Oviposition

Setty (1940) and Newkirk (1957) gave detailed descriptions of the mating of *Bittacus*. The description here is a compilation of both. The male seizes a prey and flies from leaf to leaf in search of a female. When at rest, he vibrates his hind wings, opens and closes his claspers, and bends his abdomen vertically, everting and inverting his abdominal sacs. Both male and female hang by their fore legs facing each other, and the male offers the prey to the female, which she eats during mating. In some instances the female jabs with her mouth at the male abdominal tip, where the eversible sacs are located, or at the prey. The male secures her abdomen in his claspers, then moves along the ventral surface to the terminalia. Only the female feeds during copulation. The length of copulation is proportional to the palatability of the prey and lasts from 1 to 25 minutes. When copulation is completed, the abdominal tips separate, and the individuals jerk at each other to disentangle the legs. Both male and female may mate more than once.

During oviposition the female rests on the ground with her head bent down and legs sprawled outwards. The body is quite rigid and the tip of the abdomen is inserted into cracks in the soil. Oviposition takes from 5 to 30 minutes, and several eggs are laid at a time. The female may fly from place to place and lay a few eggs in each. Oviposition occurs during the day or night. In captivity females tend to lay eggs randomly on the soil surface rather than in some place of concealment.

In the Boreidae the mating behavior of the European species *Boreus hyemalis* has been reported by several authors (Brauer 1855; Lestage 1920; Steiner 1937; Stitz 1908; Syms 1934; and Withycombe 1922). Cockle (1908) described the mating of *B. californicus*. Carpenter (1936), Crampton (1940), and Cooper (1940) described the mating of *B. brumalis*. The description given here is based on the observations of Cooper (1940) on *B. brumalis*.

The male approaches to within 10 mm or so of the female, and both remain momentarily stationary. The male may show his excitement by slowly

waving his antennae or twitching his claspers and wings. He springs at the female with his claspers in advance, seizing the antenna, tibia, or tarsi of the female. The female becomes immediately passive, and the male seizes her about the body with his modified wings. Once the female is securely gripped with his wings, the male employs his hind legs and claspers to right the female and move her venter across his back until his terminalia clasp her apical abdominal segments. The eighth sternum of the female is pried down by the male's claspers, which are inserted into a pair of pockets on the male's ninth tergum. The male releases his wings from the female, and she then flexes her rostrum between her coxae, folds her antennae between her legs, and stretches her legs posteroventrally. Once the female is in this position, the male grips her profemora and rostrum with his clasping wings. This position is maintained throughout copulation of 1–12 hours. The male may run about and feed during copulation, while the female remains motionless. This pattern of behavior follows closely observations made on *B. californicus* and *B. hyemalis.*

According to Carpenter (1931*b*), *Boreus* lays eggs one or two at a time at the bases of moss clumps. Nothing has been reported on the mating behavior or oviposition of the Meropeidae.

In *Panorpa* mating is relatively simple (Miyaké 1912). The male vibrates his wings as he approaches the female. The apex of the abdomen is extended with the claspers securing the abdomen of the female. The claspers are moved along the abdomen until the terminalia are reached and the individuals are at an acute angle to each other. In addition, Mickoleit (1971*b*) noted the use by *P. communis* of the notal and postnotal organs as pincerlike devices for holding the costa of the female during copulation. Copulation lasts for 15 minutes to several hours. Although the mating behavior of *Panorpa* is simple, there is one peculiarity that has led to some controversy. Mercier (1915) noted that prior to copulation in *P. germanica, P. alpina,* and *P. cognata* the male was seen to emit from its mouth a drop of fluid that hardened into an opaline pellet, which it placed on the soil. The female then fed on the pellet during copulation. When the pellet was consumed, another was produced. Shiperovitsh (1925) observed males of *P. communis* emitting cylindrical pellets from their mouths, and Gassner (1963) noted that unfed specimens of *P. nuptialis* regurgitated a brownish secretion on which the female fed during coitus. Syms (1934) observed no pellets being released but noted that the female fed on a dead insect during mating. Carpenter (1931*b*) observed the mating of several species of *Panorpa* but never saw such feeding behavior. One of us (Penny) has observed the depositing of salivary pillars by *P. speciosa, P. nuptialis, P. anomala,* and *P. helena.* Byers (1963) observed no salivary secretion being produced by the male of *P. nuptialis* although Gassner (1963) did observe this phenomenon. In observing the mating of *P. sigmoides,* Webb saw no evidence of a salivary secretion or pellet being offered by the male, nor did the female feed during copulation. In the field *P. sigmoides* was also observed to mate during the hours of daylight. Most authors have observed mating during the hours of darkness, but Byers (1963) found *P. nuptialis* to mate only during the daylight hours.

During oviposition the female probes the surface of the soil for an appropriate crevice, and the abdomen is extended and inserted deeply into the soil. The number of eggs laid at one time varies.

Immature Stages

In *Bittacus* the size and shape of the eggs vary considerably among the species. The eggs range in length from 0.56 to 0.72 mm and in width from 0.41 to 0.65 mm (Setty 1940).

In *B. apicalis* the eggs are oval (Fig. 1) or spherical and have a finely reticulated surface. In *B. punctiger, B. strigosus, B. occidentis, B. stigmaterus,* and *B. pilicornis,* the egg shape varies from cuboidal to heptahedral, and the egg has a shallow depression on each side (Fig. 2). The surface is rough and has numerous small protuberances.

Prior to hatching, the eggs become spherical and increase in size (Setty 1940). *B. punctiger* and *B. pilicornis* eggs hatch within 2 weeks, and the immatures overwinter as larvae. *B. strigosus, B. apicalis,* and *B. stigmaterus* pass the winter in the egg stage.

The newly hatched larva emerges through an irregular crack in the wall of the egg and feeds on the remnants of the egg shell. The larvae do not burrow through the soil in search of food, but the older larvae lie motionless on the surface among the leaf litter and ground debris. The larvae pass through five instars before pupating (Setty 1940).

The larvae of *Bittacus* (Fig. 3) are cylindrical and range in length from 11 to 14 mm in the last instar. The heavily sclerotized head is broad anteriorly. In lateral view the head is oval or elliptical. It is generally bent under the body so as to be completely hidden from above by the thorax. The antennae are short and stout and have only two segments. The single median ocellus is present as well as two large lateral eyes, which are not true compound eyes, according to Setty (1931 and 1940), but simply a group of several ocelli. The mandibles are large and heavily sclerotized and bear several large teeth. The labial and maxillary palps are short and stout and have two and four segments, respectively. The head bears numerous coarse setae and tubercles. Each of the three thoracic segments bears a pair of sharply pointed legs, and each of the first nine abdominal segments possesses a pair of short ventral prolegs. The last abdominal segment bears a ventral protrusible sucker that aids in locomotion. The dorsal and lateral margins of the thorax and abdomen bear several simple or branched protuberances, each with a simple or clavate apical seta. Individuals collected in the field usually are covered with soil which clings to these setae and protuberances.

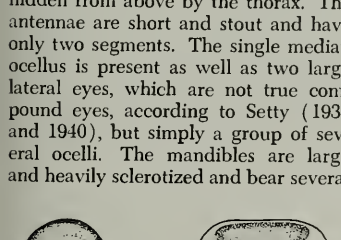


Fig. 1–2.—**Bittacus** eggs. 1.—**B. apicalis.** 2.—**B. strigosus.**

Fig. 3.—**Bittacus strigosus** larva.

The larvae are negatively phototropic and prefer moist shaded areas. Prior to pupation the fourth instar larva burrows into the soil, forming a diagonal cylindrical chamber (Setty 1940). The larva constructs a collar around the opening with a thin layer of soil laid across it. At this time the larva molts to form a prepupa. The prepupa remains in the bottom of the chamber, for 9–18 days in the case of *B. punctiger* (Setty 1940), following which it metamorphoses into a pupa.

In the case of *B. punctiger,* the pupa remains in the chamber for 13–20 days (Setty 1940), after which the adult emerges through the opening that the larva had entered.

Setty (1931, 1939, 1940, and 1941) has done extensive work on the morphology and behavior of the North American species of *Bittacus,* and much of the description of the immature stages presented here was extracted from his publications.

In North America the complete life history of *Boreus* has not been published for any species. The description presented here is for *B. hyemalis,* as described by Withycombe (1922 and 1926).

The eggs of *Boreus* are about 0.5 mm long and 0.3 mm wide. They are laid at the base of moss, and the larvae hatch in about 10 days, usually in late fall. The larvae pass through four instars, a mature larva (Fig. 4) being 6–7 mm long. The head is pale yellow and heavily sclerotized. The eyes are small and composed of several small facets. Mandibles are large, dark brown, and heavily sclerotized. Antennae are small and have two segments and a fine apical bristle. Labial palps are small. The thorax is pale white and broad and has three pairs of ventrolaterally extended legs. The legs have three segments, the basal segment being broad and the others tapering to a small, acute apical segment. The abdomen is pale white and without lateral appendages and has the apex rounded. Each segment has several fine setae.

The larvae appear to aestivate throughout the summer in small cells made in compacted soil in which they pupate in late fall. The duration of the pupal stage is 4–8 weeks.

Nothing is known of the immature stages of the Meropeidae.

In *Panorpa* the size and characteristics of the egg vary considerably. In the *lugubris* group the eggs of *P. nuptialis* are spherical or oval with a smooth surface and measure about 1.07 mm in length and 0.84 mm in width when laid (Byers 1963). In the *rufescens* group the eggs of *P. helena* are oval, have a fine network of depressions covering the surface, and measure about 1.10 mm in length and 0.65 mm in width. Felt (1895) described the eggs of *P. debilis* (as *P. rufescens*) as elliptical and oval, 0.625 mm long, and 0.6 mm wide. Numerous authors (Brauer 1852; Byers 1963; Felt 1895; Syms 1934; and Yie 1951) have observed that the color of the egg darkens before hatching. The duration of the egg period is about 8 days for *P. nuptialis* (Byers 1963) and 6–7 days for *P. debilis* (Felt 1895).

Gassner (1963) observed an egg burster on the frons of the first instar of *P. nuptialis.* It is used in rupturing the chorion of the egg. According to Gassner, the larva assumes a flattened spiral position prior to hatching. It expands and forces the egg burster through the chorion. The larva then makes a quarter turn and slices open the shell.

The larva of *Panorpa* (Fig. 5) is elongate and cylindrical. It passes through four larval instars before pupation (Boese 1973; Byers 1963; Mampe & Neunzig 1965; Shiperovitsh 1925; Yie 1951). Based on measurements of head width, Felt (1895) reported *P. debilis* (as *P. rufescens*) as having seven larval instars, as Miyaké (1912) reported for *P. klugi.* Carpenter (1931*a*) also described *Panorpa* as having seven instars. The antennae are short and stout and have a scape, a pedicel, and one flagellar segment. The eyes are composed of 25 or more facets. The mandibles are large and heavily sclerotized and have two to four mesal teeth.

The thorax bears a pair of short

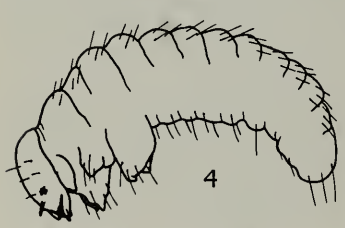


Fig. 4.—**Boreus brumalis** larva.

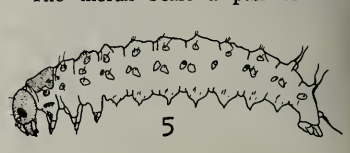


Fig. 5.—**Panorpa** sp. larva.

pointed legs on each segment and a thick sclerotized pronotal shield. A single pair of spiracles is present on the pronotal segment. The thorax and the abdomen bear numerous setigerous prominences (pinacula) and unmodified setae. The eighth and ninth abdominal segments each possess a pair of annulated setae borne on moderately sclerotized projections and a single annulated seta on segment 10. A pair of prolegs and a lateral spiracle are present on abdominal segments 1–8. Four translucent, retractible anal lobes and a basal fold of skin comprise the 11th segment.

Byers (1963) reported in detail on the life history of *P. nuptialis*, from which much of the information presented here has been taken. Boese (1973), Felt (1895), and Mampe & Neunzig (1965) have described other North American larvae. Several authors have described the immature stages of European and Asian panorpids (Brauer 1863; Miyaké 1912; Shiperovitsh 1925; Steiner 1937; and Yie 1951).

After hatching, the larvae burrow farther into the soil and feed primarily on decaying organic matter although Felt (1895) reported some larvae as being predaceous.

The larvae spend 4–5 days in each of the first three instars and are active and feed for about 2 weeks in the fourth instar, following which the full-sized larvae become quiescent and construct prepupal cells. The prepupal cell is oblong with rounded ends and is formed in compacted soil. The cell is about as long as the larva but possesses no visible lid, like that noted by Yie (1951) in Formosan panorpids. The larvae then enter a prepupal or quiescent stage, which carries them through the winter.

The duration of the pupal stage varies from 6 to 21 days. Prior to emergence the pupal skin splits along the dorsal midline, and the adult emerges. The hour of emergence is dependent upon the species. Yie (1951) found that in Formosan panorpids emergence occurred most often in the early morning.

Habitat

In the Bittacidae most species are restricted to the humid, well-shaded

Fig. 6.—Herbaceous vegetation in lowlands along the Illinois River, Starved Rock State Park, Illinois. (Photo by H. H. Ross, courtesy of Section of Botany and Plant Pathology, Illinois Natural History Survey)

Fig. 7.—Deciduous forest and herbaceous vegetation along creek bed at Trestle Hollow, Fountain Bluff, Jackson County, Illinois. (Photo by W. D. Zehr, courtesy of Section of Botany and Plant Pathology, Illinois Natural History Survey)

Fig. 8.—**Bittacus apicalis** hanging from herbaceous vegetation. (Photo by W. D. Zehr)

reas along streams and in bottomlands (Fig. 6 and 7). Individuals (Fig. 8 and 9) can be found hanging from the undersides of leaves of jewelweed (*Im-*

Fig. 9.—**Bittacus pilicornis** hanging from herbaceous vegetation. (Photo by W. D. Zehr)

patiens sp.), stinging wood nettle (*Laportea canadensis*), gooseberry (*Ribes* sp.), and a variety of other bottomland plants. *Bittacus strigosus* has the widest range of habitats, extending from the moist bottomland areas to the drier hillside areas and occurring predominantly on multiflora rose (*Rosa multiflora*). In western Illinois *B. strigosus* was collected abundantly in short pasture grass in the shade of poplars (*Populus* sp.). Little is known of the habitat for *B. occidentis*. Most of the individuals collected have been taken at lights.

In the Boreidae the various species are highly restricted in habitat. Specimens are collected only in, or very close to, patches of moss on the ground (Fig. 10). In southern Illinois *B. brumalis* lives in *Atrichum angustatum* and *Dicranella heteromalla*.

Of the habitat of the Meropeidae little is known. The majority of specimens have been collected in a variety of hardwood forests but mostly at lights or in Malaise traps. Occasionally individuals have been found under stones or rotting logs.

The habitats of the Panorpidae are similar to those of *Bittacus*. Individuals of *Panorpa* (Fig. 11) are most commonly collected as they rest on the leaves of stinging wood nettle, poison ivy (*Rhus radicans*), waterleaf (*Hydrophyllum appendiculatum*), jewelweed, and a variety of other broad-leaved plants. Only members of the *lugubris* group shun the shaded humid areas along streams and are found in the short grasses along roadside ditches or in cotton, tobacco, and soybean fields.

DISTRIBUTION AND DISPERSAL

The order Mecoptera is one of the most generalized groups of holometabolous insects and has an abundant fossil record dating back to the early Permian (Tillyard 1935).

The Bittacidae are the most highly specialized family of the Mecoptera.

Fig. 10.—Patches of moss on a hillside in Lake Murphysboro State Park. (Photo by L. J. Stannard)

Fig. 11.—**Panorpa** sp. on herbaceous vegetation. (Photo by W. D. Zehr)

Their tipulidlike appearance, single raptorial claw on the tarsus, and predaceous habit are three of the most significant specializations. Although bittacids have the bulbous basistyles of most of the Mecoptera, the presence of a four-branched sector vein and the absence of a notal organ suggest that this family's specialization began at an early date. Jurassic fossils of *Probittacus* and *Protobittacus* (Tillyard 1935) also suggest early specialization.

In the Nearctic Region the Bittacidae are represented by two genera, *Bittacus* and a wingless form, *Apterobittacus*. *Apterobittacus* is monotypic and found only in central California (Fig. 12) except for one doubtful record from southwestern Colorado. *Bittacus*, the most widespread genus of the Mecop-

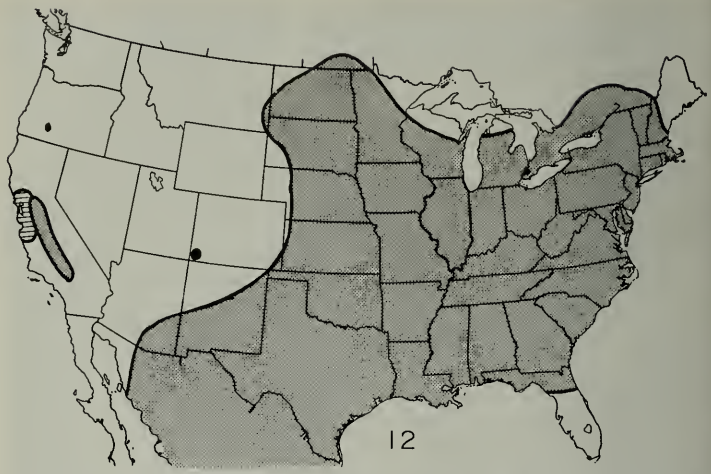


Fig. 12.—General distribution of **Bittacus** (dots) and **Apterobittacus** (lines) in the Nearctic Region.

tera (Fig. 12), extends from northern Florida to Quebec, west to eastern Montana, then south to Mexico, and an isolated species (*B. chlorostigma*) is restricted to California and Oregon.

The spread of the Bittacidae into the Nearctic Region (Byers 1969) possibly occurred during the late Mesozoic or early Tertiary, following the emergence of the Bittacidae prototype on the former southern land mass, Gondwanaland. All bittacid genera, except *Bittacus* and two apparently recent flightless derivatives of *Bittacus,* are restricted to Australia and South and Central America.

After the establishment of land connections between North and South America, *Bittacus* dispersed northward and is known from North American Eocene fossils (Carpenter 1955). Glaciations during the late Pliocene or early Pleistocene then forced the bittacids into the southern United States, Mexico, and South America (Byers 1969). After the glaciations the bittacids in the southeastern United States became separated from the main bittacid stock in Central America by xeric conditions and the disappearance of mesic forests from northern Mexico and the Southwest. Following the retreat of the glaciers, the southeastern bittacids spread northward and westward, and a second invasion from Mexico brought *B. chlorostigma* to California and *B. texanus* to the Southwest.

Illinois forms the northwest border of the distribution of *B. apicalis* (Fig. 43) and *B. punctiger* (Fig. 44). *B. stigmaterus, B. pilicornis,* and *B. strigosus* occur throughout Illinois and extend into the west-central states. *B. occidentis* has been collected only in central and northern Illinois although it is widespread from southern Ontario and New York southwestward to Arizona. Of the midwestern species, only *B. texanus* has not been recorded from Illinois.

The other three North American families (Boreidae, Panorpodidae, and Panorpidae) are all confined to the temperate and boreal forests of the northern hemisphere. All have bulbous

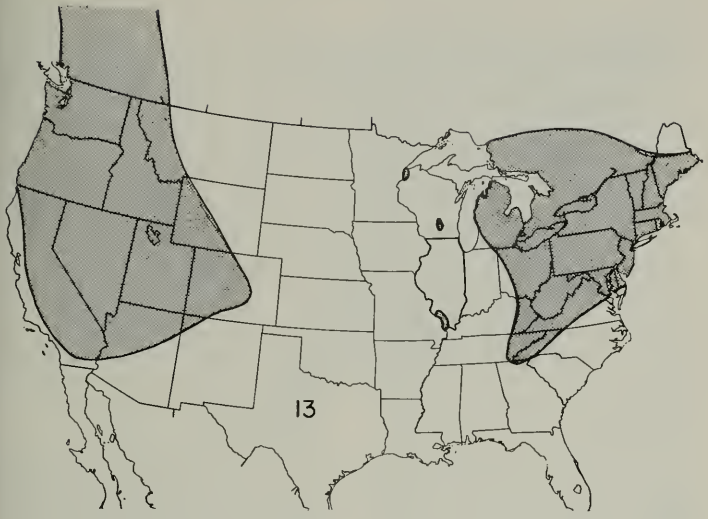


Fig. 13.—General distribution of the Boreidae in the Nearctic Region.

basistyles and pincerlike dististyles. Each has survived in a slightly different climatic zone.

The Boreidae are found primarily in the colder regions of the northern hemisphere from St. Paul Island in the Bering Sea to 12,000 feet in the Colorado Rockies (Fig. 13). In eastern North America the family has spread northward from the southern Appalachians, leaving relict populations in marginal habitats in the southern portions of its range. Adaptations to cold environments include reduction in size, loss of flight and reduction in wing size, and loss of the notal (wing-clasping) organ.

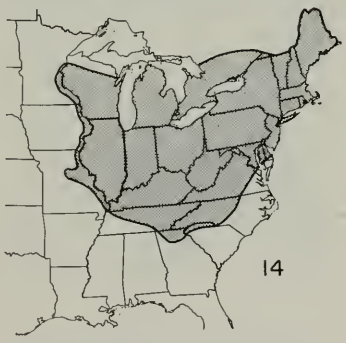


Fig. 14.—General distribution of the Meropeidae in the Nearctic Region.

The family Meropeidae is the most primitive family of the Mecoptera in North America. The broad wings with numerous costal crossveins, the short rostrum, and the elongate male basistyles and dististyles indicate the primitive nature of this family. The recent distribution of *Merope* (Fig. 14) (Byers 1973*b*) indicates the center of speciation to be in the southern Appalachians, from which area this genus has dispersed northward and to the east and west. Although widespread in the northeastern United States, records of this genus are sparse. In Illinois *Merope* has been recorded only from Pine Hills Ecological Area and Urbana.

The family Panorpodidae is found in boreal environments of montane areas of the southern Appalachian and the northwestern states (Fig. 15). Normally this family is distributed in cool areas from sea level to higher elevations in North America. Adaptations to such boreal environments include the flightlessness of females and the loss of the male notal organ.

The Panorpidae normally live at lower elevations than do the Boreidae and Panorpodidae, but ranges may broadly overlap. Species of the Panorpidae and Panorpodidae from Japan have almost identical wing venation; the North American Panorpodidae (*Brachypanorpa*) have a reduced number of sector branches. The male genitalia of the Panorpidae and Panorpodidae are also very similar, indicating a close relationship between these two families. However, Oligocene Baltic amber has yielded specimens of both *Panorpa* and *Panorpodes* so different that these families must have diverged before the Oligocene.

The majority of Nearctic Panorpidae are distributed in the eastern United States, and several species are recorded from the Southwest and Mexico (Fig. 16). Byers (1969) partitions the genus *Panorpa* north of Mexico into six distributional groups:

1. Those species occurring only in the southern Appalachians. This group contains five species found only at the middle to higher elevations.

2. Those found in the southern Appalachians but also distributed widely to the northeast, northwest, and west. This group contains eight widely distributed species. All extend into the Midwest, and four species occur in Illinois (*P. banksi, P. debilis, P. helena,* and *P. nebulosa*).

3. Those occurring primarily in the Piedmont and sometimes up into the valleys of the Appalachians. Species in this group occur principally on the eastern side of the Appalachians although both *P. consuetudinis* (= *P. elaborata*) and *P. rufescens* extend into the Midwest.

Fig. 15.—General distribution of the Panorpodidae in the Nearctic Region.

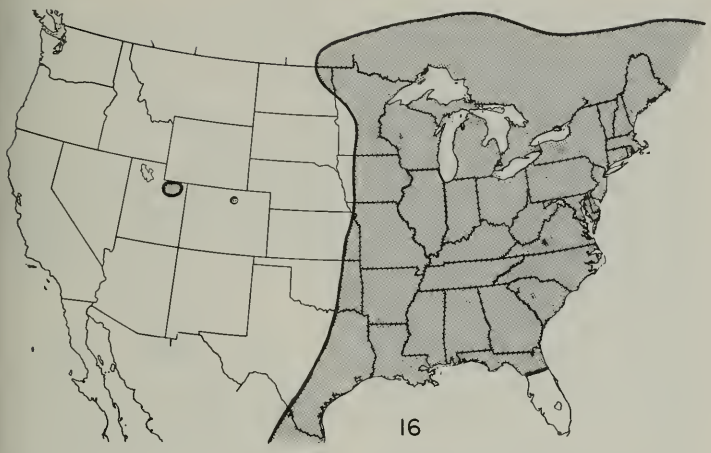


Fig. 16.—General distribution of the Panorpidae in the Nearctic Region.

4. Those inhabiting the coastal plain from Texas eastward to Florida and northeastward approximately to New Jersey. This group contains seven species, only one of which (*P. nuptialis*) extends northward into the Midwest and is known from within 1 mile of Illinois near Cairo.

5. Those occurring primarily or wholly in the formerly glaciated area of the northern Appalachians and westward. The five species in this group all occur in the Midwest to the north and east of Illinois.

6. Those found only in the Midwest. This group contains six species, four of which (*P. anomala, P. dubitans, P. speciosa,* and *P. sigmoides*) occur in Illinois.

Most species of *Panorpa* inhabit mesic temperate forests with humid, dense undergrowths of herbaceous vegetation. During periods of glaciation in North America these species possibly sought areas of relatively stable climatic conditions (Byers 1969), such as those in the southern Appalachian and Ozark-Ouachita uplift. During interglacial periods the species spread northward. The southern Appalachian area has the greatest concentration of *Panorpa* species in North America. All the species in Byers' groups one through five and some in group six appear to have arisen from a southern Appalachian ancestral stock and migrated northward and westward. In group six Byers lists six species which occur only in the Midwest. Judging from their present distributions, one can infer that three of them (*P. anomala, P. speciosa,* and *P. braueri*) may have differentiated in the area of the Ozark-Ouachita uplift.

COLLECTING AND PRESERVING MECOPTERA

With the exception of the Boreidae, the Mecoptera are generally found on, or hanging from, low herbaceous vegetation in shaded moist woodlands. *Bittacus* can be found by walking slowly through shaded weedy areas and brushing the vegetation back and forth with a net. When disturbed, bittacids will fly 10–20 feet ahead of the collector and

then hang from the vegetation again. The experienced collector may net specimens in flight or follow their flight and collect them as they hang from the vegetation. Some bittacids (*B. apicalis* and *B. occidentis*) have been collected at lights.

The collecting of *Boreus* calls for a rather hardy, determined collector, because these insects reach maturity during late fall and winter. They are associated with mosses on the ground, on bases of trees, and elsewhere. They can be collected by lying beside a patch of moss and waiting for the adults to move. They also move about on patches of snow, where they are easily seen and collected. Larvae of *Boreus* have been taken by Berlese funnel extraction from moss.

The collecting of *Merope* has been accomplished more by chance than by skill. Most specimens have been collected at lights or in Malaise traps in heavily wooded areas.

Panorpa can be collected individually from the surface vegetation. The collector must stalk slowly through the vegetation, particularly stinging wood nettle, until an individual is located. When disturbed, the somewhat sedentary members of this genus will fly a short distance or drop to the ground and escape in the leaf litter. *Panorpa* is seldom taken at lights.

Specimens of Mecoptera can be preserved in 70-percent ethyl alcohol or mounted on insect pins.

The taxonomic characters necessary to separate the genera and many of the species can be seen with a stereoscopic microscope. In the females of *Panorpa,* the genital plate is of taxonomic importance. To observe this plate, one must cut off the tip of the abdomen basal to the eighth segment and boil the tip in 10-percent KOH or leave it overnight in cold 10-percent KOH to remove the soft internal tissues. The tip is transferred to 70-percent ethyl alcohol, and the abdominal terga and sterna are separated with a pair of dissecting points, revealing the genital plate. In identifying males of some species of *Panorpa,* clearing the genital bulb in 10-percent KOH aids in species determination.

MORPHOLOGY

Several excellent papers have been published on the external and internal anatomy of the Mecoptera (Crampton 1921 and 1931; Dohanian 1915; Grassé 1951; Hepburn 1969 and 1970; Micko-

Fig. 17.—**Panorpa helena** anterior view of head.

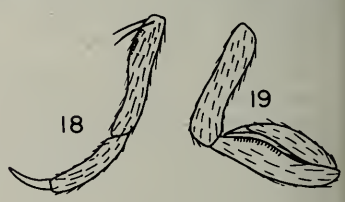


Fig. 18–19.—**Bittacus strigosus.** 18.—Apical tarsal segments with claw. 19.—Apical tarsal segments with claw reflexed.

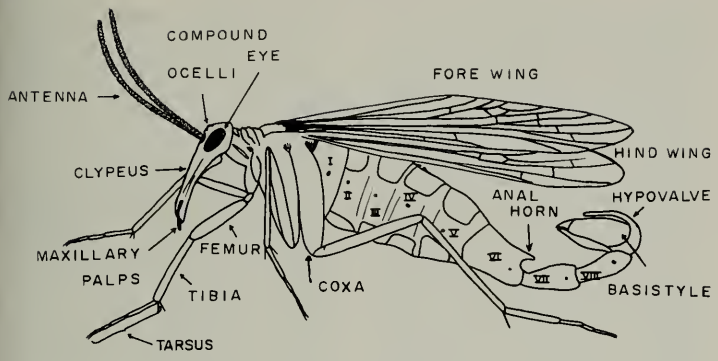
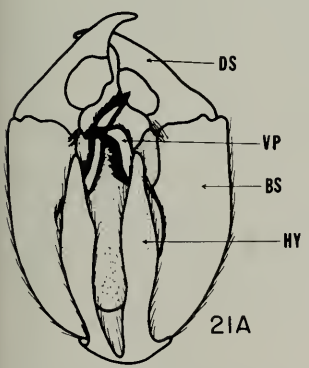


Fig. 20.—**Panorpa** sp. lateral view of male adult.

leit 1971*a*; Otanes 1922; and Potter 1938).

The descriptions are supplemented with illustrations of the morphological characters of taxonomic importance. Fig. 17 presents an anterior view of the head of *Panorpa*, showing the distinctive elongate rostrum of most of the Mecoptera. Ocelli are present in all genera of the North American Mecoptera except *Merope*. In *Boreus* the ocelli are indistinct, and numerous authors have reported them absent. In all genera the large, lateral compound eyes are widely separated, except those of *Merope*, which are reniform and almost contiguous dorsally.

The shape and venation of the wings vary from genus to genus. Fig. 24, 50, 64, and 80 illustrate the wings of all midwestern genera. In *Apterobittacus* the wings are absent, and in certain



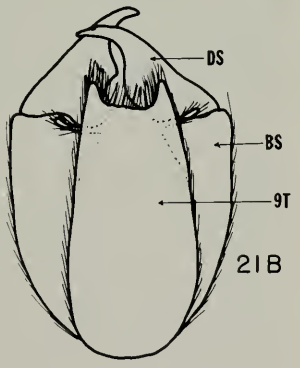


Fig. 21A–B.—**Panorpa sigmoides.** A.—Ventral view of male terminalia. DS, dististyle. VP, ventral paramere. BS, basistyle. HY, hypandrium. B.—Dorsal view of male terminalia. DS, dististyle. BS, basistyle. 9T, ninth tergum.

species of *Brachypanorpa* the females have greatly reduced wings.

The legs in all genera are elongate and cylindrical. In *Panorpa* the apical tarsal segment bears a pair of serrate claws. In *Bittacus* and *Apterobittacus* the tarsi have a single apical claw (Fig. 18 and 19), which reflexes back into a groove in the fourth tarsal segment. This claw is used in holding prey.

Fig. 20 is a lateral view of a *Panorpa* male and illustrates the scorpionlike appearance of the genus. The abdomen is thick and rounded basally and tapers apically to the elongate seventh and eighth segments. The terminalia are bulbous and reflexed over the abdomen. In *Panorpa* the sixth abdominal tergum in males may or may not possess an anal horn.

The terminalia of *Panorpa* are shown in Fig. 21A and 21B, and the morphological characters of taxonomic importance are identified.

MONOGRAPHS ON NEARCTIC MECOPTERA

Because of the small number of species of Nearctic Mecoptera, few major taxonomic revisions have been done on this group. Westwood (1846) in his monograph on the genus *Panorpa* described several Nearctic species. Walker (1853), Hagen (1861), Banks (1907), and Esben-Petersen (1915) catalogued the North American Mecoptera, and Hine (1898 and 1901) reviewed the Mecoptera north of Mexico. In 1908 Sherman reported on the Panorpidae of North Carolina; Engelhardt (1915), the Mecoptera of the northeastern United States; and Esben-Petersen (1921), the North American species. The major revision of the Nearctic Mecoptera was published by Carpenter (1931*a*) wherein he described many new species. Since then new species have been described and additional distribution data have been reported by Carpenter (1932*a*, 1935, 1936, and 1939) and Byers (1954, 1958, 1962*a*, 1962*b*, and 1973*a*).

TAXONOMIC TREATMENT

Order MECOPTERA

MECOPTERA Comstock & Comstock 1895

MECAPTERA Packard 1886

PANORPATAE Brauer 1885

The members of the order Mecoptera are moderately large, holometabolous insects, having biting mouthparts generally extended ventrally to form a prolonged rostrum. The antennae are elongate and filiform and have about 20 flagellar segments. The large compound eyes are dichoptic. Ocelli are present or absent. The maxillary palps have five segments.

The thorax is broad dorsally and tapered ventrally. The wings are usually elongate and narrow. The fore and hind wings are nearly equal in length and have numerous veins and crossveins. In several genera the wings are greatly reduced or absent. In *Merope* and *Notiothauma* the wings are very broad and rounded apically. The legs are long and slender and have five tarsal segments, ending in one or two claws. The coxae are large, and each tibia bears a pair of long spurs.

The first abdominal segment is fused to the thorax. The abdomen is generally thick basally and tapered apically except in the Bittacidae. Cerci are present apically in females and subapically in males.

KEY TO THE NEARCTIC FAMILIES OF MECOPTERA

1. Tarsi with single apical claw (Fig. 19) ..... Bittacidae
   Tarsi with two apical claws 2
2. Male brachypterous. Female with ovipositor ..... Boreidae
   Male with elongate wings. Female without ovipositor 3
3. Wings broad, rounded apically (Fig. 64), with numerous costal crossveins. Ocelli absent ..... Meropeidae
   Wings narrow, elongate (Fig. 73), with few costal crossveins. Ocelli present 4
4. Rostrum short ..... Panorpodidae
   Rostrum long (Fig. 17) ..... Panorpidae

BITTACIDAE Enderlein 1910

The raptorial tarsi with a single claw separate the bittacids from other families of the Mecoptera. Twelve genera are distinguished, and their species are recorded from all continents although they are generally absent from the northern parts of Europe, Asia, and North America. *Bittacus* is the most widespread genus, occurring in Europe, Asia, Africa, and North and South America. *Apterobittacus,* found in California, and *Anomalobittacus* from South Africa are the only flightless genera. *Anabittacus, Nannobittacus, Neobittacus, Pazius,* and *Issikiella* occur in South and Central America. *Kalobittacus* is recorded from Central America. *Austrobittacus, Edriobittacus,* and *Harpobittacus* occur only in Australia.

Of the two Nearctic genera, only *Bittacus* has been collected in Illinois.

KEY TO THE NEARCTIC GENERA OF BITTACIDAE

1. Wings present ..... Bittacus
   Wings absent ..... Apterobittacus

Apterobittacus MacLachlan

Apterobittacus MacLachlan (1893: 317). Type-species by monotypy. *Apterobittacus apterus* MacLachlan.

Body dark brown, length 20–23 mm, tipuliform. Antennae filiform with 13 flagellar segments. Both sexes wingless. Legs similar to those of *Bittacus.* Abdomen thick, cylindrical. In males, lobes of ninth abdominal tergum in lateral view, broad, subrectangular, extending well beyond apices of basistyles; in dorsal view, narrow, compressed laterally, apices converge. Basistyles broad, thick, fused ventrally. Dististyles small. Aedeagus thick basally, tapering apically to short, looped thread.

This is a monotypic genus probably restricted to California.

Bittacus Latreille

Bittacus Latreille (1805:20). Type-species: *Bittacus italicus* Müller.

Leptobittacus Hine (1898:108). Proposed by Hine for the species *B. strigosus* and *B. pilicornis.* However, Hine retained them in the genus *Bittacus.*

Thyridates Navás (1908:412). Synonymized by Banks (1913).

Diplostigma Navás (1908:413). Synonymized by Banks (1913).

Haplodictyus Navás (1908:413). Synonymized by Banks (1913).

Head small, pale to dark yellow, tapered ventrally to form distinctive rostrum. Eyes large. Ocelli large, amber, on raised subtriangular pad. Antennae long, filiform with 14 flagellar segments.

Thorax broad, compressed laterally. Wings long, narrow, tapered basally. Membranes clear or yellow, often with dark brown apex or crossveins. Subcosta ending in middle of wing. Subcostal crossvein (Fig. 24) usually basal to first fork of radial sector. R_1 forked apically to form pterostigma, which has one or two pterostigmal crossveins. Pterostigma (Fig. 22) darker than surrounding membrane. A whitish thyridium (Fig. 26) around first fork of media. Apical crossvein (Fig. 24) present or absent. Legs elongate, slender, cylindrical. Coxae large, thick, tapered apically. Femora generally slender although hind femora often swollen. Tibiae long, slender with two long spurs. Basal four tarsal segments cylindrical with small apical enlargment; fifth segment fused to apical claw which is reflexed to fit into groove in fourth segment.

Abdomen long, narrow basally. Male terminalia large (Fig. 29). Ninth tergum modified to form two laterally flattened claspers, often extending beyond apices of basistyles. Basistyles broad, fused ventrally, each with short, medially extended dististyle. Aedeagus thick basally, tapering apically. Internal skeleton of female genitalia absent. Sternal region of eighth and ninth segments fused to form subgenital plate. Tenth segment bears pair of unsegmented cerci.

Seven species of *Bittacus* occur in the Midwest.

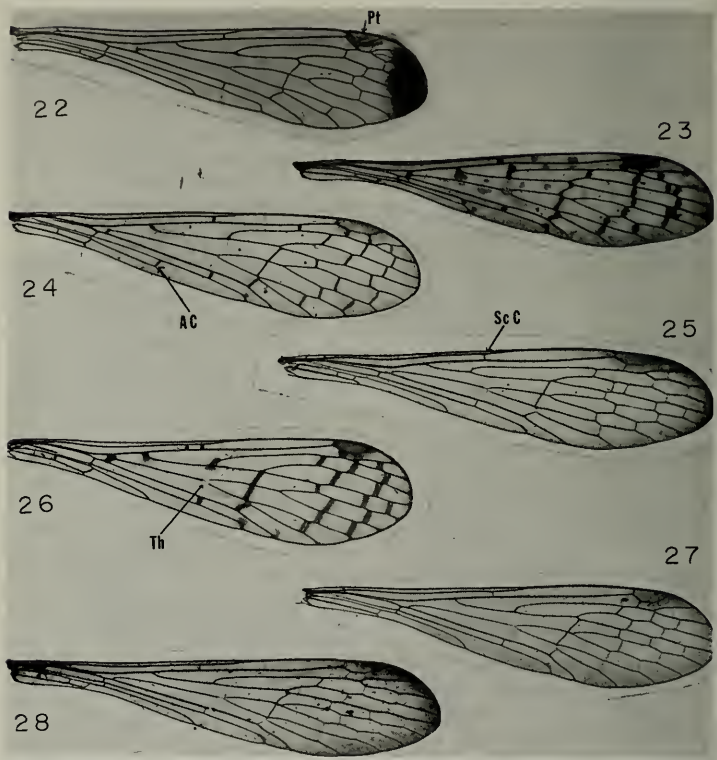


Fig. 22–28.—**Bittacus** fore wings. 22.—**B. apicalis.** Pt, pterostigma. 23.—**B. punctiger.** 24.—**B. pilicornis.** AC, apical crossvein. 25.—**B. occidentis.** ScC, subcostal crossvein. 26.—**B. strigosus.** Th, thyridium. 27.—**B. stigmaterus.** 28.—**B. texanus.**

KEY TO THE MIDWESTERN SPECIES OF BITTACUS

1. Apices of wings dark brown (Fig. 22) ..... **apicalis**

Apices of wings not dark brown ... 2

2. Apical crossvein present (Fig. 24).. 3

Apical crossvein absent (Fig. 25)... 4

3. Hind femora with brown spot surrounding base of setae .... **punctiger**

Hind femora without brown spot surrounding base of setae ..... **pilicornis**

4. Subcostal crossvein distal to first fork of radial sector (Fig. 25) .... **occidentis**

Subcostal crossvein basal to first fork of radial sector (Fig. 26) 5

5. Wing membranes colorless. Crossveins margined (Fig. 26) .... **strigosus**

Wing membranes yellow to pale brown. Crossveins usually not margined (Fig. 27) 6

6. In males, lobe of ninth tergum in dorsal view with two medial prominences, each prominence bearing several black spines (Fig. 40). In females, wing color yellow to amber ..... **stigmaterus**

In males, lobes of ninth tergum in dorsal view with one medial prominence bearing several black spines, and each lobe with a row of 10–15 thick black spines basal to medial prominence (Fig. 42). In females, wing color brown to dark brown ..... **texanus**

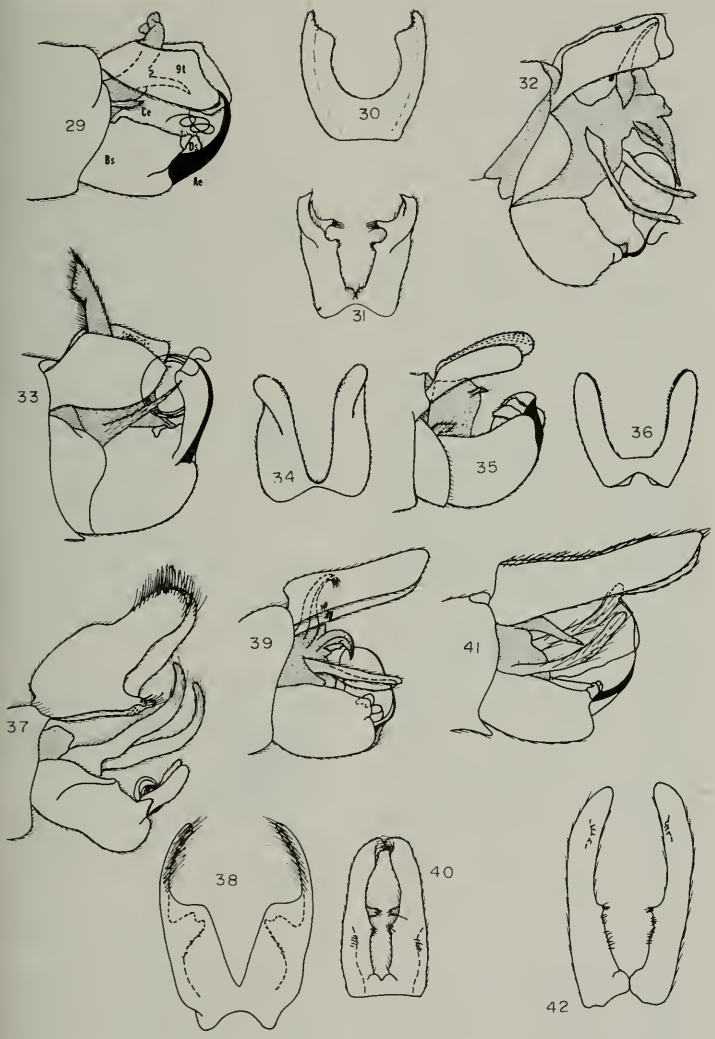


Fig. 29–42.—**Bittacus** male terminalia. 29.—**B. apicalis.** Lateral view of terminalia. 9t, ninth tergum. Ce, cerci. Bs, basistyle. Ds, dististyle. Ae, aedeagus. 30.—Dorsal view of ninth tergum. 31.—**B. punctiger.** Dorsal view of ninth tergum. 32.—Lateral view of terminalia. 33.—**B. pilicornis.** Lateral view of terminalia. 34.—Dorsal view of ninth tergum. 35.—**B. occidentis.** Lateral view of terminalia. 36.—Dorsal view of ninth tergum. 37.—**B. strigosus.** Lateral view of terminalia. 38.—Dorsal view of ninth tergum. 39.—**B. stigmaterus.** Lateral view of terminalia. 40.—Dorsal view of ninth tergum. 41.—**B. texanus.** Lateral view of terminalia. 42.—Dorsal view of ninth tergum.

Bittacus apicalis Hagen

Bittacus apicalis Hagen (1861:248). ♂, ♀. Type-locality: Southern Illinois.

Haplodictyus incertus Navás (1926:59). ♂. Type-locality: Wilmerding, Pennsylvania. Synonymized by Carpenter (1932*b*).

Head and thorax pale glossy yellow to brown.

Wings (Fig. 22) pale yellow, pterostigma and apex of wing dark brown. Subcostal crossvein basal to first fork of radial sector. One pterostigmal crossvein. Apical crossvein absent.

Legs pale yellow to brown. Hind femora slightly enlarged.

Abdomen and terminalia pale yellow to brown, occasionally eighth tergum of males dark brown to black. In males, lobes of ninth tergum in lateral view (Fig. 29) extend slightly beyond apices of basistyles, dorsal margin with medial prominence; in dorsal view (Fig. 30) lobes diverge apically, curve ventrally, apex with 30 or more black spines. Basistyles broad, thick. Dististyles short, tapered apically. Aedeagus thick at base, tapered apically to slender coiled thread. Cerci short, slender, do not extend beyond middle of basistyles.

The dark brown apices of the wings readily separate this species from all other Nearctic bittacids. When *B. apicalis* hangs from vegetation, the wings are extended laterally from the body (Fig. 8) rather than being folded over the abdomen.

In Illinois *B. apicalis* was collected on jewelweed and stinging wood nettle in moist, shaded, bottomlands along streams. Very seldom were specimens collected on the drier hillsides.

This species extends from North Carolina to New York and west to Illinois, Missouri, and Oklahoma (Fig. 43).

Illinois Records.—(Fig. 43). Collected from early May to mid-August in south and central Illinois. The northwestern limit of distribution of *B. apicalis* is in Illinois. No specimens are recorded from northern Illinois, Iowa, or Wisconsin.

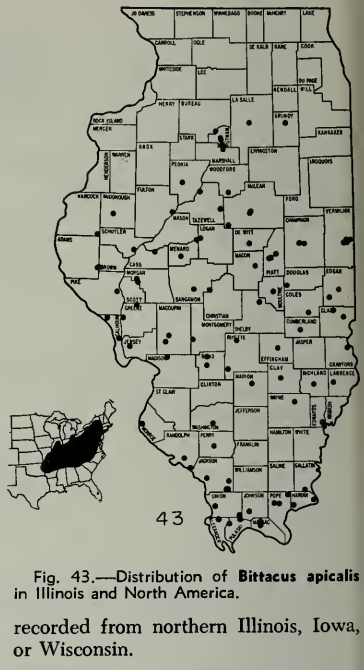


Fig. 43.—Distribution of **Bittacus apicalis** in Illinois and North America.

Bittacus punctiger Westwood

Bittacus punctiger Westwood (1846: 195). ♂, ♀. Type-locality: Georgia. Lectotype ♀ designated by Byers (1962*b*).

Head and thorax pale yellow.

Wings (Fig. 23) dark yellow; heavily patterned with dark brown markings, particularly around crossveins; pterostigma dark brown. Subcostal crossvein basal to first fork of radial sector. Two pterostigmal crossveins. Apical crossvein present.

Legs dark yellow with dark brown band at apices of femora and tibiae. Femora with dark brown spot at base of each seta, particularly on hind legs. Hind femora not noticeably swollen.

Abdomen yellowish brown to dark brown with narrow dark brown strip along posterior margin of each tergum.

Ninth tergum pale yellowish brown, basistyles dark brown. In males, lobes of ninth tergum in lateral view (Fig. 32) rectangular, not extending beyond apices of basistyles, lobe apices emarginate; in dorsal view (Fig. 31) lobes diverge apically, sides straight with two medial prominences, each with several fine black spines. Basistyles broad. Dististyles short, projecting medially. Aedeagus thickened at base, tapering apically to fine looped thread. Cerci elongate, extending slightly beyond apices of basistyles, bases swollen.

This species resembles *B. strigosus* and *B. pilicornis* in the heavily margined crossveins although it is readily separated from these species by the dark brown spot surrounding the base of each femoral seta and the dark brown maculation of the wings.

This species was collected with individuals of *B. strigosus, B. apicalis,* and *B. pilicornis* in a moist shaded woodland and among jewelweed.

B. punctiger extends from Florida to Pennsylvania and west to Illinois and Texas (Fig. 44).

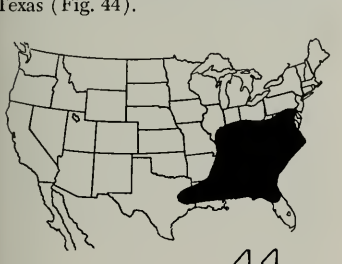


Fig. 44.—Distribution of **Bittacus punctiger** in North America.

Illinois Records.—ALEXANDER COUNTY: 1 mile N of Olive Branch, D. W. Webb, 14-VI-1972, 4 ♀; 1 mile E of Olive Branch, Penny and Byers, 30-V-1972, ♂, ♀. FRANKLIN COUNTY: 3 miles S of West Frankfort, 11-VI-1970, J. C. Marlin, 1 ♂. ILLINOIS: Belfrage Collection, Stockholm Museum, 1 ♂, 1 ♀. UNION COUNTY: Pine Hills Ecological Area, 14-VI-1972, D. W. Webb, 4 ♀.

Bittacus pilicornis Westwood

Bittacus pilicornis Westwood (1846: 196). ♂, ♀. Type-locality: America Septentrionali. Type-specimen missing.

Head and thorax dark yellow to dark brown.

Wings (Fig. 24) amber, pterostigma slightly darker than surrounding area, crossveins margined. Subcostal crossvein basal to first fork of radial sector. Two pterostigmal crossveins. Apical crossvein present.

Legs pale yellow to brown. Apices of tibiae and basistarsus dark brown. Hind femora not swollen.

Abdomen pale yellow to dark brown. In males ninth tergum and basistyles brown. In males lobes of ninth tergum in lateral view (Fig. 33) broad, not extending beyond apices of basistyles, lobe apices pointed; in dorsal view (Fig. 34) lobes thick, diverging apically, with 30 or more black spines across apical halves of lobes. Basistyles broad. Dististyles short, acute. Aedeagus with distinctive bilobed base (penunci), tapering apically to slender coiled thread. Cerci elongate, slender, extending slightly beyond apices of basistyles.

This species is similar to *B. punctiger* in having wings with an apical crossvein and margined crossveins although it differs markedly from *B. punctiger* in characters of the ninth tergum in males and the lack of a dark brown spot surrounding the base of each femoral seta.

This species is the strongest flier of the midwestern bittacids and has been collected from damp, cool, shaded bottomlands and dry, shaded hillsides. In moist areas it is associated with jewelweed and stinging wood nettle, while in drier areas it has been collected frequently on gooseberry and multiflora rose.

This species extends from Florida to Canada and west to Minnesota and Kansas (Fig. 45).

Fig. 45.—Distribution of **Bittacus pilicornis** in Illinois and North America.

Illinois Records.—(Fig. 45). Collected in Illinois from June to mid-August.

Bittacus occidentis Walker

Bittacus occidentis Walker (1853:469). ♂, ♀. Type-locality: Erie, United States. Type-specimen missing.

Bittacus arizonicus Banks (1911:350). ♂. Type-locality: Palmerlee, Arizona. Synonymized by Carpenter (1931*a*).

Head and thorax dark yellowish brown to dark brown.

Wings (Fig. 25) pale yellow, pterostigma slightly darker than surrounding membranes. Subcostal crossvein distal to first fork of radial sector. Two pterostigmal crossveins. Apical crossveins absent. Several specimens possess an apical crossvein on at least one of the fore wings. In one specimen the subcostal crossvein occurs at the first fork of the radial sector although this crossvein is normally found well beyond the fork.

Legs yellowish brown to brown, apices of tibiae dark brown. Hind femora swollen.

Abdomen yellowish brown to brown. In males ninth tergum and basistyles yellowish brown to dark brown. Ninth tergum in lateral view (Fig. 35) narrow, rounded apically, extending to or slightly beyond apices of basistyles; in dorsal view (Fig. 36) ninth tergum diverges apically, with 30 or more black spines along dorsal margins of lobes. Basistyles broad, curved dorsally. Dististyles elongate, narrow. Aedeagus very thick at base, tapered apically to slender thread which curves anteriorly. Cerci short, slender, not extending beyond middle of basistyles.

The wing's subcostal crossvein, distal to the first fork of the radial sector, and the swollen hind femur readily distinguish this species from other Nearctic bittacids.

No specific habitat has been recorded for *B. occidentis*. All Illinois specimens were collected at lights or in light traps.

This species extends from Alabama north into Canada and west to Kansas and Arizona (Fig. 46), with an isolated record from western North Dakota.

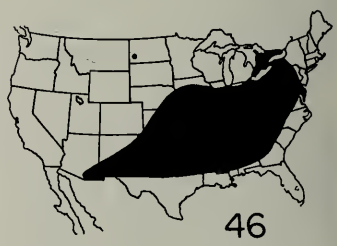


Fig. 46.—Distribution of **Bittacus occidentis** in North America.

Illinois Records. — Collected infrequently and in small numbers from mid-July to the end of September. ADAMS COUNTY: Quincy, Evers and Mills, 9-IX-1951, 2 ♂, 2 ♀; Flint, 19-IX-1912, 1 ♂. CHAMPAIGN COUNTY: Champaign, Hart, 18-VII-1889, 1 ♂; Hart, 22-VII-1889, 1 ♀, 1?; Urbana, 18-IX-1909, 1 ♂; Riegel, 19-VII-1938, 1 ♂; Riegel, 29-VIII-1938, 1 ♂; Woodworth, 12-IX-1898, 2 ♂, 4 ♀, 1?; Hart and Kahl, 22-IX-1892, 1 ♀. COLES COUNTY: Charleston, Riegel, 12-IX-1961, 1 ♀. COOK COUNTY: Chicago, W. J. Gerhard, 6-IX, 23-VII, 6 ♂, 1 ♀. MCDONOUGH COUNTY: Macomb, 25-IX-1959, 1 ♂. SANGAMON COUNTY: Springfield, Frison, 16-IX-1932, 1 ♂, 2 ♀.

Bittacus strigosus Hagen

Bittacus strigosus Hagen (1861:246). ♂, ♀. Type-locality: Chicago, Washington, St. Louis.

Head, thorax, and mouthparts dark yellow to dark brown.

Wings (Fig. 26) clear, pterostigma pale brown, crossveins margined. Subcostal crossvein basal to first fork of radial sector. Two pterostigmal crossveins. Apical crossvein absent.

Legs pale yellow. Hind femora cylindrical.

Abdomen dark yellow to dark brown. In males ninth tergum and basistyles brown. In males lobes of ninth tergum in lateral view (Fig. 37) broad basally, narrowed apically, apices of lobes rounded, extending well beyond apices of basistyles and having elongate medial prominences on ventral margins with several long black setae and spines; in dorsal view (Fig. 38) lobes broad basally, apical third constricted, converging medially at apex. Basistyles broad. Dististyles broad, elongate. Aedeagus thickened basally, extended apically in form of thin, tightly coiled thread. Cerci narrow, elongate, extending well beyond apices of basistyles, bases of cerci enlarged.

This species has margined crossveins like those of *B. pilicornis* and *B. punctiger* but lacks the apical crossvein. The lobes of the ninth tergum in dorsal view readily separate the males from other midwestern bittacid males.

B. strigosus is found abundantly in Illinois in habitats ranging from moist shaded bottomlands to dry pastures. This species can be collected on a wide range of plants.

B. strigosus extends from Louisiana and South Carolina to Canada and west to Manitoba and Montana (Fig. 47).

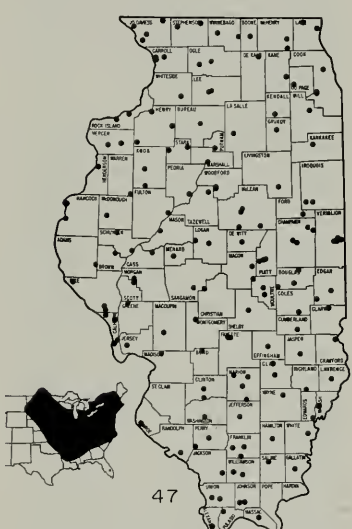


Fig. 47.—Distribution of **Bittacus strigosus** in Illinois and North America.

Illinois Records.—(Fig. 47). Collected from early June to early September in almost every county in Illinois.

Bittacus stigmaterus Say

Bittacus stigmaterus Say (1823:164). Type-locality: Fort Osage, Missouri. Type-specimen missing.

Bittacus pallidipennis Westwood (1846: 195). ♂. Type-locality unknown. Synonymized by Hagen (1861).

Head and thorax yellow to dark brown.

Wings (Fig. 27) amber, pterostigma slightly darker than surrounding area, crossveins not margined except in specimens found in western areas of Missouri and Arkansas. Subcostal crossvein basal to first fork of radial sector. Two pterostigmal crossveins. Apical crossvein absent.

In almost all specimens examined the wings were uniformly colored, and the crossveins were not margined although specimens collected in southwestern Missouri and Arkansas show some margination of the crossveins.

Legs dark yellowish brown. Femora slightly swollen.

Abdomen pale yellow to dark brown. In males ninth tergum and basistyles brown. In males lobes of ninth tergum in lateral view (Fig. 39) narrow, subrectangular, extending well beyond apices of basistyles; in dorsal view (Fig. 40) lobes converge apically, with two distinct medial prominences on each lobe, each prominence with several black spines; a small patch of spines present near ventral margin of lobes. Basistyles broad. Dististyles short, rounded apically. Aedeagus thickened basally, tapered apically. Cerci narrow, elongate, extending beyond apices of basistyles.

This species closely resembles *B. texanus*. The females are separated on the basis of wing color, which is not always reliable. In places where these two species overlap, the wing crossveins in *B. stigmaterus* are often margined. The males of these two species can be separated by the arrangement of spines on the medial margin of the ninth tergum.

This species has been collected in habitats similar to those of *B. strigosus* and *B. apicalis* although it is sometimes found in fairly dry woods.

B. stigmaterus extends from Georgia to New York and west to Minnesota and Texas (Fig. 48).

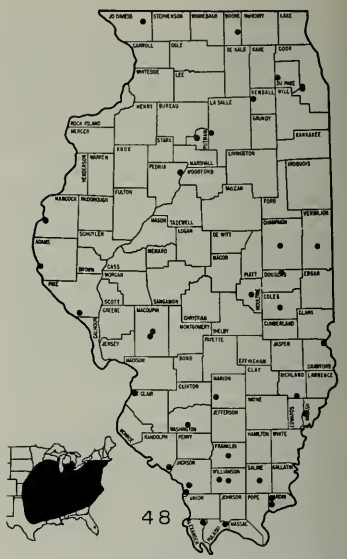


Fig. 48.—Distribution of **Bittacus stigmaterus** in Illinois and North America.

Illinois Records.—(Fig. 48). Collected from late June to mid-September.

Bittacus texanus Banks

Bittacus texanus Banks (1908:261). ♂.
Type-locality: Plano, Texas.

Head and thorax dark reddish brown.

Wings (Fig. 28) pale brown, pterostigma concolor with membranes, crossveins not margined. Subcostal crossvein basal to first fork of radial sector. Two pterostigmal crossveins. Apical crossvein absent.

Legs dark reddish brown. Hind femora slightly swollen.

Abdomen and terminalia dark reddish brown. In males lobes of ninth tergum in lateral view (Fig. 41) narrow, elongate, extending well beyond apices of basistyles; in dorsal view (Fig. 42) lobes converge apically, medial margin having a prominence bearing several short, thick spines; 10–15

short, thick spines present along medial margin basal to this prominence, three to four short and thick medial spines occur near apices of lobes. Basistyles broad. Dististyles short, globular. Aedeagus thickened basally, tapered apically to fine thread. Cerci narrow, elongate, extending well beyond apices of basistyles.

B. texanus closely resembles *B. stigmaterus* although *B. texanus* is much darker in color. The females are separated on the basis of wing color, which, as already noted, is not always reliable. The males of these two species can be separated by the arrangement of spines on the medial margin of the ninth tergum.

Little is known of the habitat of this species. In Texas individuals were collected with *B. stigmaterus* along streams under cover of willows and elms.

B. texanus has been recorded from Texas, Florida, Kansas, and New Mexico (Fig. 49).

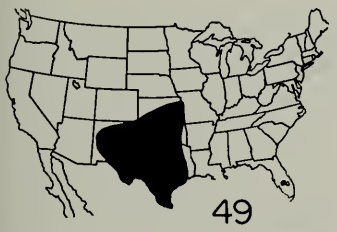


Fig. 49.—Distribution of **Bittacus texanus** in North America.

BOREIDAE Stephens 1829

The Boreidae are winter insects, the adults emerging from November until May. Adults and scarabaeiform larvae live in, and feed on, moss. The small size of these insects (varying in length from 2.5 to 5.0 mm), the presence of rudimentary wings, and the distinct ovipositor in females readily define this family of Mecoptera. The family Boreidae has only one genus, *Boreus*, which occurs in Europe, Asia, and North America. Fifteen species are recorded from North America, but only two species occur east of the Rocky Mountains.

Boreus Latreille

Boreus Latreille (1816:152). Type-species: *Boreus hyemalis* Linnaeus.

Euboreus Lestage (1940:12). Synonymized by Cooper (1972).

Ateleptera Dalman (1823:34). Synonymized by Esben-Petersen (1921).

Small, stout insects. Coloration varies from reddish in *B. elegans* to olive green in some specimens of *B. brevicaudus* to brown and black in most species. Length 2.5–5.0 mm. Head broad, tapered apically to long rostrum. Ocelli present, but difficult to see. Compound eyes black, oval. Antennae brown to black, filiform, with 18–24 flagellar segments.

Thorax reddish brown to olive to black. Pronotum broad, collarlike, anterior margin smooth, rounded. Wings light brown to black. In males wings reduced to pair of thick, chitinous, coreaceous rudiments, broad basally, tapering apically to acute point, with coarse lateral and medial setae. Hind wings thin, membranous, covered by fore wings. In females fore wings reduced to short, oval pads covering hind wing pads, except for extremely reduced wing pads of *B. reductus*. Legs dark yellow to black, elongate, with simple claws.

Abdomen short, thick, pale brown to black. In males ninth tergum short, broad, apex truncate or emarginate, with numerous short black spines; in some species a concave medial depression receives apices of dististyles. Ninth sternum (hypandrium) broad, rounded; apex rounded, truncate, or emarginate. Basistyles thick, broad. Dististyles narrow, elongate, each with mesal lobe and several thick spines along dorsal margin. In females ovipositor composed of

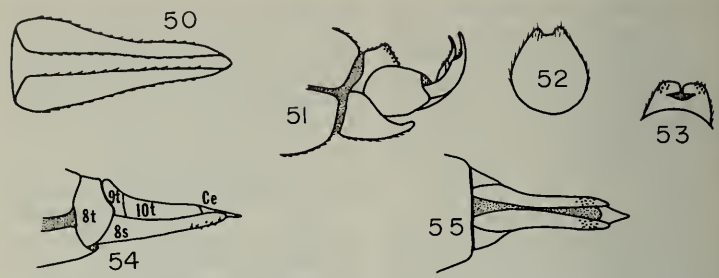


Fig. 50–55.—**Boreus brumalis.** 50.—Dorsal view of male fore wing. 51.—Lateral view of male terminalia. 52.—Ventral view of male ninth sternum (hypandrium). 53.—Dorsal view of male ninth tergum. 54.—Lateral view of female ovipositor. 8t, eighth tergum. 8s, eighth sternum. 9t, ninth tergum. 10t, tenth tergum. Ce, cerci. 55.—Ventral view of female ovipositor.

eighth through tenth segments and cerci. Eighth sternum formed by two elongate sclerotized plates. Tenth tergum subrectangular, elongate, apex emarginate. Cerci short, triangular, apex acute. Eleventh segment hidden beneath cerci.

Only one species of *Boreus* occurs in Illinois.

KEY TO THE MIDWESTERN SPECIES OF BOREUS

MALES

1. Specimens pale to dark reddish brown. Fore wing curved smoothly to apex (Fig. 57). Ninth sternum (Fig. 59) rounded apically. Ninth tergum (Fig. 60) rounded apically ..... **nivoriundus**

Specimens dark brown to black. Fore wing constricted near middle (Fig. 50). Ninth sternum (Fig. 52) emarginate apically. Ninth tergum (Fig. 53) with medial fissure ..... **brumalis**

FEMALES

1. Specimens pale to dark reddish brown. Ovipositor 1.20 mm in length (measured from base of eighth sternum to apices of cerci) .. **nivoriundus**

Specimens dark brown to black. Ovipositor 0.53 mm in length .... **brumalis**

Boreus brumalis Fitch

Boreus brumalis Fitch (1847:278). ♂, ♀. Type-locality: eastern New York.

Head and thorax dark brown to black.

Fore wings (Fig. 50) in males dark brown to black, slender, apical half narrowed, apex acute with numerous coarse black setae along lateral and medial margins. Hind wings with single apical spur. Fore wings of females dark brown to black, rudimentary, reduced to small suboval pads.

Legs elongate, dark brown to black.

Abdomen and terminalia (Fig. 51) dark brown to black. In males ninth tergum (Fig. 53) short, broad basally, apex truncate with narrow medial fissure, lateral areas of apex with numerous short black spines; shallow medial depression receives tips of dististyles. Dististyles elongate, curved dorsally, apices acute; numerous small spines along dorsal margins of the dististyles, with narrow elongate lobes on mesal margins. At rest dististyles curve dorsally to fit into dorsomedial depression of ninth tergum. Ninth sternum (hypandrium) oval, apical margin emarginate (Fig. 52). In ventral view (Fig. 55) eighth sternum of female formed by two narrow, elongate plates, 6.0 times longer than wide, rounded apically, with numerous short apical spines, bases and apices separated. In lateral view (Fig. 54) eighth sternum broad basally, apical three-fourths thick, extending beyond apex of tenth tergum. Tenth tergum elongate, thick,

3.6 times longer than wide. Tenth sternum hidden. Cerci short, triangular, apices acute.

This species is related to *B. nivoriundus*, the other eastern North American species of *Boreus*. The dark brown to black coloring generally separates *B. brumalis* from *B. nivoriundus* in addition to the constricted wing pads and emarginate apical margin of the ninth sternum (hypandrium) in males.

In Illinois individuals of *B. brumalis* have been collected primarily on moss in the beach-maple-tulip forest of southwestern Illinois along the escarpment of the Mississippi River.

B. brumalis extends from Tennessee to Massachusetts and west to Ohio and Michigan with isolated populations in Illinois, Wisconsin, and Minnesota (Fig. 56).

Illinois Records.—(Fig. 56). The first record of *Boreus* in Illinois was reported from Fountain Bluff in Jackson County by Stannard (1957). Individuals have since been collected from mid-October to mid-April only in the Ozark uplift of Illinois.

Fig. 56.—Distribution of **Boreus brumalis** in Illinois and North America.

Boreus nivoriundus Fitch

Boreus nivoriundus Fitch (1847:277). ♂, ♀. Type-locality: eastern New York.

Head and thorax light to dark reddish brown.

Fore wings in males (Fig. 57) pale brown, broad basally, tapering apically, with numerous strong black setae along lateral and medial margins. Hind wings with single apical spur. In females fore wings pale brown, rudimentary, reduced to small suboval pads.

Legs elongate, pale brown.

Abdomen and terminalia (Fig. 58) pale brown. In male ninth tergum (Fig. 60) short, broad basally, apex broadly rounded, with numerous short, black spines; medial depression receives apices of dististyles. Dististyles elongate, curved dorsally, apex acute, dorsal margin with numerous small dark spines; at rest dististyles curved dorsally to rest in dorsomedial depression of ninth tergite. Ninth sternum (hypandrium) broad, entire, oval, rounded apically (Fig. 59). In ventral view (Fig. 62) eighth sternum of female formed by two narrow, elongate plates, 6.3 times longer than wide, rounded apically, with numerous short, apical spines, bases and apices of plates separated. In lateral view (Fig. 61) eighth sternum broad basally, apical three-fourths flattened dorsoventrally, extending beyond apex of tenth tergum. Tenth tergum elongate, thick, 3.1 times longer than wide. Cerci short, fused, triangular, apex acute. Tenth and eleventh sterna hidden.

B. nivoriundus is one of two eastern species and differs from *B. brumalis* in its pale to reddish brown coloration, the longer length of the female ovipositor, and the rounded apices of the ninth tergum and sternum in males.

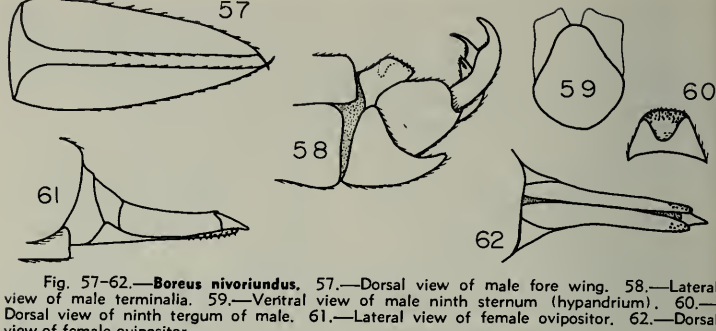


Fig. 57–62.—**Boreus nivoriundus.** 57.—Dorsal view of male fore wing. 58.—Lateral view of male terminalia. 59.—Veritral view of male ninth sternum (hypandrium). 60.—Dorsal view of ninth tergum of male. 61.—Lateral view of female ovipositor. 62.—Dorsal view of female ovipositor.

Often collected with *B. brumalis* in the deciduous forests of eastern North America.

B. nivoriundus extends from Massachusetts to Maine and southwest through New York and on to Ohio, Kentucky, and Tennessee (Fig. 63).

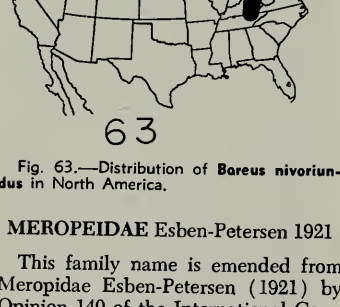


Fig. 63.—Distribution of **Boreus nivoriundus** in North America.

MEROPEIDAE Esben-Petersen 1921

This family name is emended from Meropidae Esben-Petersen (1921) by Opinion 140 of the International Commission of Zoological Nomenclature.

The family Meropeidae is the most primitive group of extant Mecoptera in North America. The broadly rounded wings with their dense venation associate the Meropeidae with the South American family Notiothaumidae although current knowledge of morphology (Mikoleit 1971*a*) indicates that these two families are not as closely related as was previously thought. The Meropeidae differ from the Notiothaumidae in the absence of ocelli, the noncoalescing radial and medial veins at the bases of the wings, and the absence of a notal organ.

Two genera are recorded for the Meropeidae. *Merope* is found in eastern and north-central North America, and *Austromerope* in western Australia.

Merope Newman

Merope Newman (1838:180). Type-species: *Merope tuber* Newman by monotypy. The description of the type-species will characterize the genus.

Merope tuber Newman

Merope tuber Newman (1838:180). ♀, ♂. Type-locality: Trenton Falls, New York.

Head pale yellow to brown. Ocelli absent.

Thorax pale yellow to pale brown. Pronotum shieldlike, extending anteriorly over vertex of head, with distinct dorsomesal suture.

Fore wing length 11.0–13.0 mm. Membranes (Fig. 64) pale whitish yellow; wing broad, apex rounded. Costa circumambient, broader along anterior

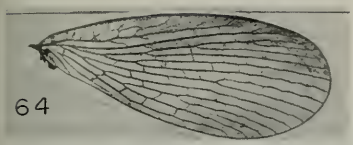


Fig. 64.—**Merope tuber** fore wing.

margin. Veins and crossveins numerous and variable. Pterostigma not distinct. Thyridium absent. Small brown basal lobe near apex of A_2. Hind wings slightly smaller than fore wings. The fore wings contain numerous veins and crossveins which show considerable variation in their number, branching, and origins.

Legs pale yellow. Tarsal claws paired, simple.

Abdomen pale yellow to brown, segments subrectangular, flattened dorsoventrally. Male terminalia (Fig. 65) pale yellow, elongate, equal in length to or longer than abdomen. Ninth tergum short, emarginate apically, forming two pointed lobes. Anus mesoventrally beneath ninth tergum. Basistyles elongate, broad basally. Dististyles elongate, shorter than basistyles, apex of each dististyle flattened laterally, emarginate, forming two black clawlike lobes; small apical concave disc in mesal margin of each dististyle (Fig. 66). Cerci present as short clavate lobes posterior to ninth tergum. Female terminalia lack sclerotized genital bulb.

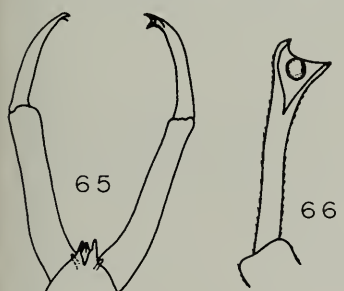


Fig. 65-66.—**Merope tuber.** 65.—Dorsal view of male terminalia. 66.—Male dististyle.

Specimens of *M. tuber* are rare in collections but have been collected from a variety of habitats. Illinois specimens have been collected in Malaise and picric acid traps. Indiana specimens have been collected by bait traps in a hickory woods near Lafayette. Most specimens recorded have been taken at lights, under stones, in rotting logs, and in European chafer traps. *Merope* appears to spend a great deal of time on the ground.

Nothing is known of the immature stages of this insect.

M. tuber extends from northern Georgia to Maine and west to Missouri and Minnesota (Fig. 67).

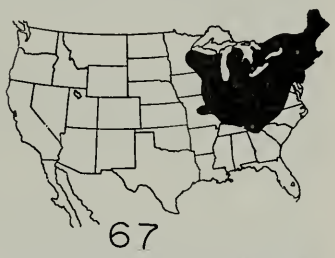


Fig. 67.—Distribution of **Merope tuber** in North America.

Illinois Records.—Collected during August in southern Illinois and during May in east-central Illinois. CHAMPAIGN COUNTY: Urbana, Trelease Woods, K. H. Leim, 1-7-V-1972, 1 ♀. UNION COUNTY: Pine Hills, H. S. Dybas, 28-VIII-1963, 29-VIII-1963, 5-VIII-1963, 2 ♂, 4 ♀.

PANORPODIDAE Issiki 1933

Byers (1965) first used the family name Panorpodidae but has recommended that Issiki (1933) be credited with the name because Issiki first suggested that the genus *Panorpodes* be raised to subfamily rank.

The short rostrum of *Brachypanorpa* with the gena bearing a distinct tooth separates the panorpodids from other families of North American Mecoptera. Two genera are distinguished, with *Panorpodes* restricted to eastern Asia and *Brachypanorpa* found in southeastern and northwestern North America. The family Panorpodidae is very closely associated taxonomically with Panorpidae, and Byers (1965) erected the family Panorpodidae on the basis of their being phytophagous and because of the differences between the larvae of the two groups.

Only *Brachypanorpa* occurs in North America, but this genus does not occur in the Midwest.

Brachypanorpa Carpenter

Brachypanorpa Carpenter (1931*a*:209). Type-species: *Panorpodes carolinensis* Banks.

Three ocelli present. Antennae filiform, 30–40 flagellar segments, genae with distinct acute lobes. Thorax yellowish brown. Wings yellowish brown to amber, crossveins not margined. Pterostigma concolor with rest of wing. Thyridium absent. Wings reduced in some females. Legs elongate, dark yellowish brown, with pair of simple claws. Body light yellowish brown. Abdomen and terminalia dark yellowish brown, oval. Ninth tergum of males oval, emarginate apically, forming two thick lateral lobes. Hypovalves thick, fused near middles of basistyles, separate apically. Basistyles oval, elongate, longer than dististyles.

Three species of *Brachypanorpa* are recorded from North America: *B. carolinensis* in the southern Appalachians and *B. oregonensis* and *B. montana* in the northwestern states (Fig. 13).

PANORPIDAE Stephens 1835

The paired, serrate claws; the elongate rostrum; the presence of a thyridium; and the narrow, elongate wings with the cubital vein not fused to the medial vein separate the panorpids from other families of Mecoptera. Three genera are recognized. *Leptopanorpa* and *Neopanorpa* are found in Asia, and *Panorpa* occurs in North America and Eurasia.

In North America *Panorpa* contains the greatest number of species of any genus of Mecoptera. Twenty-three species occur in the Midwest, eight in Illinois.

Panorpa Linnaeus

Panorpa Linnaeus (1758:551). Type-species: *Panorpa communis* Linnaeus.

Aulops Enderlein (1910:390). Synonymized by Esben-Petersen (1915).

Estenalla Navás (1912:356). Synonymized by Esben-Petersen (1915).

Head pale yellow to dark reddish brown. Ocelli amber on raised subtriangular pad. Antennae filiform with more than 30 flagellar segments. Rostrum elongate, tapered. Mandibles large, heavily sclerotized, with two or three lateral teeth. Labial and maxillary palps have two and four segments, respectively.

Thorax pale yellow to dark reddish brown. Wings colorless to amber, crossveins often margined. Membranes patterned with dark brown spots or bands. Thyridium at base of first fork of medial vein. Legs pale yellow to dark reddish brown, with serrate claws.

Abdomen and terminalia yellow to dark reddish brown. The sixth abdominal tergum of males may possess an anal horn. Apex of tergum in males tapered, truncate, or emarginate. Hypovalves generally fused near bases of basistyles except in *lugubris* group. Basistyles broad, oval, usually longer than dististyles. Dististyles simple or with large mesal lobes. Ventral parameres variable. In females the genital plate, usually heavily sclerotized, consists of a distal plate, often a basal plate, and a medial spermathecal apodeme.

KEY TO MIDWESTERN SPECIES OF PANORPA

MALES (Modified from Carpenter 1931*a*)

1. Hypovalves fused near middles of basistyles (Fig. 91) ....(*lugubris* group) nuptialis
   Hypovalves long, fused near bases of basistyles (Fig. 93) 2
2. Anal horn absent 3
   Anal horn (Fig. 20) present 9

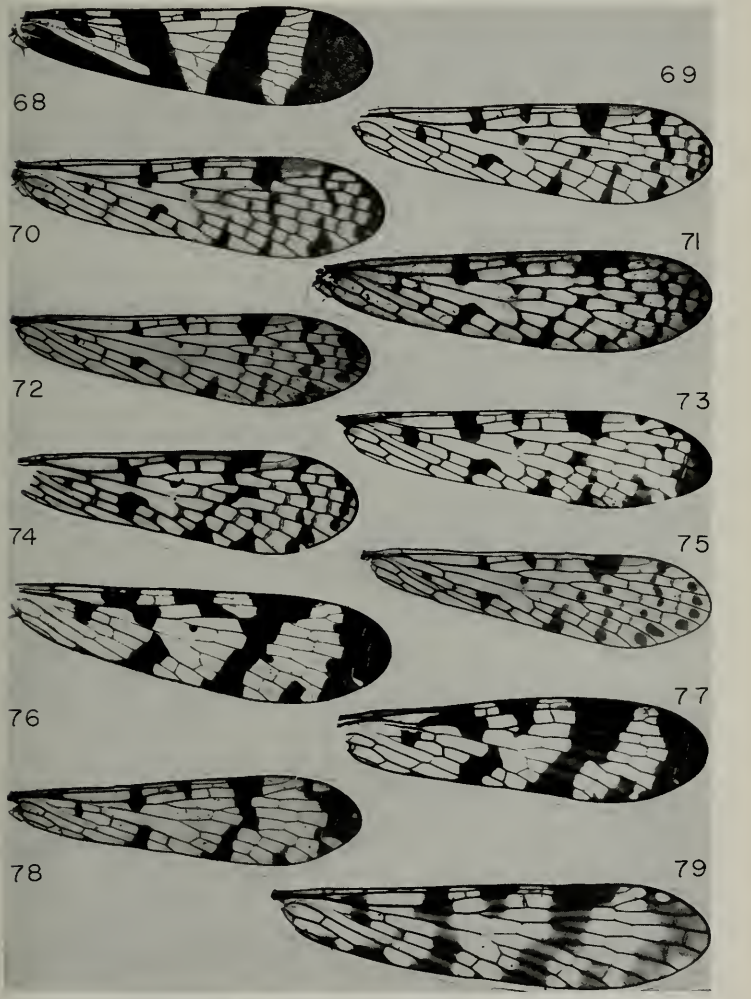


Fig. 68–79.—**Panorpa** fore wings. 68.—**P. nuptialis.** 69.—**P. maculosa.** 70.—**P. submaculosa.** 71.—**P. latipennis.** 72.—**P. acuta.** 73.—**P. banksi.** 74.—**P. sigmoides.** 75.—**P. nebulosa.** 76.—**P. mirabilis.** 77.—**P. galerita.** 78.—**P. hungerfordi.** 79.—**P. subfurcata.**

3. Aedeagus extending posteriorly between dististyles (Fig. 93) 4
Aedeagus not extending posteriorly between dististyles 5

4. Dististyles slender, smoothly curved (Fig. 93) .....**maculosa**
Dististyles broad, falcate apically (Fig. 95) .....**submaculosa**

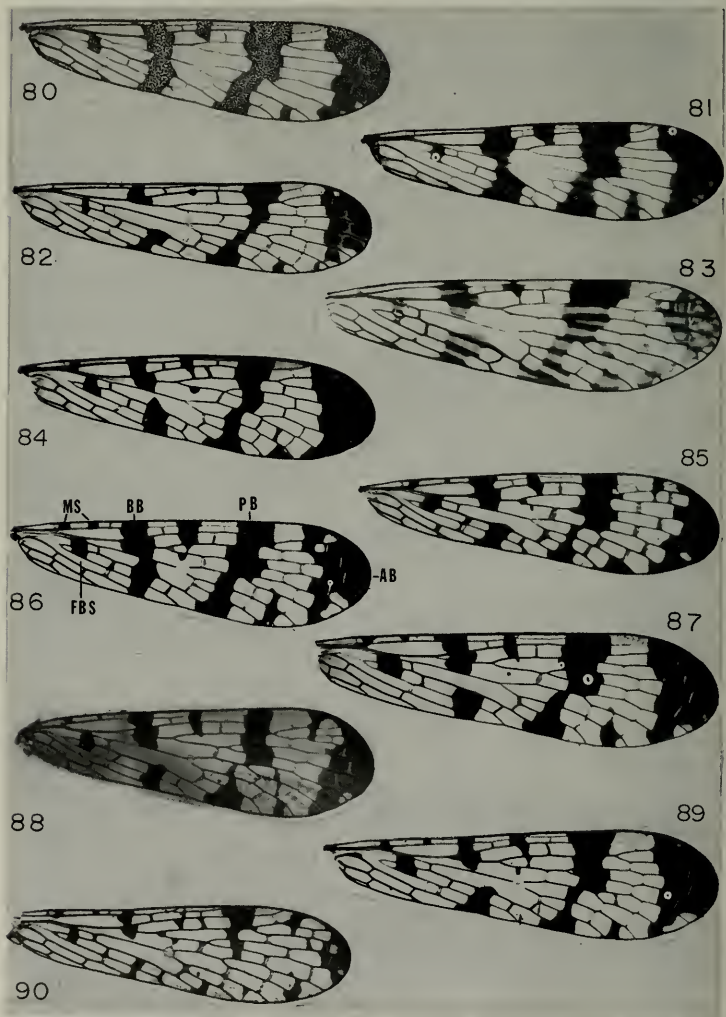


Fig. 80–90.—**Panorpa** fore wings. 80.—**P. helena.** 81.—**P. insolens.** 82.—**P. debilis.** 83.—**P. claripennis.** 84.—**P. rufescens.** 85.—**P. dubitans.** 86.—**P. braueri.** MS, marginal spots. BB, basal band. PB, pterostigmal band. AB, apical band. FBS, first basal spot. 87.—**P. speciosa.** 88.—**P. bifida.** 89.—**P. anomala.** 90.—**P. consuetudinis.**

5. Dististyles with small fingerlike lobe (Fig. 98) ..... **latipennis**

Dististyles simple, without lobes (Fig. 101) 6

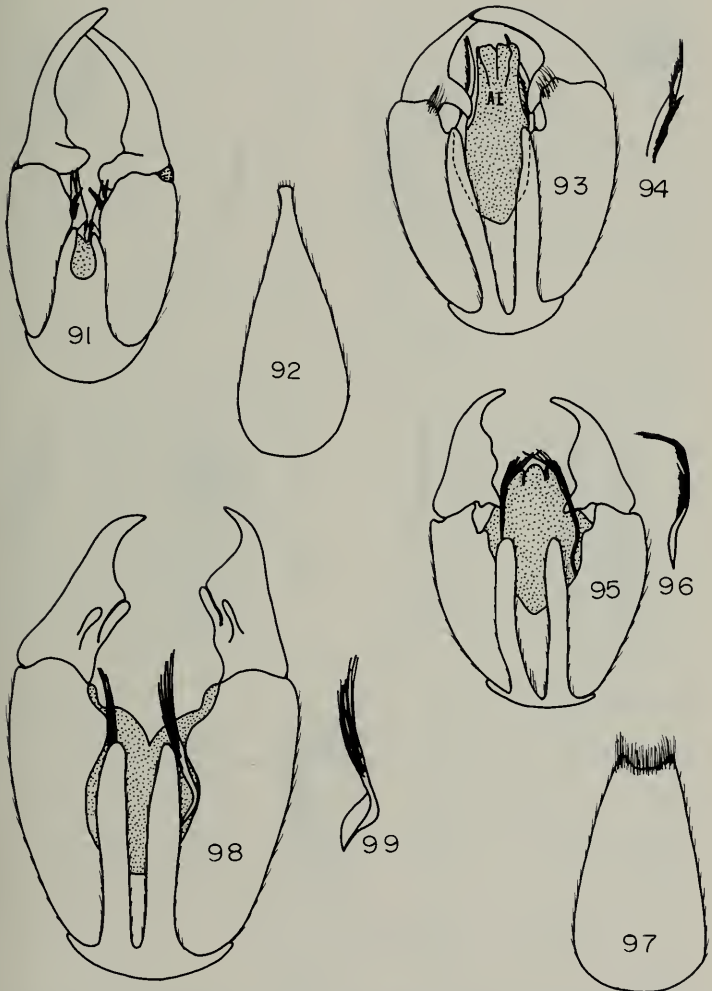


Fig. 91–99.—**Panorpa** male terminalia. 91.—**P. nuptialis.** Ventral view of terminalia. 92.—Dorsal view of ninth tergum. 93.—**P. maculosa.** Ventral view of terminalia. AE, aedeagus. 94.—Ventral paramere. 95.—**P. submaculosa.** Ventral view of terminalia. 96.—Ventral paramere. 97.—Dorsal view of ninth tergum. 98.—**P. latipennis.** Ventral view of terminalia. 99.—Ventral paramere.

6. Ninth tergum truncate apically (Fig. 100) ..... acuta
Ninth tergum emarginate apically (Fig. 103) 7
7. Ventral parameres slender, straight (Fig. 105) ..... banksi

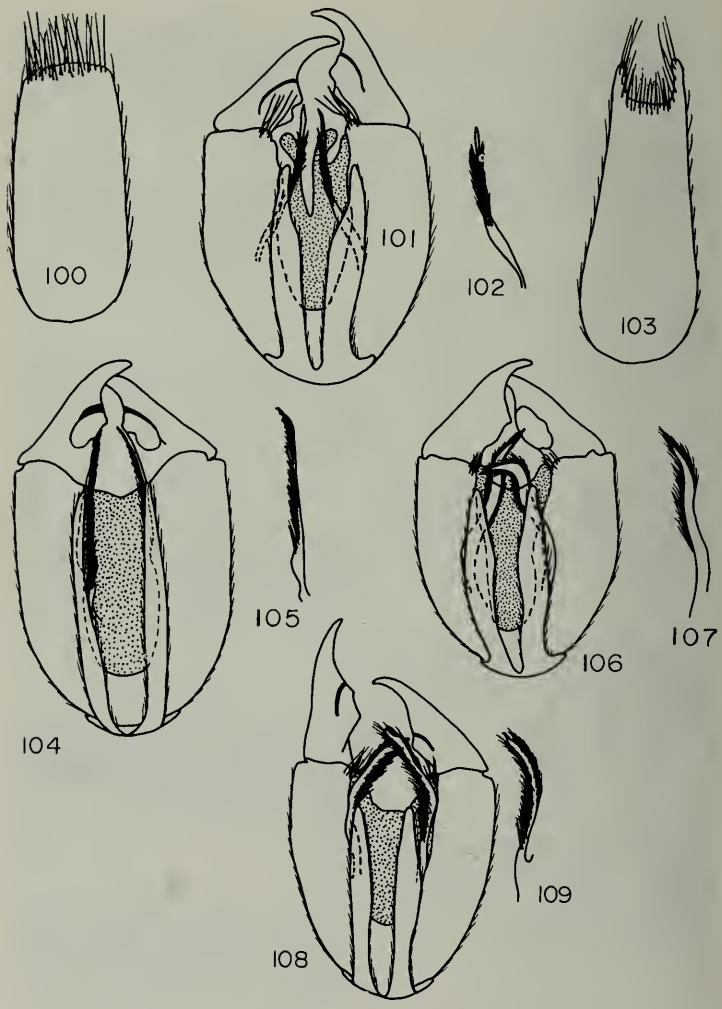


Fig. 100–109.—**Panorpa** male terminalia. 100.—**P. acuta.** Dorsal view of ninth tergum. 101.—Ventral view of terminalia. 102.—Ventral paramere. 103.—**P. banksi.** Dorsal view of ninth tergum. 104.—Ventral view of terminalia. 105.—Ventral paramere. 106.—**P. sigmoides.** Ventral view of terminalia. 107.—Ventral paramere. 108.—**P. nebulosa.** Ventral view of terminalia. 109.—Ventral paramere.

Ventral parameres thick, curved medially (Fig. 107) 8

8. Ventral parameres sigmoidally curved, with barbs covering apices (Fig. 107) .....**sigmoides**

Ventral parameres not sigmoidally curved, with apices constricted and bare (Fig. 109). A small patch of setae on tubercle near bases of dististyles .....**nebulosa**

9. Dististyles with large lobes (Fig. 115) 10

Dististyles simple, without lobes (Fig. 120) 13

10. Hypovalves thick, divergent apically (Fig. 111) 11

Hypovalves slender, elongate (Fig. 115) 12

11. Lobes of dististyles large, covering all but tips of dististyles (Fig. 111) ..... **mirabilis**

Lobes of dististyles small (Fig. 113) ..... **galerita**

12. Ventral parameres with barbs (Fig. 119) .....**hungerfordi**

Ventral parameres without barbs (Fig. 116) .....**subfurcata**

13. Ventral parameres unbranched (Fig. 121) 14

Ventral parameres branched (Fig. 137) 19

14. Each basistyle with one to three dark thick setae near base of each dististyle (Fig. 120) .....**helena**

Basistyles without dark thick setae near bases of dististyles 15

15. Hypovalves narrow, reaching to bases of dististyles (Fig. 122).... ..... **rufescens**

Hypovalves not reaching bases of dististyles 16

16. Ventral parameres with basal tuft of barbs (Fig. 125) 17

Ventral parameres without basal tuft of barbs (Fig. 129) 18

17. Ventral parameres with apical tuft of barbs (Fig. 125) .....**dubitans**

Ventral parameres without apical tuft of barbs (Fig. 127) .....**insolens**

18. Basistyles with apical tubercle bearing tuft of setae (Fig. 128)... ..... **debilis**

Basistyles without apical tubercle and setae (Fig. 130) .....**claripennis**

19. Hypovalves thick (Fig. 132). Ventral parameres as in Fig. 133 and 135 20

Hypovalves thin (Fig. 140). Ventral parameres as in Fig. 137, 139, and 141 21

20. Basal band of wing broken (Fig. 87) .....**speciosa**

Basal band continuous (Fig. 86) .... **braueri**

21. Veutral parameres (Fig. 136) extending well beyond bases of dististyles .....**bifida**

Ventral parameres (Fig. 140) short, reaching at most only slightly beyond bases of dististyles 22

22. Hypovalves very short, not reaching to bases of dististyles (Fig. 140). Ventral parameres (Fig. 141) with thick lateral branch, curved dorsally .....**anomala**

Hypovalves long, extending to or slightly beyond bases of dististyles (Fig. 138). Ventral parameres (Fig. 139) with two narrow, thin branches ..... **consuetudinis**

FEMALES

1. Wings with very broad bands (Fig. 68). Apex of genital plate truncate (Fig. 142) .....**nuptialis**

Wings with narrow bands or spots (Fig. 73 and 80). Apex of genital plate emarginate 2

2. Pterostigmal band not continuous from anterior to posterior margin of wing (Fig. 73) ....(*nebulosa* group).. 3

Pterostigmal band continuous from anterior to posterior margin of wing (Fig. 80).....(*rufescens* group).. 8

3. Spermathecal apodeme (Fig. 146) extending beyond base of distal plate. Genital plate greater than 1.0 mm in length 5

Spermathecal apodeme (Fig. 143) not extending beyond base of distal plate. Genital plate less than 1.0 mm in length 4

4. Genital plate (Fig. 143) about 0.44 mm in length; lateral lobes of apical emargination of distal plate moderately broad .....**maculosa**

Genital plate (Fig. 144) about 0.57 mm in length; lateral lobes of apical emargination of distal plate narrow .....**submaculosa**

5. Spermathecal apodeme (Fig. 146) reaches to or beyond apical emargination of distal plate 6

Spermathecal apodeme (Fig. 145) does not reach apical emargination of distal plate .....**latipennis**

6. First marginal spot present (Fig. 73). Genital plate (Fig. 146) narrow, elongate, over 1.5 mm in length .....**banksi**

First marginal spot absent. Genital plate (Fig. 147 and 149) oblong or oval, 1.5 mm or less in length 7

7. Genital plate (Fig. 149) oblong, constricted basally .....**nebulosa**
acuta

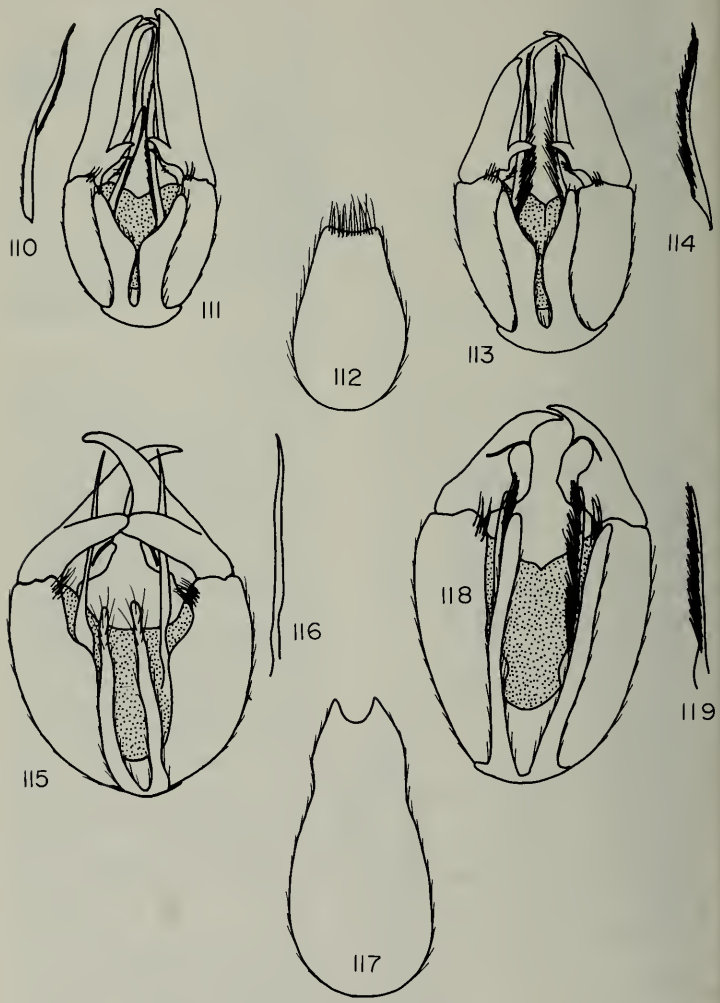


Fig. 110–119.—**Panorpa** male terminalia. 110.—**P. mirabilis.** Ventral paramere. 111.—Ventral view of terminalia. 112.—**P. galerita.** Dorsal view of ninth tergum. 113.—Ventral view of terminalia. 114.—Ventral paramere. 115.—**P. subfurcata.** Ventral view of terminalia. 116.—Ventral paramere. 117.—Dorsal view of ninth tergum. 118.—**P. hungerfordi.** Ventral view of terminalia. 119.—Ventral paramere.

Genital plate (Fig. 147) oval, basal two-thirds of plate broad ...**sigmoides**

8. Marginal spot(s) present 9
Marginal spot(s) absent 16

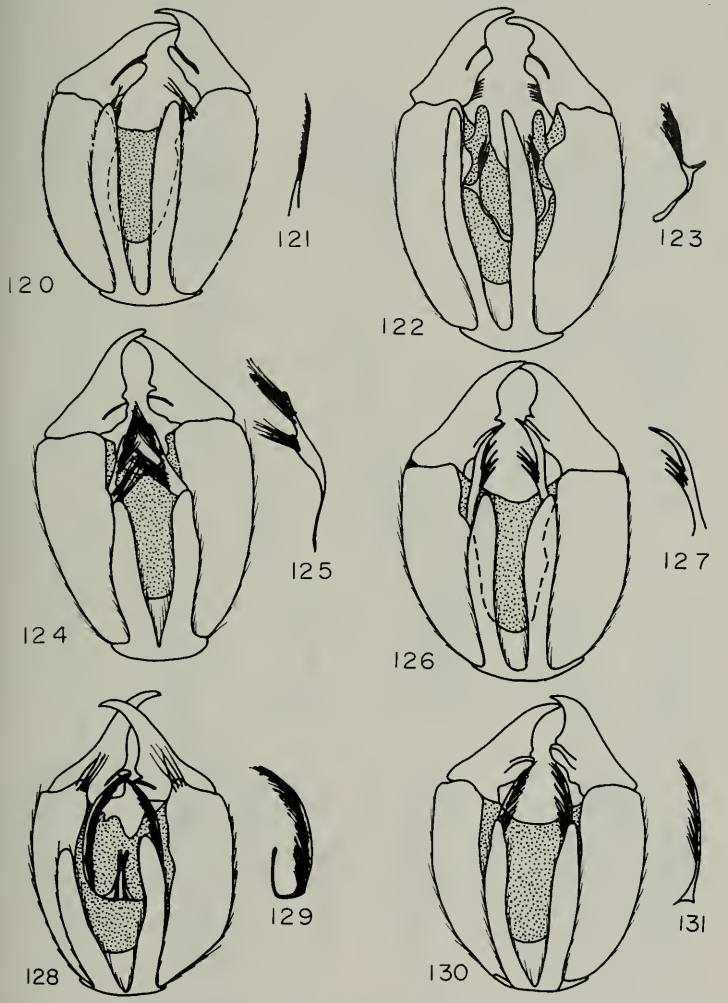


Fig. 120–131.—**Panorpa** male terminalia. 120.—**P. helena.** Ventral view of terminalia. 121.—Ventral paramere. 122—**P. rufescens.** Ventral view of terminalia. 123.—Ventral paramere. 124.—**P. dubitans.** Ventral view of terminalia. 125.—Ventral paramere. 126.—**P. insolens.** Ventral view of terminalia. 127.—Ventral paramere. 128.—**P. debilis.** Ventral view of terminalia. 129.—Ventral paramere. 130.—**P. claripennis.** Ventral view of terminalia. 131.—Ventral paramere.

9. Spermathecal apodeme extends beyond base of distal plate one or more times length of plate (Fig. 164) 10

Spermathecal apodeme extends beyond base of distal plate by less than

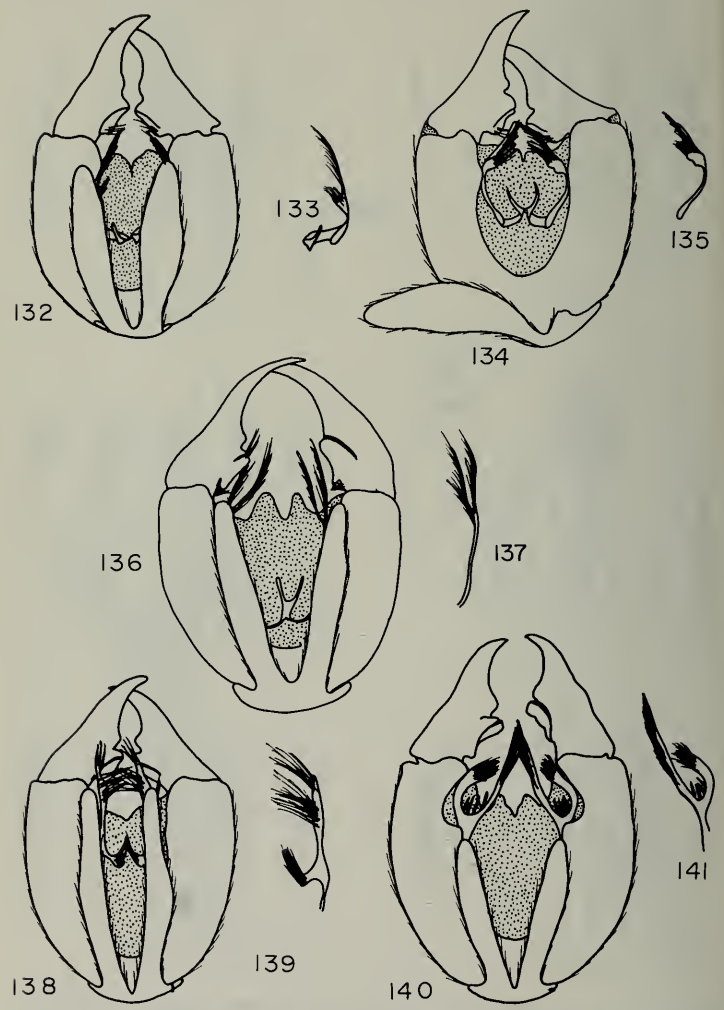


Fig. 132–141.—**Panorpa** male terminalia. 132.—**P. speciosa.** Ventral view of terminalia. 133.—Ventral paramere. 134.—**P. braueri.** Ventral view of terminalia. 135.—Ventral paramere. 136.—**P. bifida.** Ventral view of terminalia. 137.—Ventral paramere. 138.—**P. consuetudinis.** Ventral view of terminalia. 139.—Ventral paramere. 140.—**P. anomala.** Ventral view of terminalia. 141.—Ventral paramere.

length of plate (Fig. 160) 12
10. Genital plate (Fig. 164) with sub-rectangular basal membrane ..... consuetudinis

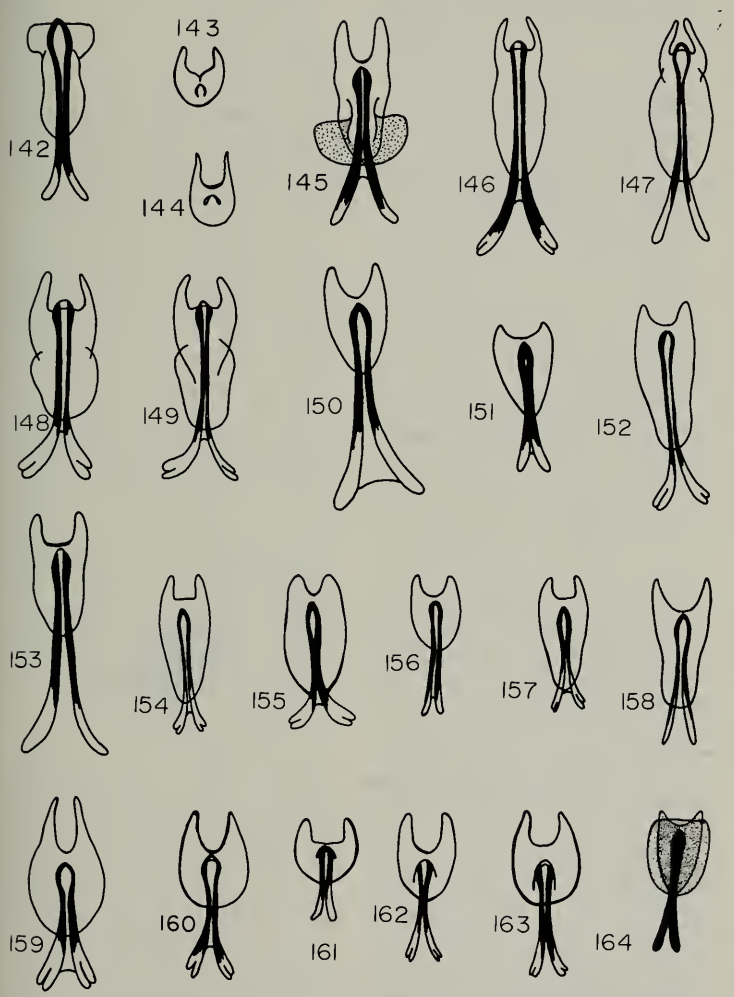


Fig. 142–164.—Female genital plate. 142.—**Panorpa nuptialis.** 143.—**Panorpa maculosa.** 144.—**Panorpa submaculosa.** 145.—**Panorpa latipennis.** 146.—**Panorpa banksi.** 147.—**Panorpa sigmoides.** 148.—**Panorpa acuta.** 149.—**Panorpa nebulosa.** 150.—**Panorpa mirabilis.** 151.—**Panorpa galerita.** 152.—**Panorpa hungerfordi.** 153.—**Panorpa subfurcata.** 154.—**Panorpa helena.** 155.—**Panorpa rufescens.** 156.—**Panorpa dubitans.** 157.—**Panorpa insolens.** 158.—**Panorpa debilis.** 159.—**Panorpa claripennis.** 160.—**Panorpa speciosa.** 161.—**Panorpa braueri.** 162.—**Panorpa bifida.** 163.—**Panorpa anomala.** 164.—**Panorpa consuetudinis.**

Genital plate without subrectangular basal membrane 11

11. Genital plate (Fig. 156) about 0.85 mm in length .....dubitans

Genital plate (Fig. 153) about 1.76 mm in length .....subfurcata

12. Genital plate (Fig. 161) short, broad, about 0.69 mm in length. Crossveins margined; basal band continuous .....braueri

Genital plate about 1 mm or more in length. Basal band broken 13

13. Genital plate (Fig. 155) about 0.98 mm in length, with lateral lobes of apical emargination short and thick. Distal plate oval. Spermathecal apodeme extends beyond base of distal plate 0.41 times length of plate .....rufescens

Genital plate subcircular. Spermathecal apodeme extends beyond base of distal plate more than 0.60 times length of plate 14

14. Genital plate (Fig. 160) deeply emarginate apically, reaching almost to apex of spermathecal apodeme .....speciosa

Genital plate (Fig. 163) with moderate emargination apically 15

15. Inner margins of apical emargination of genital plate (Fig. 162) parallel. Genital plate about 0.99 mm in length .....bifida

Inner margins of apical emargination of distal plate (Fig. 163) converging. Genital plate about 1.15 mm in length .....anomala

16. Crossveins margined 17

Crossveins not margined 18

17. Genital plate (Fig. 159) very broad basally, over 1 mm in length ..... claripennis

Genital plate (Fig. 158) constricted basally, 1 mm or less in length..debilis

18. Wing membranes colorless 19

Wing membranes pale yellow to amber 21

19. First basal spot fused with anterior part of basal band (Fig. 76)..mirabilis

First basal spot not fused with basal band 20

20. Genital plate (Fig. 151) with shallow emargination apically, about 0.97 mm in length .....galerita

Genital plate (Fig. 153) deeply emarginate apically, about 1.76 mm in length .....subfurcata

21. Genital plate (Fig. 152) elongate, about 1.50 mm in length ..hungerfordi

Genital plate less than 1.30 mm in length 22

22. Genital plate (Fig. 154) about 1.07 mm in length .....helena

Genital plate (Fig. 157) about 0.98 mm in length .....insolens

Lugubris Group

The *lugubris* group consists of three Nearctic species, *P. lugubris, P. rufa,* and *P. nuptialis,* which are dark reddish brown to black with dark, broad wing bands. The sixth abdominal tergum of males lacks an anal horn. The seventh and eighth abdominal segments are elongate and slender. The ninth tergum of males is tapered apically, and the hypovalves, or ninth sternum, are fused near the mid length of the basistyles.

Panorpa nuptialis Gerstaecker

Panorpa nuptialis Gerstaecker (1863: 187). ♀, ♂. Type-locality: Texas.

Head and thorax reddish brown.

Fore wing length 14.0–17.9 mm. Membranes (Fig. 68) amber, crossveins not margined. Apical band dark brown, broad, entire. Pterostigmal band dark brown, broad, entire, not forked. Basal band dark brown, broad, entire. Marginal and first basal spots fused. Second basal spot large, extending along posterior margin of wing from base to posterior fourth of basal band.

Legs dark reddish brown.

Abdomen reddish brown. Male terminalia reddish brown. Ninth tergum (Fig. 92) broad and rounded basally, tapering apically to narrow truncate apex. Hypovalves (Fig. 91) broad basally, fused well beyond bases of basistyles, separated apically to form two narrow, lateral lobes, ending well before bases of dististyles. Basistyles large, oval. Dististyles equal in length to basistyles. Ventral parameres narrow, elongate, branched, extending to bases of dististyles. Female genital plate large (Fig. 142), elongate, 1.35 mm in length. Distal plate broadened laterally, apex truncate. Basal plate narrow, elongate. Spermathecal apo-

deme elongate, bifurcate basally, extending slightly beyond apex of distal plate.

The broad dark bands on the wings and the elongate seventh and eighth abdominal segments associate *P. nuptialis* with *P. lugubris* and *P. rufa*. Both sexes of *P. nuptialis* are readily distinguished by the broad, unforked pterostigmal band and the large second basal spot which extends along the posterior margin of the wing from the base to the basal band.

Individuals of *P. nuptialis* have been collected in dense vegetation along a drainage ditch in Missouri, in short grass of roadside ditches, and in cotton and soybean fields. The general habitat of this and other species of the *P. lugubris* group differs markedly from that of most panorpids.

P. nuptialis is a south-central species recorded from Louisiana to Missouri and southwest into Mexico (Fig. 165).

Fig. 165.—Distribution of **Panorpa nuptialis** in North America.

It is the only species of this group to extend up the Mississippi valley, and it has been collected within a mile of Illinois.

Nebulosa Group

The *nebulosa* group consists of eight species of *Panorpa*, seven of which occur in the Midwest. The wing membranes are usually clear, and the wing bands are generally reduced to numerous small spots. In males the sixth abdominal tergum lacks an anal horn. The seventh and eighth abdominal segments are short. The ninth tergum is truncate or emarginate apically, and the hypovalves are fused at the bases of the basistyles.

Panorpa maculosa Hagen

Panorpa maculosa Hagen (1861:245). ♂, ♀. Type-locality: Pennsylvania.

Panorpa utahensis Gurney (1937:223). ♀ ♀. Synonymized by Gurney (1938), and now placed in *P. submaculosa* by Webb, Penny, and Marlin.

Head and thorax dark to reddish yellow.

Fore wing length 11.6–11.8 mm. Membranes (Fig. 69) clear to pale yellow, crossveins margined. Apical band pale brown, broken into numerous small brown spots. Pterostigmal band broad anteriorly, broken into small brown spots posteriorly. Basal band broken into two small spots. Marginal and second basal spots absent. First basal spot small.

Legs pale to dark yellow.

Abdomen dark yellow to reddish brown. Male terminalia dark yellow. Ninth tergum, as in Fig. 97, oval, broad basally, apex deeply emarginate. Hypovalves (Fig. 93) slender, elongate, ending before bases of dististyles. Basistyles broad, with medial patch of fine setae at bases of dististyles. Dististyles slender, each with large basal lobe, shorter than basistyles. Ventral parameres (Fig. 94) short, slender, unbranched, barbed along one side, extending beyond bases of dististyles. Aedeagus extending between dististyles. Female genital plate (Fig. 143) small, 0.44 mm in length. Distal plate short, rounded basally, apex deeply emarginate, forming two broad lateral lobes. Basal plate absent. Spermathecal apodeme short, not extending beyond base of distal plate and not reaching apical emargination of distal plate.

This species is closely associated with *P. submaculosa*. In both species the

aedeagus extends between the dististyles. In both *P. maculosa* and *P. submaculosa* the female genital plate is small, and the spermathecal apodeme does not extend beyond the base of the distal plate.

Individuals of *P. maculosa* have been collected on tall herbaceous vegetation in swampy woods of ash, oak, and yellow birch (Byers 1954).

P. maculosa extends from Georgia to Vermont and west to Michigan (Fig. 166).

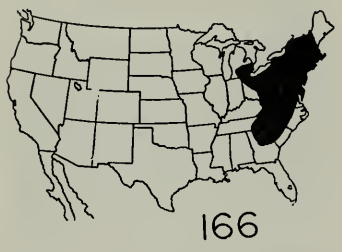


Fig. 166.—Distribution of **Panorpa maculosa** in North America.

Panorpa submaculosa Carpenter

Panorpa submaculosa Carpenter (1931*a*:255). ♂, ♀. Type-locality: Ann Arbor, Michigan.

Panorpa utahensis Gurney (1937:223). ♂ ♂. Synonymized by Gurney (1938).

Panorpa utahensis Gurney (1937:223). ♀ ♀. New synonymy. Gurney (1938) synonymized the females of *P. utahensis* with those of *P. maculosa.*

Head and thorax pale yellow to reddish brown.

Fore wing length 10.4–12.1 mm. Membranes (Fig. 70) clear, crossveins margined. Apical band dark brown, broad, with numerous large clear spots. Pterostigmal band dark brown, broad anteriorly, narrow and broken posteriorly. Basal band broken, forming two small dark brown spots. Marginal and second basal spots lacking. First basal spot small.

Legs pale to dark yellow.

Abdomen dark yellow to reddish brown. Male terminalia dark yellow. Ninth tergum (Fig. 97) elongate, broad basally, tapered toward emarginate apex. Hypovalves (Fig. 95) moderately broad, extending three-fourths length of basistyles. Basistyles broad. Dististyles short, each with large basi-mesal lobe. Ventral parameres (Fig. 96) narrow, barbed, unbranched, elongate, extending well beyond bases of dististyles. Aedeagus extends posteriorly between dististyles. Female genital plate (Fig. 144) short, 0.57 mm in length. Distal plate short, rounded, deeply emarginate apically, forming two moderately narrow lateral lobes. Basal plate absent. Spermathecal apodeme very short, not extending beyond base of distal plate and not reaching apical emargination of distal plate.

The posterior extension of the aedeagus between the dististyles associates *P. submaculosa* with *P. maculosa.* The two species differ in the shape of the dististyles.

Individuals of *P. submaculosa* are found in drier, less dense habitats than are most species of *Panorpa.*

P. submaculosa is an eastern species, extending from Georgia to Maine and west to Wisconsin (Fig. 167), with an

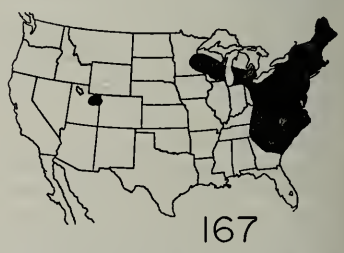


Fig. 167.—Distribution of **Panorpa submaculosa** in North America.

isolated record from Utah (Gurney 1937, described as *P. utahensis*).

Panorpa latipennis Hine

Panorpa latipennis Hine (1901:248). ♂, ♀. Type-locality: Detroit, Michigan; Sea Cliff, Long Island, New York.

Panorpa longipennis Banks (1911:349). ♀. Type-locality: Black Mountain, North Carolina. Synonymized by Carpenter (1931*a*).

Head and thorax dark reddish brown.

Fore wing length 13.0–14.0 mm. Membranes (Fig. 71) clear to faint brown, crossveins margined. Apical band pale brown, broken, with numerous clear spots. Pterostigmal band pale brown, broad anteriorly, but broken posteriorly. Basal band reduced to two small pale brown spots. Marginal and second basal spots absent. First basal spot small, pale brown. The continuity of the apical and pterostigmal bands varies considerably. In females the banding is broader and darker than it is in males.

Legs pale brown, apical segments darker.

Abdomen dark reddish brown. Male terminalia reddish brown. Ninth tergum broad, elongate, apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 98) moderately broad, extending three-fourths length of basistyles, apical one-fourth narrowed. Basistyles broad, longer than dististyles. Dististyles falcate, each with slender fingerlike lobe. Ventral parameres (Fig. 99) narrow, elongate, barbed, unbranched, extending slightly beyond bases of dististyles. Female genital plate (Fig. 145) large, elongate, 1.37 mm in length. Distal plate broad, apex deeply emarginate, forming two broad lateral lobes. Basal plate oval, tapered basally. A broad sclerotized membrane extends laterally over basal plate. Spermathecal apodeme elongate, widely bifurcate basally, not reaching apical emargination of distal plate.

In *P. latipennis* the general appearance of the male terminalia resembles those of *P. banksi* and *P. claripennis* with the fingerlike lobe of each dististyle readily separating *P. latipennis* from these two species.

In Wisconsin individuals have been collected among ferns in a red oak-white pine forest.

P. latipennis is an eastern species which extends from North Carolina to Vermont and west to Michigan and Wisconsin (Fig. 168).

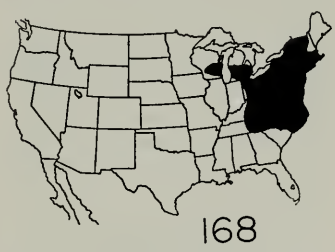


Fig. 168.—Distribution of **Panorpa latipennis** in North America.

Panorpa acuta Carpenter

Panorpa acuta Carpenter (1931*a*:253). ♂. Type-locality: Smoky Mountains, Tennessee, near Newfound Gap.

Head pale to dark yellow, thorax pale yellow to dark reddish brown.

Fore wing length 10.2–13.4 mm. Membranes (Fig. 72) clear, crossveins margined. Apical band broken into numerous pale brown spots. Pterostigmal band indistinct, broken into numerous pale brown spots. Basal band reduced to two small brown spots. Marginal and second basal spots absent. First basal spot very small, pale brown.

Legs pale yellow.

Abdomen dark yellow to dark reddish brown. Male terminalia dark yellow. Ninth tergum (Fig. 100) narrow, elongate, apex truncate. Hypovalves (Fig. 101) moderately broad, apical

third narrowed, ending before bases of dististyles. Basistyles broad, each with medial patch of thick setae at bases of dististyles. Dististyles shorter than basistyles. Ventral parameres (Fig. 102) narrow, barbed, unbranched, extending slightly beyond bases of dististyles. Female genital plate (Fig. 148) elongate, 1.47 mm in length. Distal plate deeply emarginate apically, forming two moderately broad lateral lobes. Basal lobe narrowed basally. Spermathecal apodeme elongate, extending beyond apical emargination of distal plate.

The truncate ninth tergum of males separates *P. acuta* from other species in the *nebulosa* group although the female genital plate is identical with that of *P. nebulosa.*

P. acuta has been collected in the same habitat as that of *P. nebulosa* along cool shaded ravines and at high elevations.

P. acuta is an eastern species extending from Georgia to Vermont along the Appalachian Mountains with an isolated record from Michigan (Fig. 169).

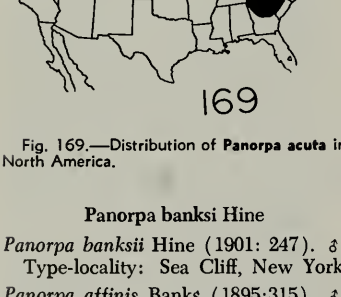


Fig. 169.—Distribution of **Panorpa acuta** in North America.

Panorpa banksi Hine

Panorpa banksii Hine (1901: 247). ♂. Type-locality: Sea Cliff, New York.

Panorpa affinis Banks (1895:315). ♂. Type-locality: Sea Cliff, New York. Original name preoccupied. Renamed by Hine (1901).

Panorpa chelata Carpenter (1931*a*: 251). ♂, ♀. Type-locality: Wollaston, Massachusetts. Synonymized by Byers (1974).

Head and thorax pale to dark yellow.

Fore wing length 10.4–12.5 mm. Membranes (Fig. 73) faintly yellow, several crossveins margined. Apical band dark brown, separated into a narrow band across apex and several dark brown subapical spots. Pterostigmal band dark brown, broad anteriorly, broken into several dark brown spots posteriorly. Basal band broken into two large spots. First marginal and first basal spots dark brown. Second marginal and second basal spots absent. The wing bands show considerable variation in the size and arrangement of spots. The first marginal spot is usually present, but in several specimens no marginal spots were evident.

Legs dark yellow.

Abdomen dark yellow to reddish yellow. Male terminalia reddish yellow. Ninth tergum (Fig. 103) elongate, emarginate apically, forming two narrow lateral lobes. Hypovalves (Fig. 104) elongate, narrow, tapered posteriorly, ending near bases of dististyles. Dististyles about one-half length of basistyles. Ventral parameres (Fig. 105) elongate, unbranched, barbed, extending well beyond bases of dististyles. Female genital plate (Fig. 146) elongate, 1.61 mm in length. Distal plate short, deeply emarginate apically, forming two narrow lateral lobes. Basal plate oval, elongate. Spermathecal apodeme elongate, widely divergent basally, extending beyond apical emargination of distal plate.

The male terminalia of *P. banksi* closely resemble those of *P. neglecta* although the hypovalves are broader than those of *P. neglecta* and the ventral parameres are barbed.

In Illinois individuals of *P. banksi* were collected in relatively dry areas away from the humid bottomlands. Near Chicago individuals were col-

lected on a dry gravel hillside among wild roses and in narrow steep ravines in cultivated areas.

P. banksi is a northeastern species extending from Georgia to Maine and west to Illinois, Iowa, and Wisconsin.

Illinois Records.—(Fig. 170). Collected from mid-May until early August. Restricted to the hilly areas of northern, western, and southern Illinois.

Fig. 170.—Distribution of **Panorpa banksi** in Illinois and North America.

Panorpa sigmoides Carpenter

Panorpa sigmoides Carpenter (1931*a*: 250). ♂, ♀. Type-locality: Turkey Run [State Park], Indiana.

Head and thorax pale yellow to dark yellowish brown.

Fore wing length 10.7–11.7 mm. Membranes (Fig. 74) clear to pale yellow, crossveins margined. Apical band dark brown, broken into a narrow apical and subapical band. Pterostigmal band dark brown, broken but forked. Basal band reduced to two dark brown spots. Marginal and second basal spots absent. First basal spot dark brown. Considerable variation occurs in the arrangement of the apical and pterostigmal bands.

Legs pale to dark yellow.

Abdomen dark yellow. Male terminalia pale to dark yellow. Ninth tergum, as in Fig. 103, broad basally, apex emarginate, forming two narrow, lateral lobes. Hypovalves (Fig. 106) enlarged medially, tapering apically, ending before bases of dististyles. Dististyles shorter than basistyles. Ventral parameres (Fig. 107) thick, unbranched, with barbs on both margins; parameres sigmoidally curved, extending beyond bases of dististyles, each apex smoothly tapered to acute point. Female genital plate elongate (Fig. 147), 1.39 mm in length, oval. Distal

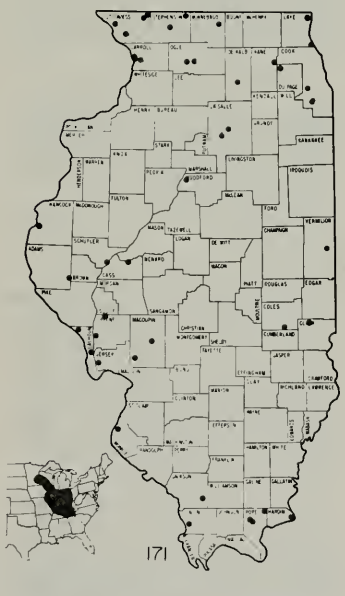


Fig. 171.—Distribution of **Panorpa sigmoides** in Illinois and North America.

plate broad, apex emarginate, forming two narrow lateral lobes. Basal plate broad, oval. Spermathecal apodeme elongate, widely bifurcate basally; apex swollen, extending beyond apical emargination of distal plate. In the female genital plate, significant variation was noted, making the separation of female specimens from *P. banksi* and *P. nebulosa* very subjective.

The male terminalia of *P. sigmoides* resemble those of *P. nebulosa*, but the middle third of the hypovalves is broader in *P. sigmoides*, and the ventral valves are sigmoidally curved.

This species was collected on stinging wood nettle and jewelweed along heavily wooded streams throughout Illinois. It appears to require a moister habitat than most species of *Panorpa*.

P. sigmoides is a midwestern species extending from Tennessee to Ohio and west to Minnesota.

Illinois Records.—(Fig. 171). Collected abundantly from the end of April to early August.

Panorpa nebulosa Westwood

Panorpa nebulosa Westwood (1846: 188). ♀. Type-locality: America boreali. Byers (1962*b*) reported that the female holotype bears the locality Trenton Falls, New York.

Head and thorax dark yellow to dark reddish brown.

Fore wing length 10.2–12.9 mm. Membranes (Fig. 75) clear, crossveins faintly margined. Apical band broken into numerous pale brown spots. Pterostigmal band pale brown, broad anteriorly, forked but broken posteriorly. Basal band reduced to two small brown spots. Marginal and second basal spots absent. First basal spot pale brown.

Legs pale to dark yellow.

Abdomen pale yellow to dark brown. Male terminalia pale yellowish brown. Ninth tergum, as in Fig. 103, broad basally, constricted at apical third, apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 108) narrow, elongate, tapered apically, extending three-fourths length of basistyles. Basistyles broad, each with patch of elongate setae at base of dististyle. Dististyles shorter than basistyles. Ventral parameres (Fig. 109) elongate, sinuate, crossing medially, barbed, unbranched, apex narrowed and bare. Female genital plate (Fig. 149) elongate, 1.40 mm in length. Distal plate large, apex emarginate, forming two broad lateral lobes. Basal plate narrowed basally. Spermathical apodeme elongate, bifurcate basally, apex swollen, reaching slightly beyond apical emargination of distal plate. Considerable variation is evident in the female genital plate, making the separation of *P. nebulosa* from *P. sigmoides* difficult.

The male terminalia of *P. nebulosa* resemble those of *P. sigmoides* although differing in the shape of the ventral parameres. The female of *P. nebulosa* cannot be separated from the *P. acuta* female on the basis of the genital plate.

This species occurs in a wide range of habitats, both wet and dry, always in wooded situations.

P. nebulosa is a wide-ranging eastern species extending from Georgia to Quebec and west to Wisconsin and Missouri (Fig. 172).

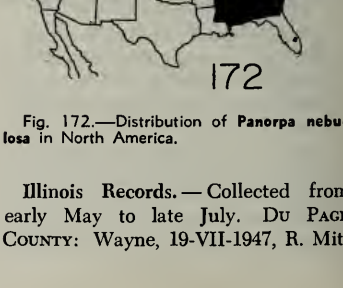


Fig. 172.—Distribution of **Panorpa nebulosa** in North America.

Illinois Records. — Collected from early May to late July. DU PAGE COUNTY: Wayne, 19-VII-1947, R. Mit-

chell, 1 ♀. Hardin County: Elizabethtown, 22-VI-1932, H. H. Ross, 1 ♂, 1 ♀. Lake County: Lake Forest, 6-V-1906, J. G. Needham, 2 ♂. Woodford County: 4 miles W of Cazenovia, 10-VI-1969, Webb and Marlin, 2 ♀. Illinois: Belfrage Collection, Stockholm Museum, 1 ♂, 1 ♀.

Rufescens Group

The *rufescens* group is the largest species-group of *Panorpa,* having 30 species, of which 15 occur in the Midwest. The wing membranes vary from clear to dark yellow and usually have broad apical and pterostigmal bands. The pterostigmal band is generally continuous from the anterior to the posterior margin of the wing. The sixth abdominal tergum of males possesses an anal horn. The ninth tergum of males is emarginate apically, often forming two narrow lateral lobes. The hypovalves (ninth sternum) are fused near the bases of the basistyles.

Panorpa mirabilis Carpenter

Panorpa mirabilis Carpenter (1931*a*: 229). ♂, ♀. Type-locality: Andover, New Jersey.

Head and thorax dark reddish brown.

Fore wing length 13.3–13.8 mm. Membranes (Fig. 76) clear to pale grey, crossveins not margined. Apical band pale brown, entire, with one or two small clear spots. Pterostigmal band pale brown, continuous, apical fork broken. Basal band pale brown, usually entire, fused with first basal spot along anterior margin. Both marginal and second basal spots absent. First basal spot pale brown.

Legs pale to dark yellow.

Abdomen pale to dark yellow. Male terminalia pale to dark yellow. Ninth tergum, as in Fig. 112, large, broad basally, tapered to shallow apical emargination. Hypovalves (Fig. 111) broad, divergent apically, ending before bases of dististyles. Basistyles narrow, each with small patch of setae near base of dististyle. Dististyles longer than basistyles each with large lobe nearly covering dististyle and with pair of large basi-medial lobes. Ventral parameres (Fig. 110) narrow, elongate, unbranched, barbed, extending almost to apices of dististyles. Female genital plate (Fig. 150) large, elongate, 1.58 mm in length. Distal plate deeply emarginate apically. Basal plate absent. Spermathecal apodeme long, extending well beyond base of distal plate but not reaching apical emargination.

The shapes of the hypovalves and dististyles readily associate *P. mirabilis* with *P. galerita,* but the narrow elongate ventral parameres of *P. mirabilis* separate the two species. In females the long spermathecal apodeme and the overall length of the genital plate of *P. mirabilis* readily separate this species from *P. galerita.*

Nothing has been recorded on the habitat of *P. mirabilis.*

P. mirabilis is a northeastern species, recorded from New Jersey, New York, Pennsylvania, and Michigan (Fig. 173).

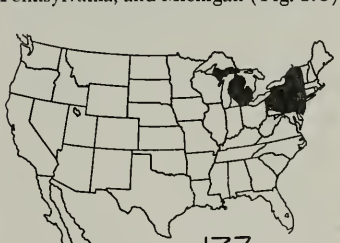


Fig. 173.—Distribution of **Panorpa mirabilis** in North America.

Panorpa galerita Byers

Panorpa galerita Byers (1962*b*:472). ♂, ♀. Type-locality: Lake Jean, Ricketts Glen State Park, Sullivan County, Pennsylvania.

Head and thorax pale to reddish yellow.

Fore wing length 12.5–13.7 mm. Membranes (Fig. 77) clear, crossveins not margined. Apical band pale brown,

entire or with few clear spots. Pterostigmal band pale brown, entire, posterior fork usually broken. Basal band pale brown, entire, occasionally fused anteriorly with first basal spot. Marginal and second basal spots absent. First basal spot pale brown.

Legs dark to reddish yellow.

Abdomen reddish brown. Male terminalia reddish brown. Ninth tergum, as in Fig. 112, oval, narrowed apically, apical margin with shallow emargination. Hypovalves (Fig. 113) broad, divergent apically, ending before bases of dististyles. Basistyles broad, each with small medial patch of setae near base of dististyle. Dististyles large, shorter than basistyles, with broad dorsal lobe covering two-thirds of each dististyle and two sinuate basi-medial lobes. Ventral parameres (Fig. 114) thick, sinuate, unbranched, barbed, extending well beyond bases of dististyles. Female genital plate (Fig. 151) short, 0.97 mm in length. Distal plate subtriangular, tapered basally, with concave apical emargination. Basal plate absent. Spermathecal apodeme extending beyond base of distal plate but not reaching apical emargination.

The large lobes of the dististyles, the divergent apices of the hypovalves, and the shape of the ninth tergum readily associate *P. galerita* and *P. mirabilis*. The males of *P. galerita* differ from those of *P. mirabilis* in the thick barbed ventral parameres, the dististyles being shorter than the basistyles, and the lobes of the dististyles covering only two-thirds of the dististyles. In females the genital plate of *P. galerita* is considerably smaller in length than that of *P. mirabilis*.

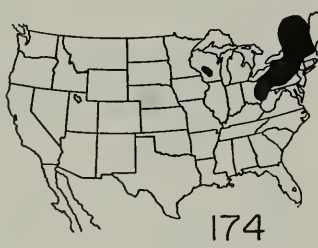


Fig. 174.—Distribution of **Panorpa galerita** in North America.

Individuals of *P. galerita* have been collected among ferns at the edge of a beech, maple, and hemlock forest.

P. galerita is a northeastern species extending from Quebec and Vermont west to Ohio with a disjunct distribution in Wisconsin (Fig. 174).

Panorpa subfurcata Westwood

Panorpa subfurcata Westwood (1846: 191). ♂, ♀. Type-locality: Nova Scotia.

Panorpa modesta Carpenter (1931*a*: 233). ♂. Type-locality: Douglas Lake, Michigan. Synonymized by Byers (1974).

Panorpa signifer Banks (1900:251). ♂, ♀. Type-locality: Gaylord, Michigan. Synonymized by Byers (1962*b*).

Head and thorax reddish to dark reddish brown.

Fore wing length 11.1–14.4 mm. Membranes (Fig. 79) clear, crossveins not margined. Apical band dark brown, broad, with several small clear spots. Pterostigmal band dark brown, broad anteriorly, forked, apical branch may or may not be continuous. Basal band broad, entire. Marginal spots variable. First basal spot dark brown, second basal spot present or absent. Byers (1962*b*) reported that the marginal spot was absent in all specimens of the type series, as is the case in most of the specimens we examined. However, material examined from Minnesota showed as many as four marginal spots.

Legs reddish to dark reddish brown.

Abdomen reddish brown. Male terminalia reddish brown. Ninth tergum (Fig. 117) long, broad basally, constricted three-fourths way from base; apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 115) slender, elongate, ending before bases of dististyles. Basistyles broad, each

with patch of elongate setae near base of dististyle. Dististyles large, almost equal in length to basistyles, with large medial lobe. Ventral parameres (Fig. 116) slender, elongate, unbranched, bare, extending well beyond bases of dististyles. Female genital plate (Fig. 153) long, 1.76 mm in length. Distal plate oval, apex emarginate. Basal plate absent. Spermathecal apodeme long, widely divergent basally, not reaching apical emargination of distal plate.

The large lobes of the dististyles relate *P. subfurcata* to *P. mirabilis* and *P. galerita*, but the narrow hypovalves and the elongate, bare ventral parameres readily separate *P. subfurcata* from the latter two species.

Collected in the dense undergrowth of birch-maple woodlands.

P. subfurcata is a northeastern species, extending from North Carolina to Nova Scotia and west to Minnesota and western Ontario (Fig. 175).

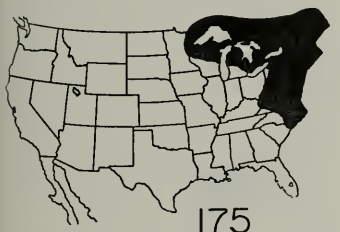


Fig. 175.—Distribution of **Panorpa subfurcata** in North America.

Panorpa hungerfordi Byers

Panorpa hungerfordi Byers (1973*a*: 367). ♂, ♀. Type-locality: 4 miles west of Pellston, Emmet County, Michigan.

Head and thorax dark reddish brown.

Fore wing length 11.3–12.0 mm. Membranes (Fig. 78) pale yellow, crossveins not margined. Apical band entire, pale brown, with two to four small clear spots. Pterostigmal band pale brown, continuous, forked, with apical branch broken. Basal band broken into two large pale brown spots. Marginal and second basal spots absent. First basal spot small.

Legs dark yellowish brown.

Abdomen dark reddish brown. Male terminalia reddish brown. Ninth tergum, as in Fig. 117, large, broad basally, tapered to deep apical emargination. Hypovalves (Fig. 118) slender, elongate, extending to base of dististyles. Basistyles broad. Dististyles shorter than basistyles, large, falcate, each with large mesal lobe. Ventral parameres (Fig. 119) slender, unbranched, barbed, extending to middle of dististyles. Female genital plate (Fig. 152) elongate, 0.87 mm in length. Distal plate broad apically, narrowed basally, apex having moderately shallow emargination. Spermathecal apodeme elongate, extending beyond base of distal plate but not reaching apical emargination.

This species was intially identified by authors as *P. virginica*, which it resembles in the shape of the dististyles and the ventral parameres. On closer examination *P. hungerfordi* differs (Byers 1973*a*) in the absence of a small tooth on each dististyle present in *P. virginica*; these species also differ in the shape of the lobes on the dististyles and in the lengths of the ventral parameres.

Nothing has been reported on the habitat of this species.

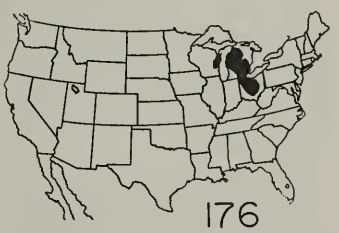


Fig. 176.—Distribution of **Panorpa hungerfordi** in North America.

Panorpa hungerfordi is distributed through Wisconsin, Michigan, and Ohio (Fig. 176).

Panorpa helena Byers

Panorpa helena Byers (1962*b*:474). ♂, ♀. Type-locality: Swampy woods south of Hopewell Lake, French Creek State Park, Berks County, Pennsylvania.

Panorpa venosa (Authors). Synonymized by Byers (1962*b*).

Head dark yellow, thorax reddish brown.

Fore wing length 10.9–12.7 mm. Membranes (Fig. 80) clear to amber, crossveins not margined. Apical band dark brown, broad, entire, occasionally having few small clear spots. Pterostigmal band dark brown, broad, apical branch generally separated, forming small spot. Basal band broad, entire. Marginal and second basal spots absent. First basal spot small.

Legs pale yellow, fourth and fifth tarsal segments dark brown to black.

Abdomen dark yellow. Male terminalia dark yellow. Ninth tergum, as in Fig. 117, oblong, rounded basally, tapered apically, deeply emarginate apex forming two broad lateral lobes. Hypovalves (Fig. 120) moderately thick, extending to bases of dististyles. Basistyles broad, each with one to three dark black setae near bases of dististyles. Dististyles about two-thirds length of basistyles. Ventral parameres (Fig. 121) narrow, elongate, barbed, unbranched, extending to bases of dististyles. Female genital plate (Fig. 154) oval, 1.07 mm in length. Distal plate oval, tapered basally, apex emarginate. Basal plate absent. Spermathecal apodeme elongate, base bifurcate, apex not reaching apical emargination of distal plate.

The dark setae at the bases of the dististyles relate *P. helena* with *P. americana,* but they differ in the shapes of the hypovalves and the ventral parameres. If the dark setae at the bases of the dististyles were absent, the male terminalia of *P. helena* would resemble closely those of *P. insolens.*

P. helena is probably the most abundant and widely distributed species of *Panorpa* in North America. It is collected readily in a moist shady woods with a thick herbaceous undergrowth of jewelweed, stinging wood nettle, and poison ivy.

P. helena extends from Georgia to Massachusetts and west to Manitoba, with an isolated record from Utah.

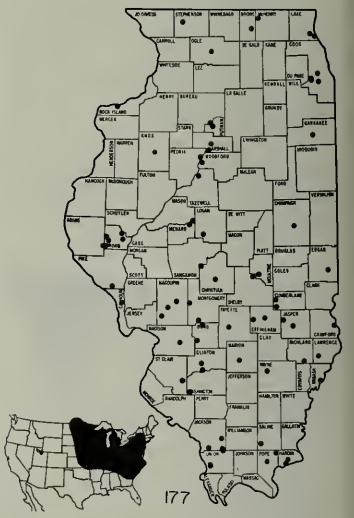


Fig. 177.—Distribution of **Panorpa helena** in Illinois and North America.

Illinois Records.—(Fig. 177). Collected abundantly from early May to mid-October throughout the state.

Panorpa insolens Carpenter

Panorpa insolens Carpenter (1935: 106). ♀. Type-locality: Cincinnati, Ohio.

Head and thorax reddish brown.

Fore wing length 10.9–12.4 mm. Membranes (Fig. 81) pale yellow,

crossveins not margined. Apical band dark brown, entire. Pterostigmal band dark brown to black, entire, broad along anterior margin, forked with apical branch broken. Basal band dark brown, broad, continuous. Marginal and second basal spots absent. First basal spot dark brown, small.

Legs yellowish to reddish brown.

Abdomen reddish brown. Male terminalia dark yellowish brown. Ninth tergum, as in Fig. 117, broad basally, tapering apically to deep emargination forming two thick lateral lobes. Hypovalves (Fig. 126) moderately thick, ending slightly before bases of dististyles. Basistyles broad. Dististyles shorter than basistyles. Ventral parameres (Fig. 127) unbranched, barbed, but bare on apical half, extending to middles of dististyles. Female genital plate (Fig. 157) 0.98 mm in length. Distal plate narrowed basally, wider apically, with deep apical emargination. Basal plate absent. Spermathecal apodeme elongate, extending beyond base of distal plate but not reaching apical emargination.

P. insolens was described by Carpenter on the basis of a single female, which had the basal band of the right fore wing broken at the middle and the upper and lower portions fused with the first basal spot, a condition not present in the left fore wing. The spermathecal apodeme was confined to the distal plate. In the holotype, the broken end of the spermathecal apodeme is evident, and when the portion that was broken off is added to the remainder of the apodeme retained in the distal plate, the apodeme extends beyond the base of the distal plate. We concluded, after comparing the wing patterns and female genital plate of the holotype with specimens collected near the type-locality, that Carpenter based his description on an aberrant specimen. Byers (1973*a*) has also discussed this variation in Carpenter's holotype of *P. insolens*.

The male terminalia of *P. insolens* resemble closely those of *P. helena*, though lacking the dark setae near the bases of the dististyles. These species also have differences in the shapes of the ventral parameres.

Collected on stinging wood nettle along shaded streams in northern Kentucky.

P. insolens is known only from southern Ohio and northern Kentucky (Fig. 178).

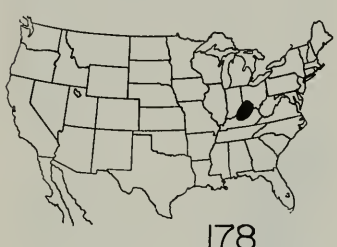


Fig. 178.—Distribution of **Panorpa insolens** in North America.

Panorpa debilis Westwood

Panorpa debilis Westwood (1846:191). ♀, ♂. Type-locality: America Septentrionali. Byers (1962*b*) designated the lectotype ♀ and reported the type-locality as Trenton Falls, New York.

Panorpa canadensis Banks (1895:315). ♂. Type-locality: Sherbrooke, Quebec. Synonymized by Byers (1962*b*).

Head and thorax dark yellow to reddish brown.

Fore wing length 10.4–11.4 mm. Membranes (Fig. 82) colorless, crossveins faintly margined. Apical band dark brown, broad, almost entire except for few pale spots. Pterostigmal band dark brown, apical branch broken, leaving small spot. Basal band brown, separated into two large spots. Marginal and second basal spots absent. First basal spot small.

Legs dark yellow to reddish brown.

Abdomen dark yellow to dark red-

dish brown. Male terminalia reddish brown. Ninth tergum, as in Fig. 117, broad basally, apex deeply emarginate, forming two lateral lobes. Hypovalves (Fig. 128) moderately broad, rounded apically, ending well before bases of basistyles. Basistyles broad, each with cluster of long setae near bases of dististyles. Dististyles shorter than basistyles. Ventral parameres (Fig. 129) elongate, curved, barbed, converging apically, extending beyond bases of dististyles. Female genital plate (Fig. 158) short, 0.79 mm in length. Distal plate narrowed basally, expanded apically, with deep emargination forming two broad lateral lobes. Basal plate absent. Spermathecal apodeme short, not reaching apical emargination of distal plate.

The male terminalia of *P. debilis* resemble those of *P. rufescens,* but the ventral parameres of *P. debilis* converge apically and the hypovalves are broader.

Byers (1954) reported *P. debilis* inhabiting a wide variety of habitats. In southern Illinois it was collected on jewelweed in the Pine Hills area. In central Wisconsin individuals were collected in upland raspberry patches.

P. debilis is an eastern species, extending from North Carolina to Quebec and west to Illinois and Wisconsin, with a doubtful record in Colorado (Fig. 179).

Fig. 179.—Distribution of **Panorpa debilis** in North America.

Illinois Records. — Collected only twice in Illinois in mid-May and early July. OGLE COUNTY: Grand Detour, 2-VII-1932, Dozier and Mohr, 1 ♂, 1 ♀. UNION COUNTY: Pine Hills, 18-V-1963, W. Brigham, 1 ♂.

Panorpa claripennis Hine

Panorpa claripennis Hine (1901:252). ♂. Type-locality: Sherbrooke, Quebec.

Head and thorax dark reddish brown.

Fore wing length 12.0–14.0 mm. Membranes (Fig. 83) colorless, crossveins faintly margined. Apical band dark brown, broad, broken posteriorly. Pterostigmal band dark brown, broad anteriorly, tapered posteriorly, with apical branch of fork broken. Basal band broken, forming two large dark brown spots. Marginal and second basal spots absent. First basal spot small.

Legs dark yellow.

Abdomen dark reddish brown. Male terminalia reddish brown. Ninth tergum, as in Fig. 117, elongate, deeply emarginate apically, forming two broad lateral lobes. Hypovalves (Fig. 130) moderately broad, tapered apically, ending before bases of dististyles. Basistyles broad. Dististyles shorter than basistyles. Ventral parameres (Fig. 131) elongate, barbed, extending well beyond bases of dististyles. Female genital plate (Fig. 159) broad, 1.30 mm in length. Distal plate oval, broad, deeply emarginate apically, forming two narrow lateral lobes. Basal plate absent. Spermathecal apodeme broad, bifurcate basally, apex not reaching apical emargination of distal plate.

The male terminalia of *P. claripennis* resemble those of *P. latipennis,* differing in the absence of the basal lobes on the dististyles.

Individuals collected at Otter Creek, Wisconsin, were abundant on jewelweed on a shaded hillside of a steep ravine.

P. claripennis is a northeastern species, extending from Maine and Quebec to Wisconsin with an isolated record from western Florida (Fig. 180).

Fig. 180.—Distribution of **Panorpa claripennis** in North America.

Panorpa rufescens Rambur

Panorpa rufescens Rambur (1842:330). ♂, ♀. Type-locality: Amerique septentrionale.

Panorpa venosa Westwood (1846:190). Type-locality: Georgia. Lectotype ♀ designated by Byers (1962*b*). Synonymized by Byers (1962*b*).

Panorpa confusa Westwood (1846: 190). ♂, ♀. Type-locality: Massachusetts. Lectotype ♂ designated by Byers (1962*b*). Synonymized by Carpenter (1931*a*).

Head and thorax pale to dark yellow.

Fore wing length 11.4–12.4 mm. Membranes (Fig. 84) clear to pale yellow, crossveins not margined. Apical band dark brown, entire, with few clear spots. Pterostigmal band dark brown, entire, posterior fork broken. Basal band broken, forming two large spots. Marginal and first basal spot small. Second basal spot absent.

Legs pale to dark yellow.

Abdomen dark yellow. Male terminalia pale yellow. Ninth tergum, as in Fig. 117, large, broad basally, apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 122) slender, extending to or just below bases of dististyles. Basistyles broad. Dististyles falcate, with row of coarse setae along mesal margin. Ventral parameres (Fig. 123) slender, barbed, unbranched. Female genital plate (Fig. 155) broad, 0.98 mm in length. Distal plate oblong, broad basally, with apical emargination forming two broad lateral lobes. Basal plate absent. Spermathecal apodeme extending beyond base of distal plate but not reaching apical emargination.

The male terminalia of *P. rufescens* resemble those of *P. debilis*. However, the hypovalves of *P. rufescens* are narrower and much longer, and the shape of the ventral parameres is different.

Nothing has been reported on the habitat of this species.

Panorpa rufescens is an eastern species extending from Florida to Canada and west to Michigan, Illinois, and Alabama (Fig. 181).

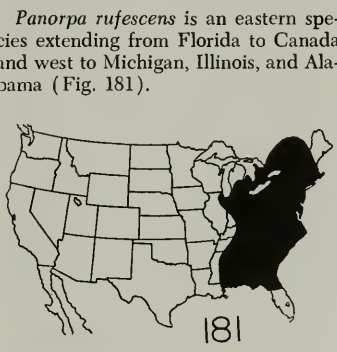


Fig. 181.—Distribution of **Panorpa rufescens** in North America.

Illinois Records. — COOK COUNTY: North Evanston, 20-VIII-1905, W. J. Gerhard, 1 ♀; Bowmanville, 3-VIII-1904, A. B. Wolcott, 1 ♂.

Panorpa dubitans Carpenter

Panorpa dubitans Carpenter (1931*a*: 243). ♂. Type-locality: Hessville, Indiana.

Head and thorax reddish brown.

Fore wing length 9.9–11.8 mm. Membranes (Fig. 85) pale yellow to amber, crossveins margined. Apical band dark brown, broad, with several basal white spots. Pterostigmal band dark brown, broad anteriorly, forked posteriorly, apical fork broken. Basal band broken, forming two dark brown spots. Marginal and first basal spots dark brown. Second basal spot absent. Some variation was noted in the color of the fore

wings and in the size and number of clear spots in the apical band. In 50 percent of the specimens examined, the second marginal spot was absent.

Legs reddish brown.

Abdomen dark yellowish brown to reddish brown. Male terminalia dark yellowish brown. Ninth tergum elongate, base broad, apex emarginate, forming two slender lateral lobes. Hypovalves (Fig. 124) elongate, moderately broad, ending well before bases of dististyles. Basistyles broad, with projection along mesal margin. Dististyles shorter than basistyles. Ventral parameres (Fig. 125) elongate, barbed, unbranched, extending to bases of dististyles. Female genital plate (Fig. 156) short, 0.85 mm in length. Distal plate oval, apex emarginate, forming two broad lateral lobes. Basal plate absent. Spermathecal apodeme elongate, extending well beyond base of distal plate although not reaching apical emargination.

Superficially the male terminalia of *P. dubitans* resemble those of *P. speciosa*, especially in the shapes of the ventral parameres and hypovalves. The males of *P. dubitans* are distinguished from those of *P. speciosa* in having narrower hypovalves, longer basistyles, and fewer and broader barbs, tending to occur in tufts, on the ventral parameres.

In northern Illinois *P. dubitans* was collected on stinging wood nettle along the bottomlands of Sugar Creek in the Macktown Forest Preserve, Winnebago County.

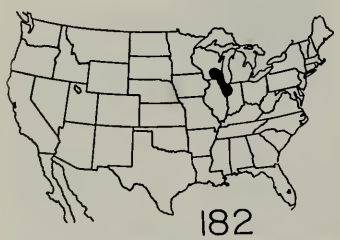


Fig. 182.—Distribution of **Panorpa dubitans** in North America.

P. dubitans is a north-central species, occurring in Illinois, Indiana, and Wisconsin (Fig. 182).

Illinois Records. — Collected abundantly from mid-May to early September in northern Illinois. COOK COUNTY: Thornton, 22-VI-1949, Ross and Stannard, 1 ♂; Thornton, Glenwood Forest Preserve, 3-VI-1970, L. J. Stannard, 1 ♂. LAKE COUNTY: Waukegan, 7-VII-1932, T. H. Frison, 1 ♂. WINNEBAGO COUNTY: Macktown Forest Preserve, J. C. Marlin, 16-VII-1969, 1 ♂, 17-VI-1970, 4 ♂, 3 ♀, 4-IX-1971, 1 ♂; D. W. Webb, 10-VII-1970, 2 ♂.

Panorpa speciosa Carpenter

Panorpa speciosa Carpenter (1931*a*: 243). ♂. Type-locality: Heyworth, Illinois.

Head and thorax pale yellow to dark brown.

Fore wing length 10.7–12.0 mm. Membranes (Fig. 87) clear to amber, crossveins faintly margined. Apical band dark brown, entire, with one or two posterior clear spots. Pterostigmal band dark brown, broad anteriorly, forked, apical fork broken. Basal band broken, forming two large dark brown spots. Marginal and first basal spots small. Second basal spot absent.

Considerable variation was noted in the pattern of the apical and pterostigmal bands. In certain specimens the pterostigmal band is continuous and has both posterior branches. The number of marginal spots varies from one to four. In a few specimens the basal band is weakly continuous.

Legs pale to dark yellow.

Abdomen pale yellow to dark yellowish brown. Male terminalia pale to dark yellow. Ninth tergum, as in Fig. 117, elongate, broad basally, apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 132) broad, expanded medially, apices rounded, ex-

tending three-fourths length of basistyles. Basistyles broad. Dististyles about two-thirds length of basistyles, each dististyle with small patch of elongate setae near base. Ventral parameres (Fig. 133) branched, elongate, barbed, each with apical branch extending slightly beyond base of dististyle. Female genital plate (Fig. 160) short, oval, 1.17 mm in length. Distal plate oval, broad basally, emarginate apically, forming two lateral lobes. Basal plate absent. Spermathecal apodeme elongate, widely bifurcate basally, not reaching apical emargination.

The male terminalia of *P. speciosa* are indistinguishable from those of *P. braueri* although these species can be separated by the characters of the basal band. In the holotype of *P. braueri*, the ventral parameres are very similar to those of *P. speciosa* in being branched, but the mesal branch in *P. braueri* is somewhat thicker and larger than that in *P. speciosa*. In females the genital plate of *P. speciosa* is much longer than it is in *P. braueri*.

This species has been collected abundantly in Illinois on stinging wood nettle, jewelweed, and poison ivy in humid shaded areas along slow-moving streams.

P. speciosa is a north-central species extending from Arkansas and Tennessee to Minnesota and Wisconsin (Fig. 183).

Illinois Records.—(Fig. 183). Collected frequently from late April until early November. The prolonged collection period indicates the possibility of two generations per year.

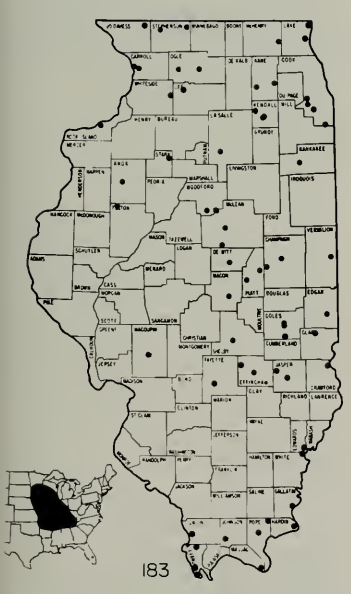


Fig. 183.—Distribution of **Panorpa speciosa** in Illinois and North America.

Panorpa braueri Carpenter

Panorpa braueri Carpenter (1931*a*: 242). ♂, ♀. Type-locality: Washington County, Arkansas.

Head and thorax dark yellowish brown.

Fore wing length 10.0–11.4 mm. Membranes (Fig. 86) pale yellow, crossveins margined. Apical band dark brown, entire, with several small clear spots. Pterostigmal band dark brown, broad from anterior margin to posterior, apical fork broken, small. Basal band dark brown, broad, continuous. Two marginal spots and first basal spot dark brown. Second basal spot absent.

Legs dark yellowish brown.

Abdomen dark reddish brown. Male terminalia dark yellowish brown. Ninth tergum, as in Fig. 117, elongate, base broad, apex emarginate, forming two broad lateral lobes. Hypovalves (Fig. 134) broad, expanded medially, apices rounded, extending three-fourths length of basistyles. Basistyles broad. Dististyles about two-thirds length of basistyles, each with small patch of elongate setae at base of inner basal cusp. Ventral parameres (Fig. 135) narrow, elongate, each with broad mesal branch and slender apical branch extending beyond base of dististyle. In ventral view the slender apical branch is often

hidden, giving the paramere the appearance of having a single, broad, bulbous apex. Female genital plate (Fig. 161) small, broad, 0.69 mm in length. Distal plate broad, deeply emarginate apically, forming two broad lateral lobes. Basal plate absent. Spermathecal apodeme short, not reaching apical emargination of distal plate.

P. braueri is very closely related to *P. speciosa*, and little difference exists in the characters of the male terminalia. These species may be separated by the broad, continuous basal band in the wing of *P. braueri*. In females of *P. braueri* the genital plate is much shorter than that of *P. speciosa*.

Byers (1954) reported collecting Missouri specimens of *P. braueri* on small patches of *Impatiens* in a shaded swale.

P. braueri seems restricted to northwestern Arkansas and southern Missouri (Fig. 184).

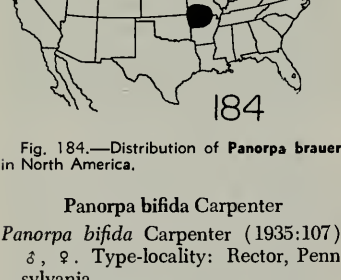


Fig. 184.—Distribution of **Panorpa braueri** in North America.

Panorpa bifida Carpenter

Panorpa bifida Carpenter (1935:107). ♂, ♀. Type-locality: Rector, Pennsylvania.

Head and thorax dark yellowish brown.

Fore wing length 12 mm. Membranes (Fig. 88) pale yellow, crossveins not margined. Apical band pale brown, entire, with one or two clear spots. Pterostigmal band pale brown, continuous, apical work broken. Basal band pale brown, broken into two large spots. Two marginal spots and large first basal spot present. Second basal spot absent.

Legs pale yellow.

Abdomen dark yellowish brown. Male terminalia dark yellowish brown. Ninth tergum elongate, deeply emarginate apically, forming two narrow lateral lobes. Hypovalves (Fig. 136) broad, extending almost to bases of dististyles. Basistyles broad. Dististyles each with small patch of elongate setae near base. Ventral parameres (Fig. 137) narrow, elongate, each with two thin, barbed, branches extending beyond base of dististyle, united basally to form Y-shaped projection. Female genital plate (Fig. 162) broad, 0.99 mm in length. Distal plate broad, deeply emarginate apically to form two broad lateral lobes. Basal plate absent. Spermathecal apodeme elongate, not reaching apical emargination of distal plate.

P. bifida is related to *P. anomala*, but it is easily distinguished from *P. anomala* by the narrow elongate branches of the ventral parameres.

Nothing has been reported on the habitat of this species.

P. bifida is known only from Pennsylvania and Ohio (Fig. 185).

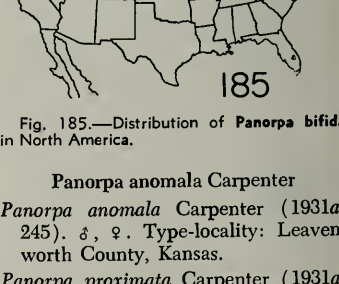


Fig. 185.—Distribution of **Panorpa bifida** in North America.

Panorpa anomala Carpenter

Panorpa anomala Carpenter (1931*a*: 245). ♂, ♀. Type-locality: Leavenworth County, Kansas.

Panorpa proximata Carpenter (1931*a*: 247). ♂. Type-locality: Washington

County, Arkansas. Synonymized by Byers (1974).

Head and thorax dark yellow to dark reddish brown.

Fore wing length 10.6–12.4 mm. Membranes (Fig. 89) pale yellow, crossveins faintly margined. Apical band dark brown to black, broad, usually entire. Pterostigmal band dark brown, broad anteriorly, broken posteriorly. Basal band broken, forming two dark brown spots. Two marginal spots and first basal spot small. Second basal spot absent. In most specimens the apical band of the fore wing is broad and entire although several specimens showed the apical band broken into several small dark brown spots and a narrow subapical band. In some specimens a second basal spot was present and the second marginal spot absent.

Legs dark yellow.

Abdomen dark yellow to dark reddish brown. Male terminalia dark reddish brown, oval. Ninth tergum, as in Fig. 117, emarginate apically, forming two broad lateral lobes. Hypovalves (Fig. 140) broad apically, ending well before bases of distisyles. Basistyles broad. Dististyles shorter than basistyles. Ventral parameres (Fig. 141) elongate, barbed, with one branch extending posteriorly beyond bases of dististyles and a mesal branch curved dorsally. Female genital plate (Fig. 163) oval, 1.15 mm in length. Distal plate short, deeply emarginate apically, forming two acute lateral lobes. Basal plate absent. Spermathecal apodeme elongate, bifurcate basally, not reaching apical emargination of distal plate.

The shape of the male terminalia of *P. anomala* resemble somewhat those of *P. elaborata* but differ markedly in the short hypovalves and heavily barbed ventral parameres.

In Illinois *P. anomala* was initially collected along the bottomlands of the Illinois River at Morris in a dense growth of stinging wood nettle. Individuals in southern Illinois were collected on jewelweed in shaded areas along small creeks.

P. anomala is a western species, occurring from southeastern Tennessee and northwestern Georgia west to Wisconsin, Kansas, and Arkansas (Fig. 186).

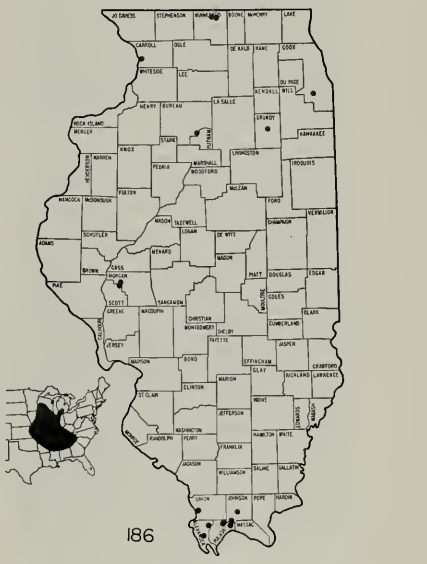


Fig. 186.—Distribution of **Panorpa anomala** in Illinois and North America.

Illinois Records.—(Fig. 186). Collected from late May until mid-August in northern, western, and southern Illinois. Carpenter (1931*a*) erroneously recorded *P. anomala* in Illinois from Starved Rock State Park on the basis of an imperfect female. This specimen has since been identified as a female of *P. speciosa.*

Panorpa consuetudinis Snodgrass

Panorpa consuetudinis Snodgrass (1927:77). ♂. Type-locality: Takoma Park, Maryland. Neotype ♂ designated by Byers (1974).

Panorpa elaborata Carpenter (1931*a*: 239). ♂, ♀. Type-locality: Falls Church, Virginia. Synonymized by Byers (1974).

Head and thorax dark yellowish brown.

Fore wing length 10.0–11.0 mm. Membranes (Fig. 90) amber, crossveins margined. Apical band dark brown, broad, with several subapical clear spots. Pterostigmal band dark brown, broad anteriorly, forked posteriorly. Basal band continuous or broken. Marginal and first basal spots small. Second basal spot lacking.

Legs dark yellow.

Abdomen dark yellow. Male terminalia dark yellow. Ninth tergum elongate; base broad, tergum constricted beyond middle, apex deeply emarginate, forming two narrow lateral lobes. Hypovalves (Fig. 138) narrow, elongate, extending to bases of dististyles. Basistyles broad. Dististyles shorter than basistyles. Ventral parameres (Fig. 139) extend beyond bases of dististyles, each paramere with two branches, mesal branch barbed, apical branch with two tufts of barbs. Female genital plate (Fig. 164) short, 0.85 mm in length. Distal plate concave apically, not deeply emarginate, sides parallel. Basal plate absent. Large, subrectangular, sclerotized membrane covers most of distal plate. Spermathecal apodeme elongate, bifurcate basally, not reaching apical emargination of distal plate.

The male terminalia of *P. consuetudinis* are similar to those of *P. dubitans* although differing in the longer hypovalves and the branched ventral parameres.

Little is known of the specific habitat of *P. consuetudinis*. In Kentucky individuals were collected with specimens of *P. insolens* in densely shaded vegetation along a slow-moving stream.

P. consuetudinis is an eastern species, extending from South Carolina to New York and west to Indiana and Mississippi (Fig. 187).

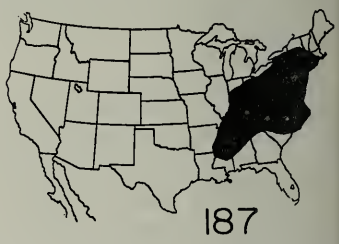


Fig. 187.—Distribution of **Panorpa consuetudinis** in North America.

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INDEX

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BULLETIN

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Volume 31, Article 5.—Larvae of the Sericothripini (Thysanoptera: Thripidae), with Reference to Other Larvae of the Terebrantia, of Illinois. By Thomas C. Vance. August, 1974. 64 p., index.

Volume 31, Article 6.—Root Infection of Woody Hosts with *Verticillium albo-atrum*. By Gerald L. Born. 41 p., index.

BIOLOGICAL NOTES

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