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Survey of the Microcoryphia (Insecta) of the Northeastern United States and Adjacent Provinces of Canada

PEDRO WYGODZINSKY¹ AND KATHLEEN SCHMIDT²

ABSTRACT

A survey of the Microcoryphia of New York, New Jersey, and Pennsylvania as well as the New England states and the Canadian provinces of New Brunswick, Nova Scotia, and Newfoundland showed four species present. *Petrobius brevistylis* and *Trigoniophthalmus alternatus* were probably introduced from Europe on ballast; *Pedetontus saltator*, new species, and *Machiloides petauristes*, new species, are native. *Petrobius canadensis* Paclt, 1969, is synonymized with *Petrobius brevistylis* Carpenter, 1913. The presence of *Petrobius maritimus* (Leach) in North America

is not confirmed. *Machilis variabilis* Say, described from "North America," is not identifiable.

Males were not found among the hundreds of specimens of North American *Trigoniophthalmus alternatus* examined, making a parthenogenetic mode of reproduction highly likely. Males were rare in *Petrobius brevistylis* (approximately 3 percent of all specimens examined), and were not discovered among the limited material of the new species of *Pedetontus* and *Machiloides*.

INTRODUCTION

Machilids are abundant in genera and species in the southeastern and western United States and in western Canada, but appear to be rarely collected in the eastern United States and eastern Canada. The literature on North American machilids is scattered. There is no comprehensive work and correct identification of these insects is therefore laborious, if feasible at all.

We have amalgamated the data contained in the literature with our own information on the systematics, distribution, and ecology of the machilids in the region studied in the hope of making knowledge of machilids of the northeastern United States and of adjacent areas of Canada more accessible.

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ACKNOWLEDGMENTS

First, we express our gratitude to Dr. Paul E. Schaefer, of Durham, New Hampshire. Dr. Schaefer provided the initial stimulus for writing the present paper and allowed us to use his notes. He also made it possible for us to incorporate his specimens into the collections of the American Museum of Natural History (AMNH).

Dr. Charles J. Cole, American Museum of Natural History, gave of his time to acquaint us with recent work on parthenogenesis. Dr. R. Hoebecke, Department of Entomology, Cornell University (CU), permitted us to study specimens under his care and provided information on the biology of a machilid species. Mr. Sidney Horenstein, American Museum of Natural History, advised us on geological and geographical matters. Dr. J. E. H. Martin, of the Biosystematics Research Institute, Agriculture Canada (CNC) sent us valuable material. Mr. A. Singer, Photography Studio, of the American Museum of Natural History, assisted us with photographic work. Mr. Louis Sorkin, also of the American Museum of Natural History, collected and contributed specimens. Dr. H. Strümpel, of the Hamburg Zoological Museum, lent us types that were crucial to our studies. Dr. H. Sturm, of the Hochschule Hildesheim, generously gave us specimens. Dr. Barry Wright, Nova Scotia Museum, Halifax (HZM), made it possible for us to examine the machilids of that museum. Ms. Candy Feller, National Museum of Natural History (Smithsonian Institution), gave us a valuable specimen. Part of the fieldwork that led to this paper was carried out by the authors, ably assisted by Dr. R. Schmidt (Fordham University) and Dr. R. T. Schuh (American Museum of Natural History). We thank all of the above.

GEOGRAPHICAL DISTRIBUTION

The region studied is known with certainty to harbor four species of Microcoryphia: *Trigoniophthalmus alternatus*, *Petrobius brevistylis*, *Pedetontus saltator*, and *Machiloides petauristes*. The first two species are com-

mon in Europe where other species of the respective genera also occur, but no endemic species of these genera have been found in North America. The last two species belong to genera which are represented in eastern North America by various endemic species in addition to those described here.

The question arises as to the origin of the disjunct distribution of the European and American populations of *Petrobius brevistylis* and *Trigoniophthalmus alternatus*, viz., either vicariance as a consequence of geological events of the past, or dispersal through the agency of man. We cannot imagine that these wingless, rather large insects, both species of which live almost exclusively on rocks, floated or were transported by air currents across the gap of the northern Atlantic to arrive alive on the American shores. It seems even less conceivable that the eggs, which are glued to rocks when they are laid, would be able to make such a journey without the intervention of man.

The vicariance hypothesis cannot be proved or disproved but it should be kept in mind that the minimum for the opening of the northern Atlantic is considered to be 49 million years (Malcolm McKenna, personal commun.) and we cannot imagine that either *Petrobius brevistylis* or *Trigoniophthalmus alternatus* could have remained unchanged morphologically for such a long period, on both sides of the Atlantic. There is no reason for considering a Beringian bridge because the two species, or even their genera, are not known from either Siberia or northwestern North America.

Dispersal through the agency of man seems plausible. Lindroth (1957) exposed the important role ballast played for the westward transport of insects across the Atlantic in historic times. *Petrobius* and *Trigoniophthalmus* have several of the properties that make an insect especially fit to be thus transported (adapted from Lindroth, *loc. cit.*). These machilids are terricolous, have no pronounced moisture requirements, will settle disturbed areas or open waste places, are flightless, and have parthenogenetic reproduction, namely, all *Trigoniophthalmus*

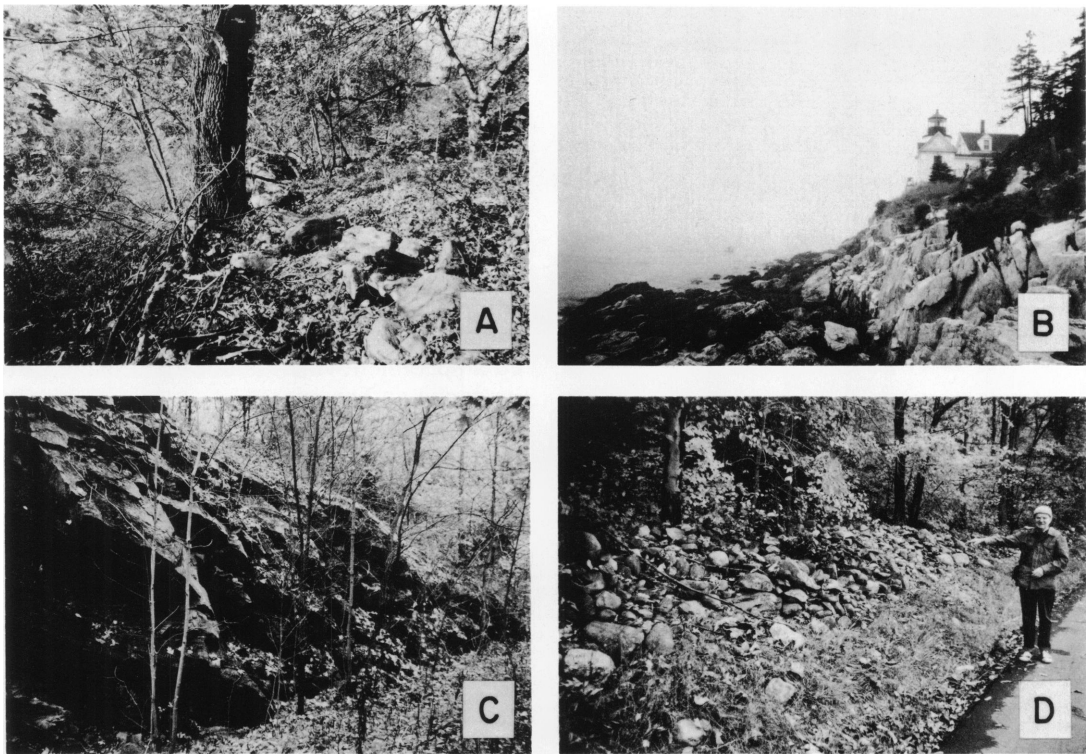


FIG. 1. Some habitats of *Microcoryphia* in the northeastern United States. A. Remains of stone wall in disturbed area where *Trigoniophthalmus alternatus* occurs (Westchester Co., New York). B. Rocky coast where *Petrobius brevistylis* is found (Hancock Co., Maine). C, D. Limestone cliff and rock wall each inhabited by *Pedetontus saltator* and *Machiloides petauristes* (Balesville, Sussex Co., New Jersey, type locality for both species).

alternatus and most *Petrobius brevistylis*. Both *Petrobius* and *Trigoniophthalmus* lay their eggs on rocks, a substance frequently used for ballast. Lindroth (*loc. cit.*) actually collected a specimen of *Petrobius* at a ballast-place in southern Devon (England) at Dartmouth. Also, Stach (1939) reported *Trigoniophthalmus alternatus* from a locality near Hamburg, Germany, the specimens having been collected on bricks at the foot of a river wall just above a steamboat landing. Stach (*loc. cit.*) implied that such a situation indicates that boat traffic might play a role in machilid dispersal. Janetschek (1951) was the first to attribute the presence of *T. alternatus* on Long Island, New York, to introduction by man.

SYSTEMATICS

MACHILIS LATREILLE, 1806

Machilis is a genus restricted to Europe and is only listed here because the name has been occasionally used incorrectly for American machilids.

Machilis variabilis Say, 1821

Say (1821) described *M. variabilis* from "probably every temperate part of North America." No more detailed type locality is given, and the description does not provide any features usable in modern machilid taxonomy. Types are not extant.

Gervais (1844) indicated this species as from North America, without any detail.

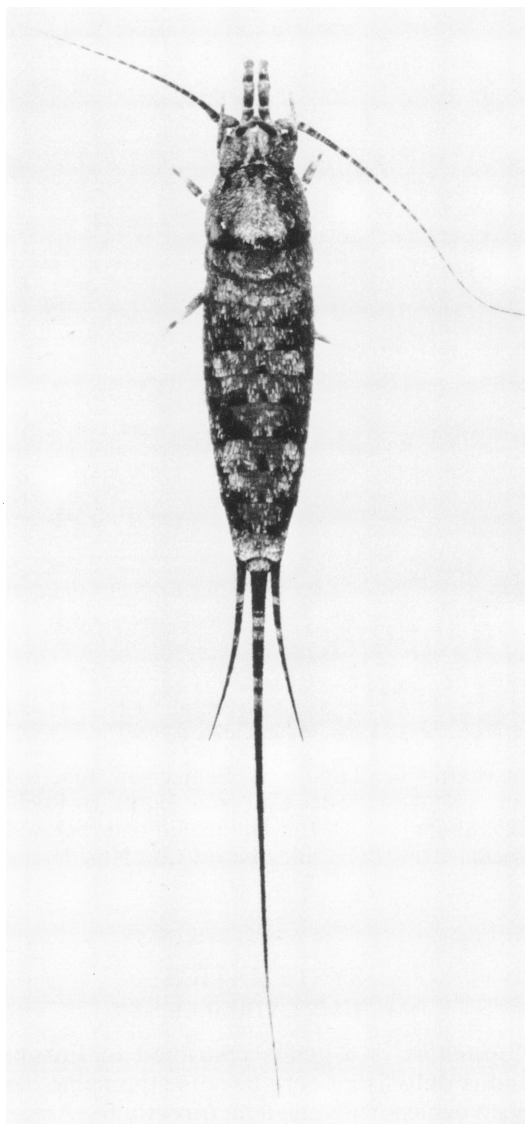


FIG. 2. *Trigoniophthalmus alternatus*, female, Rockfall, Connecticut.

Packard (1873) reported this species from the northeast for the first time, as "Mass., under stones."

Seaton (1903) recorded *Machilis variabilis* from Ithaca, New York, and gave some notes on its biology.

Silvestri (1911) saw only juvenile speci-

mens, but stated the species to be "widely distributed over the eastern portion of the United States."

Folsom (1928) reported the species from the southern end of Canandaigua Lake in New York and to be generally distributed in other states, namely, Massachusetts (no locality given), Indiana, Tennessee, and North Carolina.

Robert (1964) reported *Machilis variabilis* from localities in Quebec (Rigaud, Cté. Vaudreuil, and Laval-des-Rapides). He illustrated a specimen which is not identifiable as to its genus and species.

We conclude that *Machilis variabilis* is unidentifiable, and we strongly suggest that the name not be used any more for American machilids.

KEY TO THE GENERA OF MICROCORYPHIA OF THE NORTHEASTERN UNITED STATES

1. Ocelli subtriangular, located submedially (fig. 3A); ovipositor completely covered by coxites of ninth segment *Trigoniophthalmus* Verhoeff
- Ocelli shoesole-shaped, transverse, situated before anterior border of eyes (fig. 5A, 7A, 9A); ovipositor of mature females extending to or beyond level of apex of stylets of ninth segment (figs. 8Q, 9R) 2
2. Scapus and pedicellus without scales; urosternites with median sclerite reduced (fig. 9N) and each with not more than one pair of exsertile vesicles (fig. 9N); males without parameres *Machiloides* Silvestri
- Scapus and pedicellus with scales; median sclerite of urosternite well developed (figs. 6H, 8H), urosternites II-V each with two pairs of exsertile vesicles (fig. 8H); males with one pair of parameres (fig. 6B, C) .. 3
3. Mandibles with four apical teeth (fig. 8D, E); parameres of males segmented *Pedetontus* Silvestri
- Mandibles without distinct apical teeth (fig. 6E, F); parameres of males entire (fig. 6B, C) *Petrobius* Leach

TRIGONIOPHTHALMUS VERHOEFF, 1910

This genus has its greatest diversity in the Balkans, where nine species are found. A tenth species, *alternatus*, has a wide range.

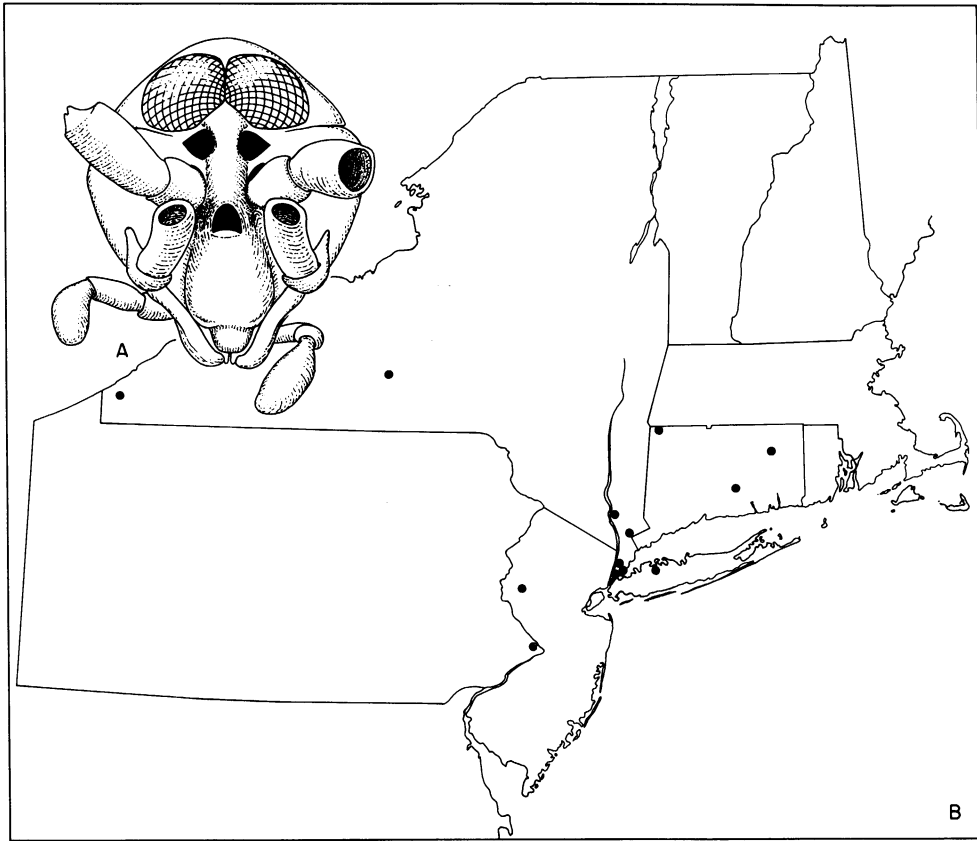


FIG. 3. *Trioniophthalmus alternatus*. A. Head, frontal view. B. Distribution map.

It has been reported from throughout Europe except Scandinavia, and is also found in the northeastern United States.

Trioniophthalmus alternatus
(Silvestri, 1904)
Figures 2, 3, 4

This species was originally described from Italy (Silvestri, 1904) but was later found to be widespread in Europe. The first and, until now, the only American record was that by Silvestri (1911) who listed it from Cold Spring, Long Island, New York. We now know that *T. alternatus* ranges widely over the area under consideration (fig. 3B).

MATERIAL EXAMINED: *Connecticut:* Fairfield County: Greenwich, The Nature Conservancy, Still Pond Preserve, July 4,

1979 (L. N. Sorkin, M. Klemens; AMNH), several females; Litchfield County: Canaan, limestone quarry, October 2, 1977 (L. N. Sorkin; AMNH), six females; Middlesex County: Rockfall, May 22, 1963 (P. Wygodzinsky, AMNH), three females, one juvenile; same data, June 17, 1963 (J. M. Burns, AMNH), five females, one juvenile. Tolland County: Bassett's Bridge Road, Sept. 16, 1979 (B. Massie, K. Schmidt; AMNH), one female.

New Jersey: Hunterdon County: Clinton, May 15, 1963 (P. Wygodzinsky, J. Wood); three females, three juveniles; same data but May 13, 1977 (P. Wygodzinsky, R. T. Schuh; AMNH), 35 second and third instar juveniles.

New York: Bronx: Pelham Bay Park, Rod-

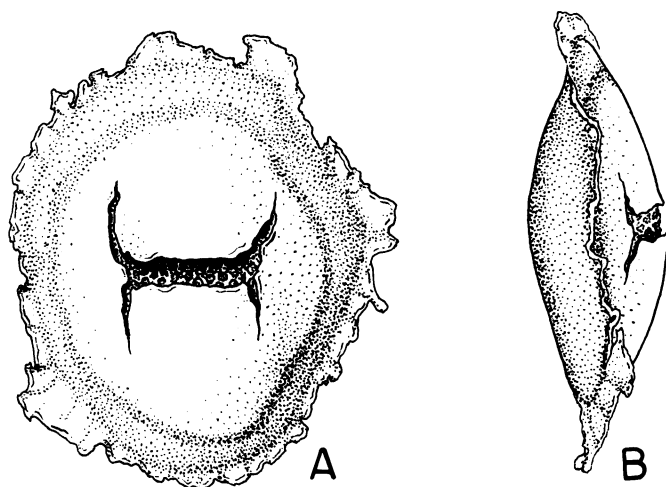


FIG. 4. *Trigoniophthalmus alternatus*, egg. A. Top view. B. Side view.

man's Neck region, May 1961 (A. Klots, AMNH), one female; Van Cortland Park, October 13, 1963 (A. Gromulat; AMNH), one female. Chautauqua County: Chautauqua, October 1956 (AMNH), three females. Rockland County: Iona Island (in Hudson River south of Bear Mountain Bridge), May 15, 1965 (J. and W. Ivie; AMNH), two juveniles. Tompkins County: Ithaca, July 19, 1977 (E. R. Hoebeke; CU), approximately 100 females. Westchester County: Armonk, Calder Ecology Study Center, April 23 and 24, 1979 (K. Schmidt, AMNH), three second and third instar juveniles; same data, May 15, 1979 (K. Schmidt, AMNH), three juveniles; same data, Sept. 27, 1979 (K. Schmidt; AMNH), nine females; Crompond, 4 miles east of Peekskill, Sept. 1975 (B. Cutler; AMNH), one female; Sawmill River Road, at Rider Road, north of Nepera Park Station, July 19, 1979 (K. Schmidt; AMNH), 10 females. Yonkers, Nepera Park, Oct. 13, 1934 (A. Klots; AMNH), two females; July 19, 1979 (K. Schmidt; AMNH), 12 females.

Pennsylvania: Bucks County: Neshaminy Creek, east of Jamison, June 1955, October 27, 1963, May 16, 1964, May 2, 1965, July 18, 1966, July 1966, June 29, 1969 (J. and W. Ivie; AMNH), 29 females; Neshaminy Creek, northeast of Jamison, Horseshoe Bend, Oc-

tober 1954, July 1955, June 1956, July 28, 1963 (W. Ivie; AMNH), four females, 116 juveniles.

Extralimital: *Maryland*: Plummer's Island, Nov. 1979 (AMNH), one female.

BIOLOGY: *Trigoniophthalmus alternatus* occurs in disturbed areas (fig. 1A) and usually close to the ground. Specimens were collected in rock walls, under low rocks, around foundations, on old cement walls where green algae grow, and in limestone quarries. Hidden and presumably inactive during the day, *T. alternatus* emerges at dusk. Hoebeke (*in litt.*) observed "hundreds of specimens" appearing and milling around at twilight on top of a stone wall adjacent to a building on the campus of Cornell University. Specimens "were not observed prior to sunset or later in the evening; they appeared to be abundant only over a relatively short span on either side of twilight."

The eggs of *Trigoniophthalmus alternatus* (fig. 4A, B) are lenticular and closely adhere to the rocks on which they are laid. They are deposited on the undersurfaces of the rocks in areas where they are not in contact with the soil. Although light orange initially, the eggs turn black within three days. Frequently, the chorion is torn (fig. 4) and the black blastoderm cuticle becomes visible. The mi-

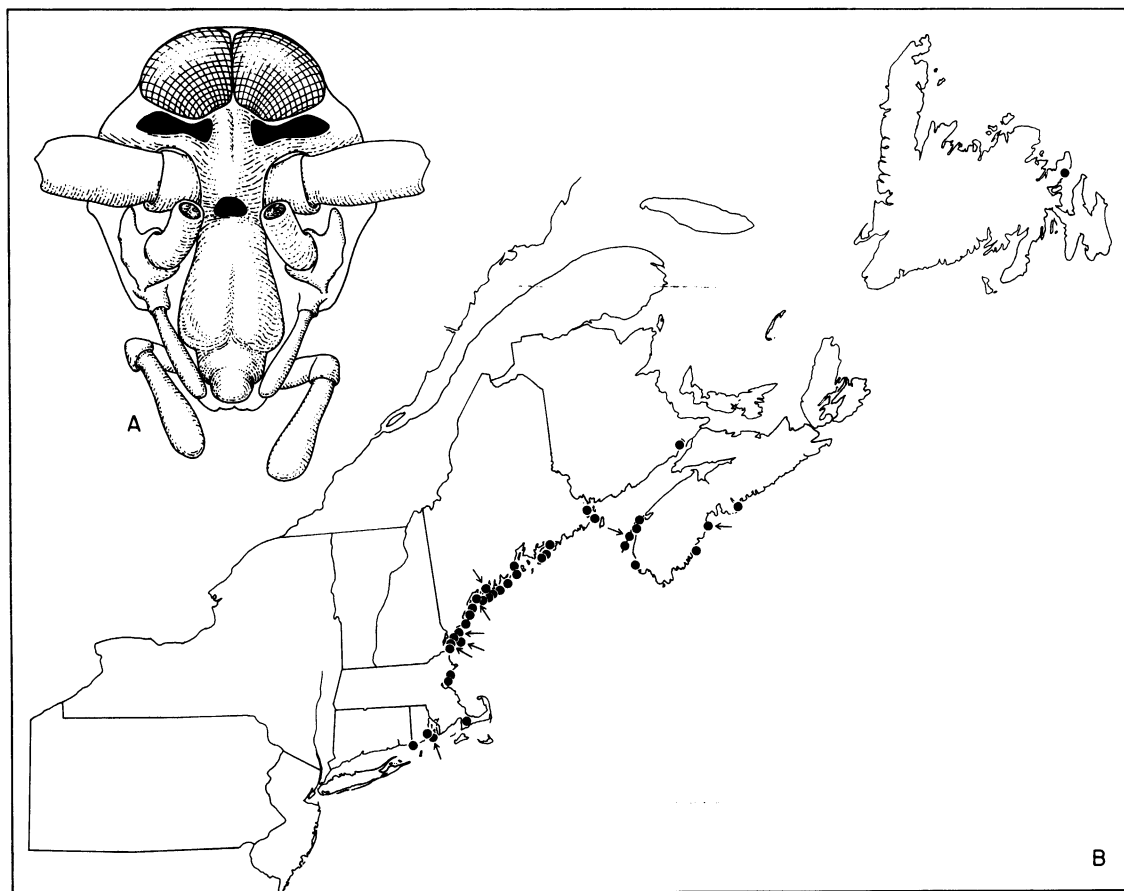


FIG. 5. A. Head of female of *Petrobius brevistylis*, frontal view. B. Distribution map of *Petrobius* in the United States (data from material examined, from the literature and from correspondence).

crostructure of the blastoderm cuticle has been beautifully illustrated by Larink (1979).

Stach (1939) and Wygodzinsky (1941) called attention to the scarcity of males of this species north of the European Alps, and hypothesized the presence of parthenogenesis in that area. Wygodzinsky (*loc. cit.*) demonstrated the existence of parthenogenesis experimentally in one female from northern Switzerland. No males were found among the hundreds of American specimens that we examined. This suggests that the American populations of *Trigoniophthalmus alternatus* also are parthenogenetic.

PETROBIUS LEACH, 1809

This genus has four species occurring along the seacoasts of northern, central, and western Europe, the Adriatic and Black seas, and Iceland. *Petrobius* was first reported from the New World by Swan (1956) and later by Bousfield (1958, 1962). The latter author had his specimens identified as *Petrobius maritimus* and reported the species to occur from Nova Scotia along the New England coast as far south as Cape Neddick in Maine. Paclt (1969) described a species, here synonymized, from Newfoundland. We can now extend the known range of the ge-

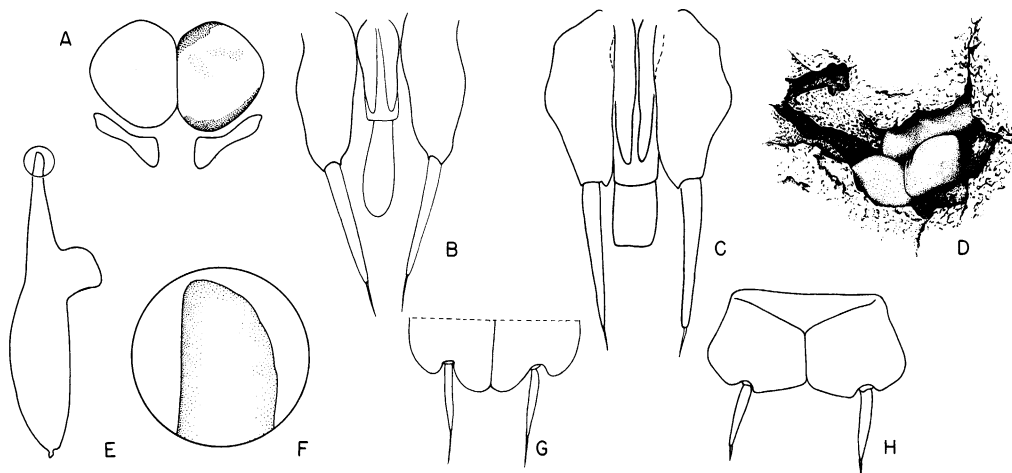


FIG. 6. A, B. *Petrobius brevistylis*. A. Eyes, frontal view. B. Male (Holland), genital area. C. *Petrobius maritimus* (Holland), genital region. D–G. *Petrobius brevistylis*, Rhode Island. D. Eggs. E. Mandible, schematic. F. Apex of mandible, high magnification. G. Posterior portion of coxites of eighth abdominal segment of male. H. *Petrobius maritimus*, male (Holland), eighth urosternite.

nus south to Rhode Island. The presence of *P. maritimus* in the New World is not confirmed (see under heading of *Petrobius maritimus*) but for completeness we include the species in the present paper.

The following key points out the characters that help to distinguish *Petrobius brevistylis* from *P. maritimus*. Without practice, it may be difficult at best to identify females to species. The only diagnostic character, annulated versus concolorous antennae, cannot be used for weakly pigmented or poorly preserved specimens. In Europe, *P. maritimus* and *P. brevistylis* do not occur in the same ecological niche; thus, it may be permissible to identify females based on their close association with the easily identifiable males. A careful analysis of the scale pattern, yet to be done, may reveal further differences.

KEY TO THE SPECIES OF *PETROBIUS* REPORTED FROM NORTH AMERICA

1. Flagellum of antennae uniformly dark, at most intermediate jointlets slightly lighter brown; coxites of eighth abdominal segment of male each with a distinct lobe posteromedially (fig. 6G); distal portion of penis elongate

pear-shaped, narrowest at base (fig. 6B) ...

2. Flagellum of antennae with dark chains, sharply contrasting with white intermediate jointlets; coxites of eighth abdominal segment truncate posteromedially (fig. 6H); apical portion of penis short, subrectangular, subequal in width throughout (fig. 6C) ...

Petrobius brevistylis Carpenter, 1913

Figures 5, 6A, B, D–G

Petrobius canadensis Paclt, 1969 (new synonymy).

Petrobius brevistylis is here recorded for the first time in the New World under its correct name. Thanks to Dr. H. Strümpel, of the Hamburg Zoological Museum, we have seen the types of *canadensis*, which are three immature females (7–8 mm. long). All three have weakly segmented unusually short whitish ovipositors, which, together with the reduced size of the specimens, clearly indicate they are immatures. The antennae, preserved in one specimen, are pigmented as typical for *brevistylis*. We could find no differences between the specimens labeled as *canadensis* by Paclt, and speci-

mens of *brevistylis* of comparable size. We therefore synonymize *canadensis* with *P. brevistylis*.

MATERIAL EXAMINED: CANADA: *New Brunswick*: Albert County: Hopewell at Hallowell Rocks, Sept. 5, 1969 (P. E. Schaefer; AMNH), seven females, one juvenile.

Nova Scotia: Digby County, Long Isle, Sept. 2, 1963 (P. M. Taschereau; NSM), one male, 14 females; Halifax County: Herring Cove (below Halifax), Sept. 4, 1969 (P. E. Schaefer, AMNH), five males, 198 females, one juvenile.

UNITED STATES: *Maine*: Cumberland County: Bailey Island, Sept. 15, 1967 (P. E. Schaefer; AMNH), 21 females, one male; Bailey Island, Land's End, Sept. 9, 1967 (P. E. Schaefer; AMNH), eight females; Cape Elizabeth Light, Sept. 4, 1968 (P. E. Schaefer; AMNH), three females; Hancock County: Bass Harbor Head Lighthouse, July 31, 1979 (R. and K. Schmidt; AMNH), 16 females, 10 juveniles; Sorrento, June 9, 1969 (P. E. Schaefer; AMNH), 39 females; Mount Desert Island, Acadia National Park, Bass Harbor Head Lighthouse, July 31, 1979 (R. and K. Schmidt; AMNH), four females, 21 juveniles; Mount Desert Island, Ingraham Point east of Seal Harbor, July 31, 1979 (K. and R. Schmidt; AMNH), four females, 11 juveniles; Mount Desert Island, Seal Harbor, Ingraham Point, July 31, 1979 (R. and K. Schmidt; AMNH), six females and nine juveniles; Mount Desert Island, near Anemone Cove, June 9, 1969 (P. E. Schaefer; AMNH), 53 females. Knox County: Owls Head Light near Rockland, Sept. 13, 1967 (P. E. Schaefer; AMNH), six females; Port Clyde, Sept. 23, 1967 (P. E. Schaefer; AMNH), 23 females; Rockport, Sept. 13, 1967 (P. E. Schaefer; AMNH), seven females. Lincoln County: Newagen, Sept. 14, 1967 (P. E. Schaefer; AMNH), five females; Newagen (town landing), Nov. 14, 1969 (P. E. Schaefer; AMNH), five females; Westport, July 18, 1964 (P. E. Schaefer; AMNH), seven females, four males, 13 juveniles; Pemaquid Point Light, Sept. 13, 1967 (P. E. Schaefer; AMNH), three females. Sagadahoc County: Baypoint, Sept. 14, 1967 (P. E. Schaefer; AMNH), 39 females; Westpoint, Sept. 15,

1967 (P. E. Schaefer; AMNH), four females. Washington County: Eastport, Aug. 23, 1967 (P. E. Schaefer; AMNH), two females, 11 juveniles; Quoddy Head Light, Aug. 23, 1967 (P. E. Schaefer; AMNH), five females, nine juveniles. York County: Cape Neddick light-house, "The Nubble," May 16, 1964, Oct. 8, 1963, June 12, 1964, Sept. 28, 1964, Oct. 16, 1964, June 10, 1965, Sept. 21, 1967, May 21, 1973 (P. E. Schaefer; AMNH), 37 females; same data (P. E. Schaefer; CNC), two females, one male. York Harbor (Marshall House side), one female; York Harbor, Kennebunkport, Blowing Rock, Aug. 28, 1967 (P. E. Schaefer; AMNH), 46 females; Kittery, Appledore Island (Isles of Shoals), Sept. 29, 1968 (P. E. Schaefer; AMNH), two females.

Massachusetts: Barnstable County: Cape Cod, Ashumet Pond, Sept. 1, 1965 (P. E. Schaefer; AMNH), one female. Essex County: Marblehead Neck, Castle Rock, Oct. 11, 1967, Oct. 11, 1969 (P. E. Schaefer; AMNH), four females; Nahant, East Point, Oct. 11, 1967 (P. E. Schaefer; AMNH), 12 females.

New Hampshire: Rockingham County: Rye, Isles of Shoals, Star Island, Aug. 22, 1968 (P. E. Schaefer; AMNH), 76 females; Fort Stark, Newcastle, Sept. 25, 1967, Sept. 25, 1969 (P. E. Schaefer; AMNH), nine females; Wallis Sands, Sept. 27, 1967, Sept. 9, 1968, Sept. 10 (year unknown) (P. E. Schaefer; AMNH), 36 females, three males.

Rhode Island: Newport County: Jamestown Island, at Fort Weatherall State Park, Sept. 22, 1979 (P. Wygodzinsky and R. and K. Schmidt; AMNH), one female; Jamestown Island at Beavertail Light, Sept. 22, 1979 (P. Wygodzinsky, R. and K. Schmidt; AMNH), 15 females, one male. Washington County: Narragansett, at Newton Avenue and at sea wall, Sept. 22, 1979 (P. Wygodzinsky, R. and K. Schmidt; AMNH), 30 females. Watch Hill, at Coast Guard Lighthouse, Sept. 23, 1979 (P. Wygodzinsky, R. and K. Schmidt; AMNH), six females.

BIOLOGY: As with all other species of the genus, *brevistylis* inhabits cliffs along rocky coasts (fig. 1B). We have found specimens of *P. brevistylis* on both granite and decaying shale. They were most numerous at approx-

imately 5 to 20 feet above the high tide line. During the daytime, *P. brevistylis* was found resting in horizontal and oblique cracks in the rocks, and occasionally under rocks on the ground. The eggs were described in detail by Delany (1959), who provided much other valuable information on the biology of *Petrobius*. The insects lay their eggs in single-layered groups in small crevices on the protected undersurfaces of rocks. Although ovoid upon extrusion from the ovipositor, the final shape of the eggs may be quite irregular (fig. 6D); they apparently take on the shape of the space available to them. The eggs are light orange initially, but turn dark brown within one week after being laid. Larink (1972) has shown that the chorion frequently tears so that the blastoderm cuticle becomes visible, as in *Trigoniophthalmus* (fig. 4A, B).

We have taken data on sex ratios for 76 samples of North American *Petrobius brevistylis*, with a total of 838 specimens; 63 specimens were juveniles of undetermined gender. Males were found in 10 of the 76 samples, in addition to females and/or juveniles. The actual number of males encountered was 24, thus constituting 3.1 percent of the total of sexed specimens. The arrows on our map (fig. 5B) show the places where males were collected, in addition to females. This sex ratio, so highly slanted in favor of the females, suggests at least occasional reproduction through parthenogenesis. Unequal sex ratios are also known from European populations of *Petrobius*. Davies and Richardson (1970) found for *P. brevistylis* in Britain an overall sex ratio of 1.7 females per male. However, these authors reported a great excess of females in one Northumberland locality, where 119 females but only three males were taken. At the same locality, 46 females of *P. maritimus* were collected, but no males turned up. In other sites of Northumberland "many" males were found in addition to the females. Finally, Agrell (1944) described *Petrobius lohmanderi* from Sweden—possibly a synonym of *P. maritimus*—which has no males. The author suggested that *lohmanderi* might reproduce parthenogenetically. Thus, the highly slanted

sex ratio of American *Petrobius brevistylis* does not stand alone. The phenomenon is also known in other machilid genera (see under the heading of *Trigoniophthalmus alternatus*).

Rearing experiments and cytogenetic studies are needed for more information on the reproductive mechanisms in North American *Petrobius brevistylis*.

Petrobius maritimus Leach, 1909

Figure 6C, H

Petrobius maritimus was reported from the New World by Bousfield (1958, 1962) from several localities in Nova Scotia. Schaefer (1965) reported a species "similar to the 'Rockhopper' *Petrobius maritimus*" from the coast of Maine. We have not seen this species either from Nova Scotia or Maine or from any other locality on the shores of the Atlantic Ocean where we did collect *Petrobius brevistylis*. We suspect that the determinations cited by Bousfield were erroneous, and that the respective specimens were really *P. brevistylis*. Since we have not seen these specimens and thus cannot verify our hypothesis, we list the localities of *maritimus* as taken from the literature as follows:

CANADA: Nova Scotia: Digby County: Pond Cave, Brier Island, July 10, 1958; Haight Brook near mouth, July 11, 1958; Deep Cave, July 11, 1958. Lunenburg County, Spindler's Cave, July 10, 1956. Queens County; Western Head, southeast of Liverpool, July 18, 1956. Yarmouth County: Cape Fourchu, July 5, 1956.

PEDETONTUS SILVESTRI, 1911

Pedetontus is represented in our area by one species, described below. The genus has been reported in the literature only from the western United States, from Japan, and from Formosa. Material before us shows the genus also to occur widely in the eastern United States and adjacent areas of Canada, extending south to the southernmost Appalachians; we have also seen material from the Mexican state of Hidalgo.

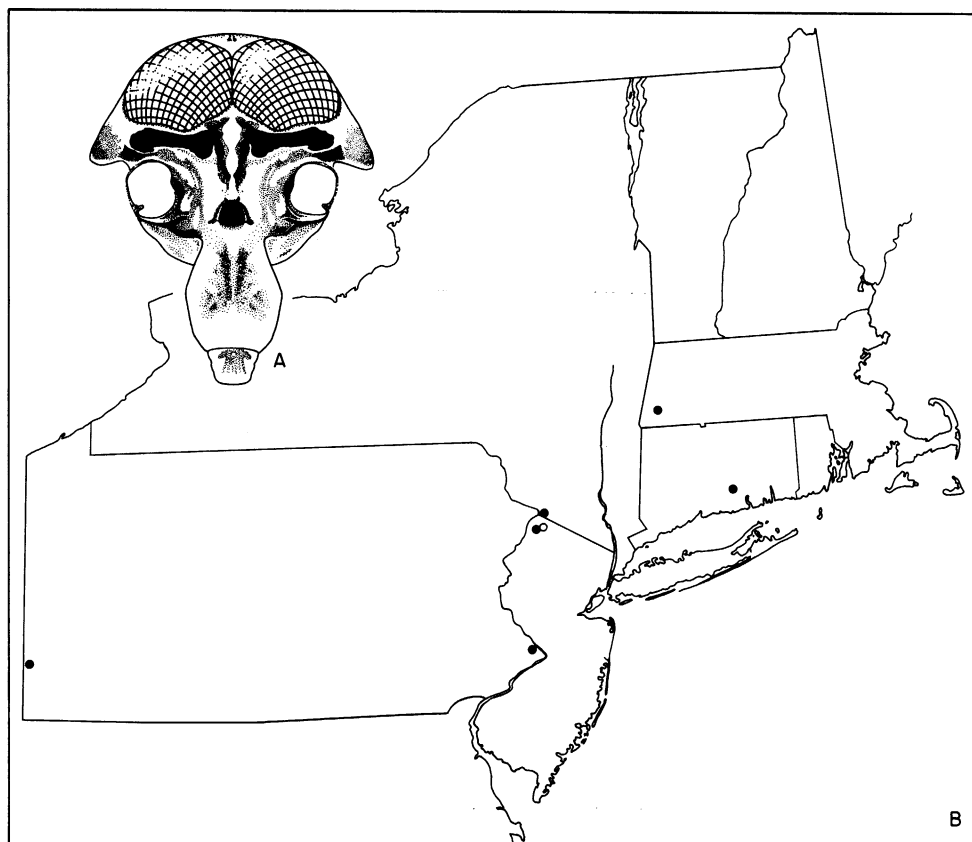


FIG. 7. *Pedetontus saltator*, female. A. Head, front view. B. Map of the distribution of *Pedetontus* (closed circles) and *Machiloides* (open circle) in the northeastern United States.

***Pedetontus saltator*, new species**

Figures 7, 8

DIAGNOSIS: The female of *P. saltator* is closest morphologically to the female of the western North American *P. superior*, from which it differs by its shorter ovipositor.

DESCRIPTION: Female. Length of mature specimens 11–12 mm., maximum length of antennae 12 mm., of terminal filament 14 mm., of cerci 12 mm. Color of body pale reddish yellow; hypodermal pigment of variable intensity and extension on head, mouthparts, base of antennae, and on legs. Scale pattern dark reddish brown, with small black and grayish pattern elements.

Head with pigment pattern as shown in figure 7, characterized by presence of 1+1

elongate, narrow vertical dark spots between ocelli. Eyes (fig. 8B) as long as wide, their line of contact equal of half their length. Ocelli (fig. 7A) dark, slightly shorter than anterior border of eyes, narrowly sole-shaped. Antennae when complete up to 2 mm. longer than body. Scapus pigmented as shown in figure 8F. Flagellum from pale brown to white, concolorous; intermediate jointlets of same color as chains. Chains of distal portion of antennae with an average of 15 jointlets. Maxillary palpi pigmented almost throughout; seventh article unpigmented, two-thirds as long as penultimate (fig. 8C, G). Scales present on all articles of maxillary palp. Labial palp and its pigment shown in figure 8A; terminal article extensively, penultimate

sparsely pigmented; terminal article narrowly subcylindrical, four times as long as maximum width.

Pigmentation of legs shown in figure 8I, J, variable in density and extension, but in all cases with first tarsal segment conspicuously darkened. Tibiae with a few scattered translucent spinelike setae, especially conspicuous on third pair of legs; similar setae more numerous on tarsal segments.

Median sclerites of urosternites II–VI forming angle of 110° (fig. 8H). Stylets white, those of ninth abdominal segment as long as coxite (fig. 8P, Q). Distal spine of stylet V one-third as long as stylet (fig. 8N), of stylet IX one-sixth the length of respective stylet (fig. 8P, Q).

Ovipositor attaining level of apex of stylets of ninth segment, brown, distinctly sclerotized. Gonapophyses of primary type, consisting of 50–55 articles, their chaetotaxy as illustrated (fig. 8K, L, R). Cerci with two apical spurs (fig. 8O).

TYPE: *New Jersey*: Sussex County: Balesville, October 11, 1979 (P. Wygodzinsky, K. Schmidt; AMNH), one female, holotype.

ADDITIONAL MATERIAL EXAMINED: *Connecticut*: Middlesex County, Higby Mountain, July 1963 (P. Wygodzinsky, AMNH), 13 females. Four miles west of Middletown, north end of Higby Mountain, October 27 (J. M. Burns; AMNH), one female. No date (J. M. Burns; AMNH), two females.

Massachusetts: Berkshire County, Tyngsboro, Sept. 11, 1959, Sept. 23, 1960, Aug. 15, 16, 17, 1963 (A. E. Treat and B. G. Treat; AMNH), 14 mature and immature females.

New Jersey: Sussex County: Balesville, early summer 1979 (K. Schmidt; AMNH), three mature females, paratypes, four juvenile females; April 21, 1979 (K. and R. Schmidt; AMNH), one female; Oct. 11, 1979 (P. Wygodzinsky, K. Schmidt; AMNH), nine immature females.

New York: Orange County: Port Jervis, "Trilobite Hill," July 14, 1979 (P. Wygodzinsky, K. Schmidt; AMNH), one mature and one immature female.

Pennsylvania: Bucks County: Jamison,

Neshaminy Creek, Oct. 27, 1963 (J. and W. Ivie; AMNH), six females.

ETYMOLOGY: From the Latin *saltator*, hopper, dancer, in allusion to the jumping habit of machilids.

DISCUSSION: This is the first species of the genus described from the eastern United States. Of the five western species of *Pedotontus*, three are distinguished by the possession of two pairs of exsertile vesicles on urosternites II–V, whereas the remaining two (*californicus* and *superior*) have two pairs of vesicles on urosternites II–VI. The latter condition obtains in *P. saltator*. The relatively large line of contact of the eyes (fig. 8B) and the narrowly subcylindrical labial palp (fig. 8A) are shared by *saltator* and *superior*. In mature females of our species, the ovipositor attains but does not extend beyond the apex of the stylets of the ninth urosternite (fig. 8Q); *P. superior* has a much longer ovipositor which extends beyond the apex of the terminal spine of the last pair of stylets by 1 mm. Males are unknown for either species; if they become known, they may furnish additional diagnostic characters.

BIOLOGY: We have collected this species in crevices in limestone cliffs, on boulders, and in leaf litter between boulders. We found the species also in old stone walls, from close to the surface to at least 2 feet below the top of the stone wall. At night, specimens were found on the surface. Treat (label data) collected a specimen on a tree.

All 54 *P. saltator* including juveniles examined were females. We hypothesize that the species is parthenogenetic, at least for the populations examined.

Among specimens from Balesville and from Neshaminy Creek collected in October, we found, in addition to females with an ovipositor as described above, others of adult size (9–11 mm.) with a much shorter and not conspicuously sclerotized ovipositor (fig. 8P). These specimens may have hatched early in 1979, whereas the larger ones may represent specimens that have already overwintered once.

OBSERVATION: We have seen an immature, poorly preserved female of *Pedotontus* which we cannot identify specifically. The

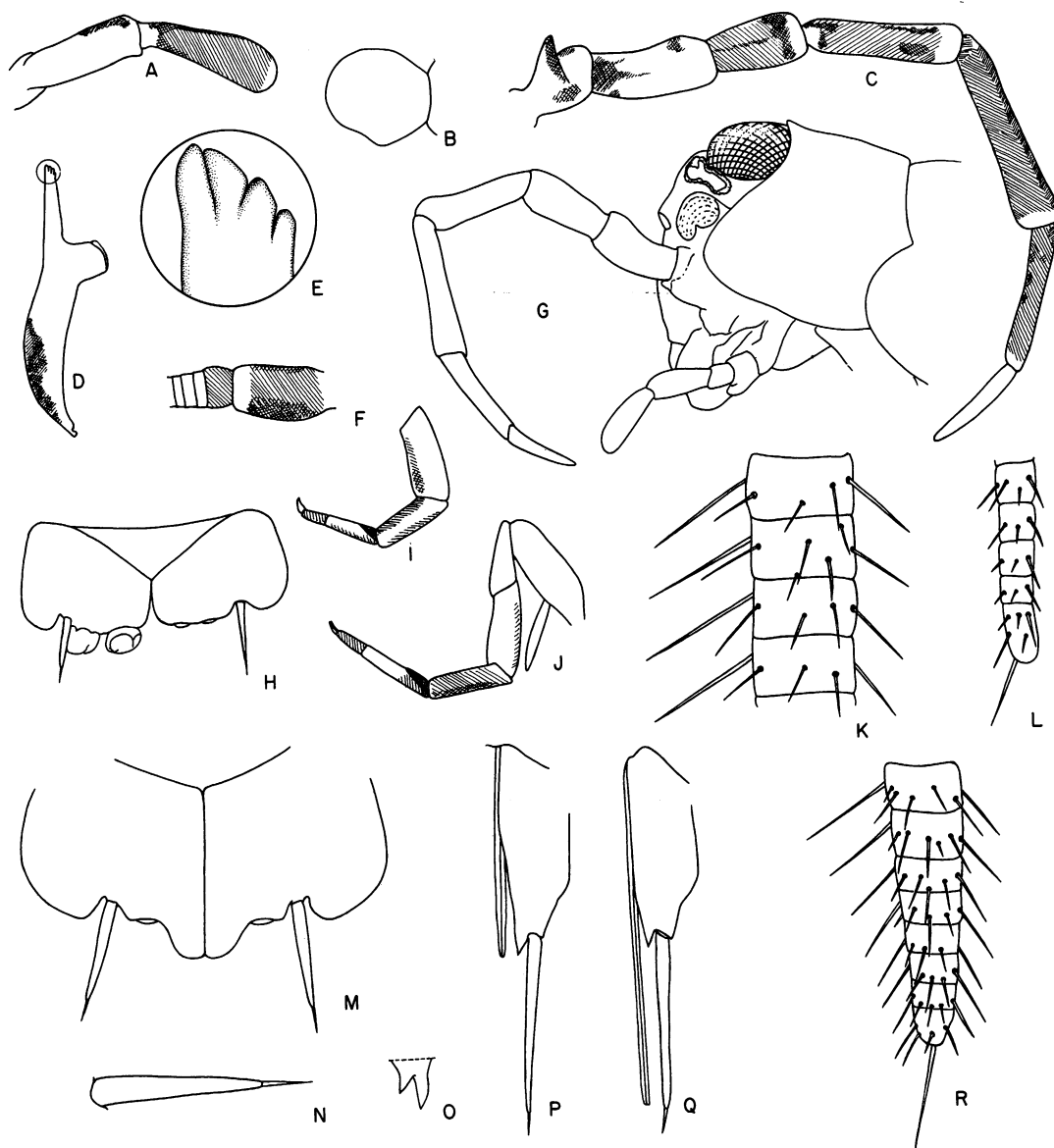


FIG. 8. *Pedetontus saltator*, female. A. Labial palp. B. Eye, semilateral view. C. Maxillary palp. D. Mandible. E. Apex of mandible, higher magnification. F. Base of antenna, to show pigment pattern. G. Head, side view. H. Urosternite of fifth abdominal segment. I. Portion of foreleg. J. Hind leg. K. Anterior gonapophysis, articles 27-30. L. Posterior gonapophysis, terminal articles. M. Seventh urosternite. N. Stylet of fourth abdominal segment. O. Apex of cercus. P. Gonocoxite of ninth segment, with short ovipositor. Q. Gonocoxite of ninth segment, with normal ovipositor. R. Apex of anterior gonapophysis.

locality data are Pennsylvania/ Washington Co./ West Alexander/ July 7, 1966/ J. and W. Ivie/ AMNH. We have included the speci-

men here because its finding considerably augments the known range for *Pedetontus* in Pennsylvania (see fig. 7B).

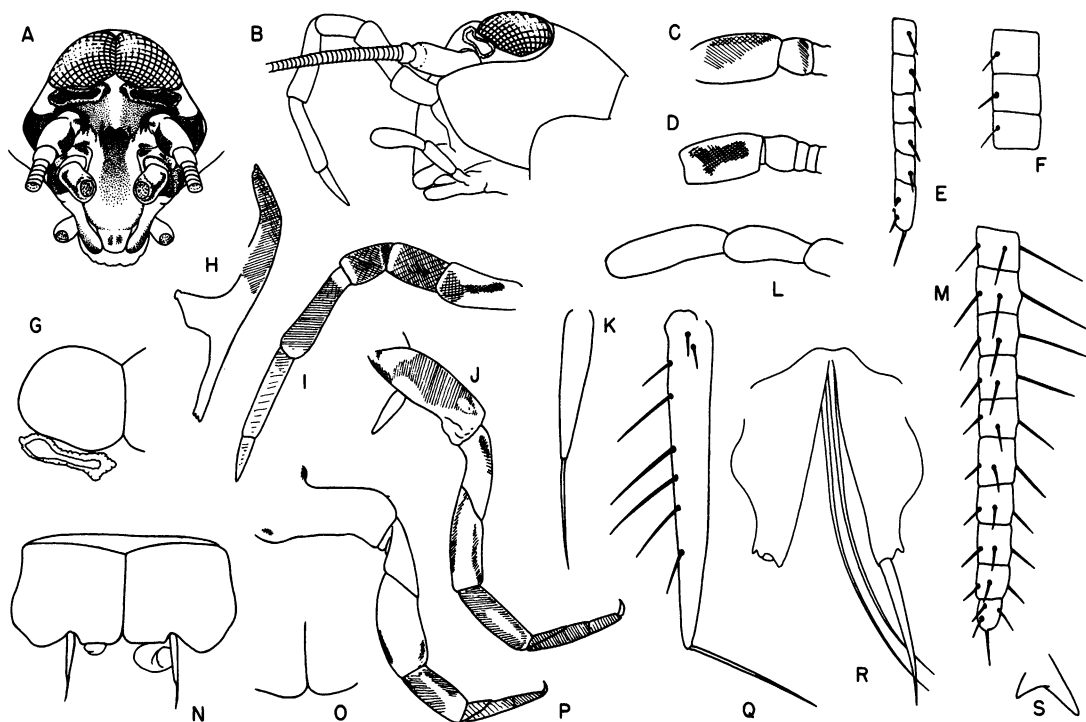


FIG. 9. *Machiloides petauristes*. Female. A. Head, frontal view. B. Head, side view. C. Base of antenna, inner lateral surface. D. Base of antenna, outer lateral surface. E. Distal portion of gonapophysis of ninth segment. F. Articles of central portion of anterior gonapophysis. G. Eye and ocellus, sublateral view. H. Mandible. I. Maxillary palp. J. Hind leg. K. Stylet of fifth abdominal segment. L. Labial palp, schematic. M. Distal portion of posterior gonapophysis. N. Fifth urosternite. O. Distal area of center of seventh urosternite. P. Foreleg. Q. Stylet of ninth abdominal segment, with large spinelike setae. R. Coxites of ninth segment, with anterior gonapophyses. S. Apex of cercus.

MACHILOIDES SILVESTRI, 1904

In the United States, *Machiloides* has previously been reported with one species (*M. banksi*) found in Great Falls, Virginia, and Plummers Island, Maryland (Silvestri, 1911). We have collected species of the genus as far south as Tennessee and North Carolina (unpublished) and in the present paper extend the known range of the genus to northern New Jersey. The genus has not been found in the western United States, but has species in temperate southern South America, in South Africa, and Madagascar, Tasmania, and in southern Spain.

The new species is represented on figure 7 by a hollow circle.

KEY TO THE FEMALES OF THE NAMED
NORTH AMERICAN SPECIES
OF *MACHILOIDES*

1. Clypeus predominantly light colored, with faint central longitudinal spot (fig. 9A). Maxillary palp with articles III–V extensively darkened (fig. 9I); second article with one pigment spot (fig. 9I); fourth article of maxillary palp very short and stout, three times as long as wide (fig. 9I). Coxa and femur of forelegs with very small pigment spots (fig. 9P), tarsus of third pair of legs uniformly darkened (fig. 9J); basal tarsal segment of forelegs not darker than the others (fig. 9P); anterior gonapophyses with approximately 45 articles *petauristes*, new species
Clypeus light-colored along middle, broadly

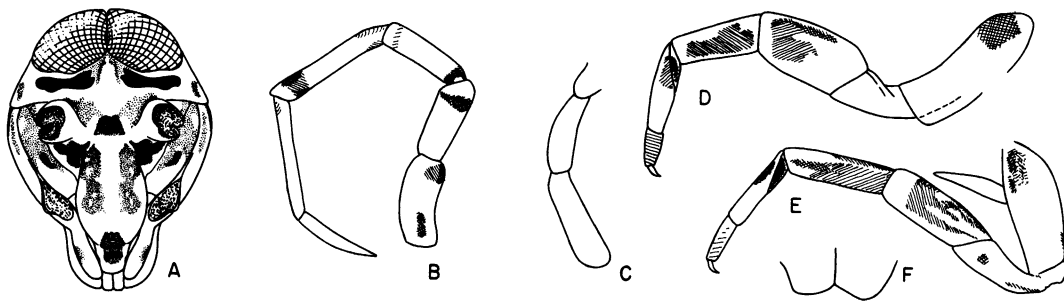


FIG. 10. *Machiloides banksi*. Female. A. Head, frontal view. B. Maxillary palp. C. Outline of labial palp. D. Foreleg, with pigment pattern. E. Hind leg, with pigment pattern. F. Distal area of center of seventh urosternite.

margined with dark pigment (fig. 10A). Articles III–V of maxillary palps with dark pigment forming narrow dark rings (fig. 10B); second article of palp with two spots (fig. 10B); fourth article of maxillary palp slender, about six times as long as wide (fig. 10B). Coxa and femur of forelegs with large pigment spots (fig. 10D); third pair of legs with first tarsal segment conspicuously darkened (fig. 10E). Anterior gonapophyses with approximately 55 articles. . . *banksi* Silvestri

***Machiloides petauristes*, new species**

Figures 7B, 9

DIAGNOSIS: *Machiloides petauristes* differs from the other described North American species, *M. banksi* Silvestri, in the female by conspicuous differences in the pigment pattern of the clypeus, the maxillary palp and the legs, and by the very short fourth article of the maxillary palp.

DESCRIPTION: Female. Length of mature specimens 10–11 mm.; maximum observed length of antennae 4 mm., of terminal filament 7 mm., of cerci, 3 mm. Body color pale reddish yellow. Hypodermal pigment present on head, mouthparts, base of antennae, and legs.

Head with pigment pattern as shown in figure 9A, characterized by extensive pigment on frons, in area between ocelli and insertion of antennae, and predominantly light-colored clypeus. Eyes of uniform greenish color, as long as wide (fig. 9G), their line of contact equal to two-thirds of their length. Ocelli (fig.

9A) dark, shorter than anterior border of eyes, narrowly sole-shaped. Antennae shorter than body. Inner and outer surface of scapus each with large pigment spot (fig. 9C, D). Flagellum pale brown; intermediate jointlets whitish on basal third on antennae. Chains of distal portion of flagellum with up to eight jointlets. Maxillary palp (fig. 9I) with extensive hypodermal pigment as illustrated. Second segment with one large spot. Third and especially fourth segments unusually short and stout, fourth only three times as long as wide (fig. 9I). Terminal article half as long as penultimate. Labium and palp not pigmented; palp (fig. 9L) subcylindrical, four times as long as wide.

Pigment pattern of legs as shown in figure 9J, P.

Coxa of forelegs with two minute spots at its base, two short parallel bands on femur and two wide dark bands on tibia. Tarsi uniformly dark brown. Tibiae and tarsi of all legs with darkly pigmented spinelike setae; most numerous on tarsi.

Stylets of abdominal segments with short hairs and, especially on those of ninth segment, with heavily pigmented strong, long setae (fig. 9Q). Stylets of ninth segment, with apical spine excluded, half as long as coxite. Distal spine of stylet V (fig. 9K) over half as long as stylet itself (1/1.4). Distal spine of stylet IX slightly longer than one-third of stylet. Median projections of urosternite VII (fig. 9O) rounded apically. Ovipositor pale

brown, distinctly sclerotized, attaining level of apex of distal spine of stylet IX. Gonapophyses of primary type, consisting of approximately 45 articles. Articles of median and apical portion of anterior gonapophyses each with three large setae (fig. 9M). Articles of basal third of anterior gonapophyses with one short seta each (fig. 9F). Articles of posterior gonapophyses each with a single seta (fig. 9E).

Cerci with two apical spurs (fig. 9S).

TYPES: *New Jersey:* Sussex County, Balesville, Oct. 11, 1979 (P. Wygodzinsky and K. Schmidt; AMNH), one female, holotype, three females, paratypes. Data as above, April 21, 1979 (K. and R. Schmidt, AMNH), one female, paratype.

ETYMOLOGY: Taken from the Greek *petauristes*, a vaulter, tumbler, in allusion to the peculiar jumping habits of machilids.

DISCUSSION: *Machiloides petauristes* is the second North American species of the genus, the first being *M. banksi* Silvestri, 1911. We describe our species as new, even though the diagnostically more useful males were not found among our material. The females of the two species possess sufficient diagnostic characters to distinguish them safely from each other.

The most conspicuous differential characters of the females of the two North American *Machiloides* are mentioned in the above key. An additional character of potential diagnostic value is the shape of the inner posterior processes of the coxites of the seventh urosternite: distinctly rounded posteriorly in *petauristes* (fig. 9O) and subtruncate in *banksi* (fig. 10F).

BIOLOGY: We have collected *M. petauristes* near Balesville in two slightly different habitats: low limestone cliffs formed by an old railroad cut (fig. 1C) and a stone wall formed by mostly calcareous stones (fig. 1D). *Pedetontus saltator* occurred in the same habitats. The female of *petauristes* collected in April contained several mature eggs; no eggs were found in the apparently overwintering specimens collected in mid-October.

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