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**NORTH AMERICAN SPECIES OF THE GENUS HYDROCHOREUTES
(ACARINA: PIONIDAE)¹**

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Members of the water mite genus *Hydrochoreutes* have a Holarctic distribution. They are found in lakes, ponds, and sluggish streams, but usually only in small numbers and therefore long series of specimens are difficult to obtain. Two species, *ungulatus* (Koch) and *krameri* Piersig, have a widespread range in Europe and Siberia and the latter species is also known from Algeria. Marshall (1937) reported *ungulatus* from Maine, Michigan, Wisconsin and California. However, the present author has seen no specimens from North America which can be assigned to the latter species and the illustrations in Marshall's paper are definitely not those of *ungulatus*. Therefore, there are no authentic records of the latter species in the New World. Cook (1956) named a new species, *intermedius*, from North America. Both the description and illustrations are inadequate for the latter and it is treated along with four new species in this paper.

The genus *Hydrochoreutes* is unique among the pionids in that the male possesses a well developed petiole. The petiole consists of a central piece and two slightly shorter lateral pieces. Each of these sclerites is made up of a plate-like portion attached to the body (Fig. 18) and an elongated posterior extension. Since the central and lateral pieces may be curved and lie in different planes relative to each other, a great deal of foreshortening is often present in standard dorsal and ventral views. A lateral view is necessary in order to understand the true proportions of the petiolar sclerites (compare figures 28 and 30). The late Professor O. Lundblad kindly provided the author with specimens of *ungulatus* and *krameri* from Sweden. Figures 22 and 27 illustrate lateral views of the petiole in these two species.

In presenting measurements, those of the holotype and allotype are given first. If a series of specimens is available, the range of variation is given in parentheses following the measurements of the primary types. Holotypes and allotypes will be deposited in the Field Museum of Natural History (Chicago).

Hydrochoreutes intermedius Cook

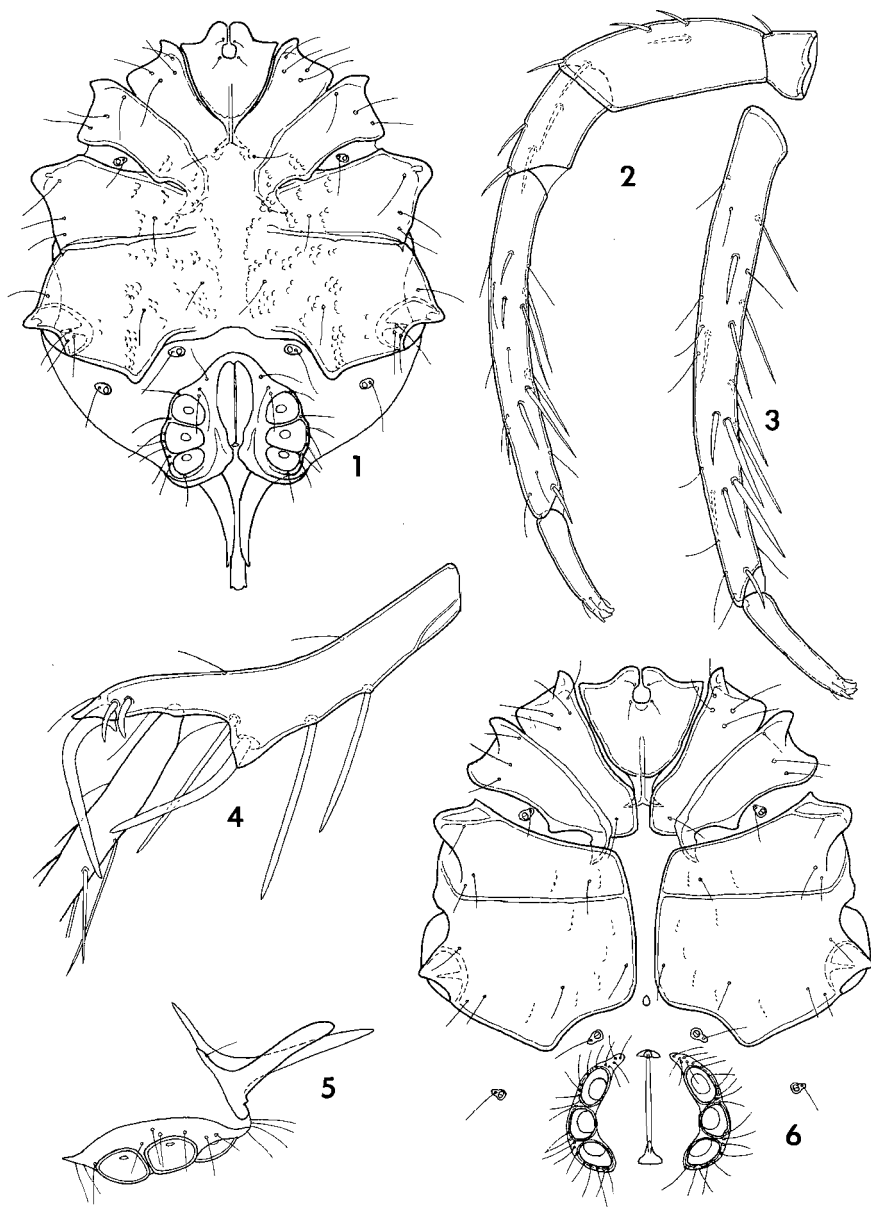
(Figs. 1-6)

Male: Length between anterior end of capitulum and posterior end of fourth coxae 395 μ -456 μ ; all coxae fused together medially but with a slight separation laterally between the second and third coxae (Fig. 1); genital field 152 μ -170 μ in width; genital acetabula relatively large and placed close together on their respective sides; largest acetabulum 41 μ -51 μ in width; central piece of petiole straight and extending slightly beyond the posterior ends of the lateral pieces; lateral piece of relatively uniform height along most of length when viewed laterally (Fig. 5).

Dorsal lengths of the palpal segments: P-I, 37 μ -44 μ ; P-II, 133 μ -142 μ ; P-III, 89 μ -95 μ ; P-IV, 236 μ -251 μ ; P-V, 81 μ -88 μ ; Figure 2 illustrates the proportions and chaetotaxy of the palp in one individual; chaetotaxy of P-IV somewhat variable with one or two of the more proximal heavy setae absent in some individuals of the same population; dorsal lengths of the distal segments of the first leg: I-Leg-4, 274 μ -296 μ ; I-Leg-5, 319 μ -342 μ ; I-Leg-6, 358 μ -401 μ ; dorsal lengths of the distal segments of the third leg: III-Leg-4, 266 μ -288 μ ; III-Leg-5, 342 μ -380 μ ; III-Leg-6, 365 μ -440 μ ; III-Leg-4 modified as shown in Figure 4; III-Leg-4 with two heavy setae located proximal to the heavy, curved ventral seta; dorsally-located large heavy seta on III-Leg-4, 140 μ -148 μ in length; all legs extremely long and provided with swimming hairs; swimming hairs increasing in length and number on posterior legs.

Female: Length between anterior end of capitulum and posterior end of fourth coxae 623 μ -684 μ ; all coxal groups separated; genital field 207 μ -251 μ in width; genital acetabula large and placed relatively close to each other (Fig. 6).

¹This work supported in part by a grant (GB-12375) from the National Science Foundation.



Hydrochoreutes intermedius Cook. Fig. 1, ventral view, male; Fig. 2, medial view of palp, male; Fig. 3, P-IV and V, female; Fig. 4, lateral view of III-Leg-4, male; Fig. 5, lateral view of petiole, male; Fig. 6, ventral view, female.

Dorsal lengths of the palpal segments: P-I, 64 μ -72 μ ; P-II, 228 μ -266 μ ; P-III, 182 μ -197 μ ; P-IV, 502 μ -547 μ ; P-V, 144 μ -156 μ ; P-V only slightly curved; Figure 3 illustrates P-IV and V; dorsal lengths of the distal segments of the first leg: I-Leg-4, 547 μ -585 μ ; I-Leg-5, 562 μ -608 μ ; I-Leg-6, 425 μ -456 μ ; all legs extremely long and provided with swimming hairs as in male.

Material Examined: 14 males, 3 females, taken in the Polson Bay area of Flathead Lake, Lake County, Montana, June 29, 1954 (type locality).

Hydrochoreutes minor, n. sp.

(Figs. 7-12)

Male: Length between anterior end of capitulum and posterior end of fourth coxae 334 μ (312 μ -364 μ); all coxae fused medially but with a separation laterally between second and third coxae (Fig. 7); genital field 125 μ (118 μ -138 μ) in width; genital acetabula placed relatively close together (in some specimens, similar to those illustrated in Figure 1); largest acetabulum 29 μ (29 μ -32 μ) in width; central piece of petiole relatively short but slightly longer than lateral pieces; tip of central piece slightly trifid at distal end when viewed dorsally, and appearing notched in lateral view (Fig. 11); lateral piece of petiole curved dorsally, distal half gradually tapering to a point.

Dorsal lengths of the palpal segments: P-I, 33 μ (31 μ -37 μ); P-II, 111 μ (111 μ -124 μ); P-III, 78 μ (77 μ -83 μ); P-IV, 199 μ (185 μ -207 μ); P-V, 59 μ (59 μ -66 μ); Figure 9 illustrates the proportions and chaetotaxy of the palp; P-IV of some specimens bears an additional heavy seta; dorsal lengths of the distal segments of the first leg: I-Leg-4, 220 μ (206 μ -228 μ); I-Leg-5, 251 μ (240 μ -251 μ); I-Leg-6, 319 μ (297 μ -319 μ); dorsal lengths of the distal segments of the third leg: III-Leg-4, 213 μ (198 μ -216 μ); III-Leg-5, 273 μ (258 μ -288 μ); III-Leg-6, 334 μ -380 μ : III-Leg-4 modified as shown in Figure 10; III-Leg-4 with two heavy ventral setae proximal to the heavy, curved ventral seta; dorsally-located large heavy seta on III-Leg-4, 104 μ (104 μ -120 μ) in length; all legs extremely long and provided with swimming hairs; swimming hairs increasing in number and length on posterior legs.

Female: Length between anterior end of capitulum and posterior end of fourth coxae 471 μ (440 μ -516 μ); all coxal groups separated; genital field 196 μ (177 μ -235 μ) in width; usually with a pronounced separation between the genital acetabula on their respective sides (Fig. 8).

Dorsal lengths of the palpal segments: P-I, 53 μ (45 μ -53 μ); P-II, 197 μ (186 μ -212 μ); P-III, 152 μ (148 μ -163 μ); P-IV, 395 μ (380 μ -440 μ); P-V, 121 μ (89 μ -121 μ); Figure 12 illustrates P-IV and V; chaetotaxy of P-IV variable, with four to six heavy setae present on inner surface; dorsal lengths of the distal segments of the first leg: I-Leg-4, 395 μ (365 μ -425 μ); I-Leg-5, 407 μ (395 μ -425 μ); I-Leg-6, 327 μ (304 μ -349 μ); swimming hairs as in male.

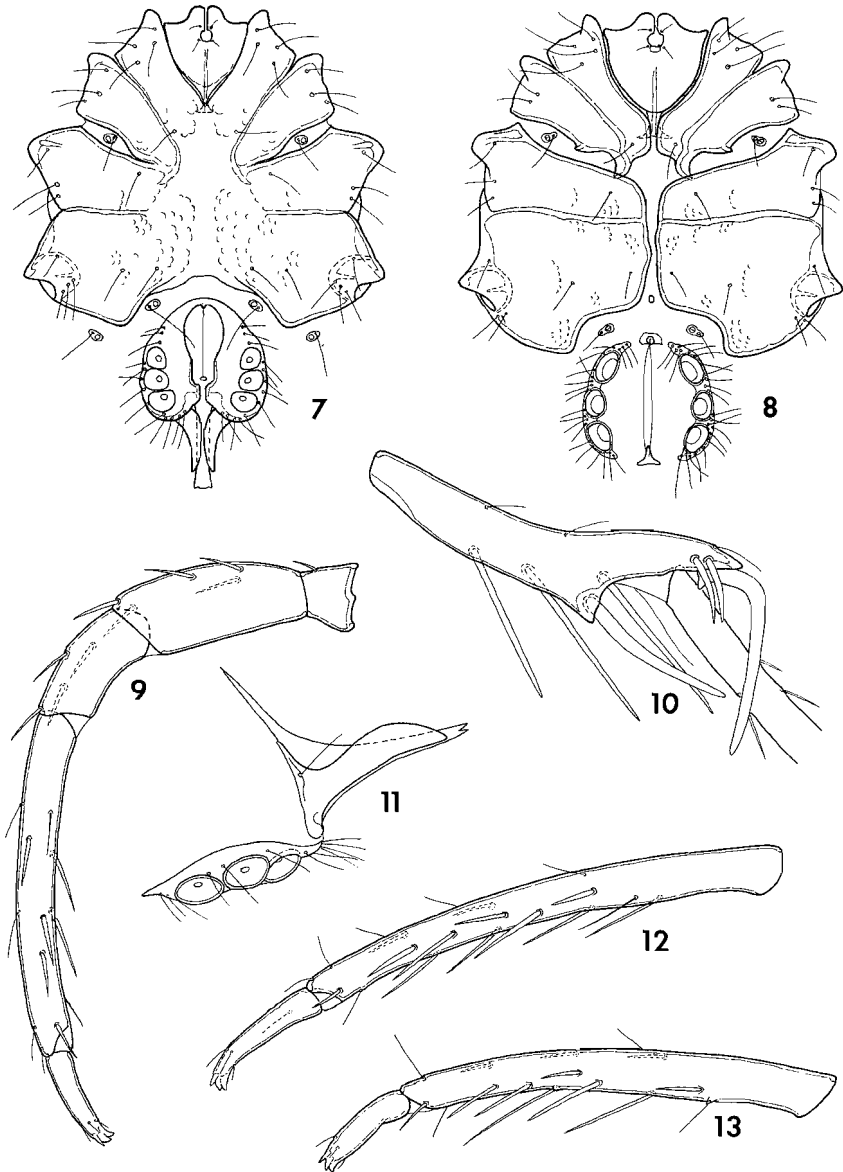
Holotype: Adult male, taken in the southeast end of Pontiac Lake, Oakland County, Michigan (T3N/R8E/S14), May 13, 1960.

Allotype: Adult female, same area as holotype on June 24, 1967.

Paratypes: 1 male, taken at the mouth of Bessey Creek (at junction with Douglas Lake), Cheboygan County, Michigan (T37N/R3W/S18), August 6, 1949; 1 female, from Portage Lake, Washtenaw County, Michigan (T1S/R3E/S1), May 13, 1951; 1 male, taken in the Hook Point area of Douglas Lake, Cheboygan County, Michigan (T37N/R3W/S22), June 18, 1952; 2 males, 2 females, same area as previous collection on July 1, 1952.

Two female specimens, apparently belonging to the present species, were collected in North Twin Lake, Mahnom County, Minnesota, July 8, 1969. These are similar to the females described above but, as it is difficult to identify species with certainty from the female alone, they are not assigned to the type series.

Discussion: *H. minor* is closely related to *intermedius* but the latter is a much larger species. Petioles differ in males of the two species. The lateral piece, when viewed laterally, is of relatively uniform height for most of its length in *intermedius* (Fig. 5). In *minor*, this sclerite tapers rapidly in the distal one third (Fig. 11). In addition to size, the females differ in that the genital acetabula of *intermedius* are very close together (Fig. 6) while those of *minor* are somewhat separated (Fig. 8). Both of these North American species are related to the Old World species *ungulatus*. However, III-Leg-4 in males of the latter species bears three



Hydrochoreutes minor n. sp. Fig. 7, ventral view, male; Fig. 8, ventral view, female; Fig. 9, medial view of palp, male; Fig. 10, lateral view of III-Leg-4, male; Fig. 11, lateral view of petiole, male; Fig. 12, P-IV and V, female.
Hydrochoreutes michiganensis n. sp. Fig. 13, P-IV and V, female.

or four long heavy setae proximal to the ventral curved seta. Only two heavy setae are found proximal to the curved ventral seta in the North American forms.

Hydrochoreutes michiganensis, n. sp.

(Figs. 13-19)

Male: Length between anterior end of capitulum and posterior end of fourth coxae 365μ ; posterior coxal groups fused medially but anterior groups separated (Fig. 14); genital field 137μ in width; genital acetabula placed close together on their respective sides; largest acetabulum 30μ in width; central piece of petiole slightly trifid at distal end when viewed dorsally and appearing notched in lateral view; central piece of petiole distinctly shouldered proximally when viewed laterally (Fig. 19, arrow A); lateral piece of petiole curved and gradually tapering to a point in distal one half.

Dorsal lengths of the palpal segments: P-I, 29μ ; P-II, 126μ ; P-III, 87μ ; P-IV, 199μ ; P-V, 61μ ; Figure 16 illustrates the proportions and chaetotaxy of the palp; dorsal lengths of the distal segments of the first leg: I-Leg-4, 236μ ; I-Leg-5, 262μ ; I-Leg-6, 342μ ; dorsal lengths of the distal segments of the third leg: III-Leg-4, 213μ ; III-Leg-5, 281μ ; III-Leg-6, 388μ ; III-Leg-4 modified as shown in Figure 17; III-Leg-4 with two heavy ventral setae located proximal to the curved ventral seta; the large, dorsally-located heavy, curved seta on III-Leg-4, 89μ in length; posterior two pairs of legs with a few swimming hairs.

Female: Length between anterior end of capitulum and posterior end of fourth coxae 440μ (440μ - 471μ); all coxal groups separated; genital field 170μ (163μ - 170μ) in width; genital acetabula placed relatively near each other on their respective sides (Fig. 15); acetabular plates well separated from the postgenital sclerite.

Dorsal lengths of the palpal segments: P-I, 44μ - 48μ ; P-II, 160μ (160μ - 190μ); P-III, 122μ (122μ - 145μ); P-IV, 289μ (289μ - 334μ); P-V, 76μ (76μ - 78μ); Figure 13 shows P-IV and V; dorsal lengths of the distal segments of the first leg: I-Leg-4, 334μ (334μ - 395μ); I-Leg-5, 338μ (338μ - 418μ); I-Leg-6, 288μ (288μ - 304μ); swimming hairs as in male.

Holotype: Adult male, collected at the mouth of Bessey Creek (at junction with Douglas Lake), Cheboygan County, Michigan (T37N/R3W/S18), August 6, 1949.

Allotype: Adult female, same data as holotype.

Paratype: 1 female, from Nelson's Lake, Cheboygan County, Michigan (T38N/R3W/S22), June 21, 1951.

Discussion: The pronounced shoulder on the central piece of the petiole (Fig. 19, arrow A) will distinguish males of *michiganensis* from all other species of *Hydrochoreutes*. Females of the present species somewhat resemble those of *intermedius* and *minor* but there are differences in the palp. P-V in *michiganensis* is comparatively shorter and does not gradually taper distally (compare Fig. 13 with Figs. 3 and 12).

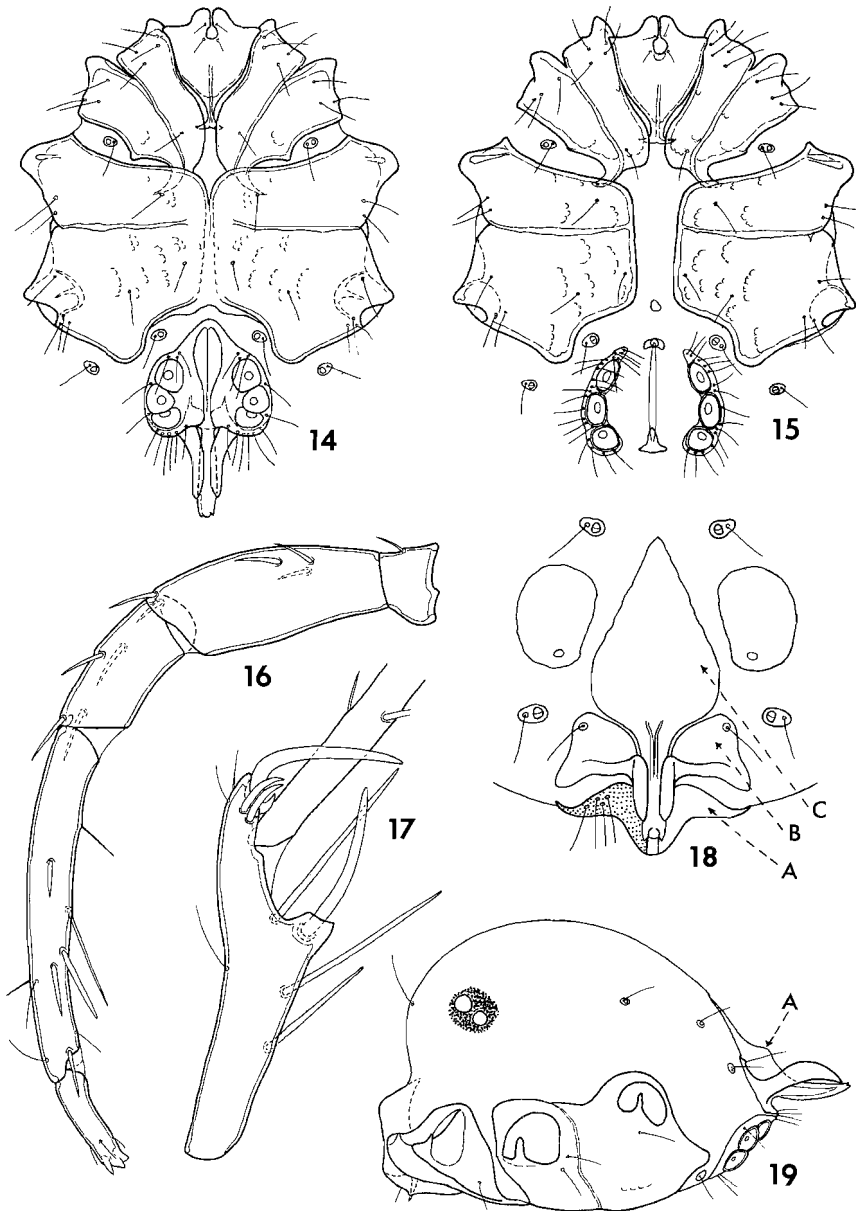
Hydrochoreutes microporus, n. sp.

(Figs. 20, 21, 23-26)

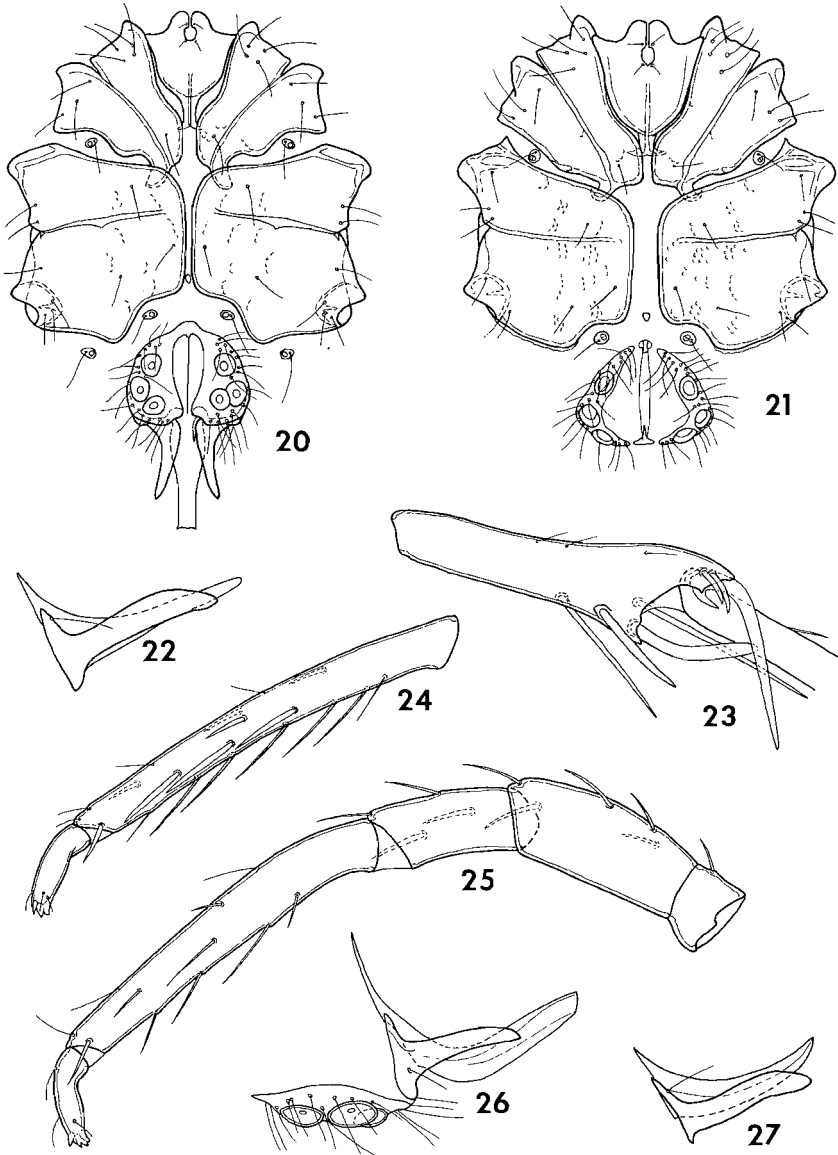
Male: Length between anterior end of capitulum and posterior end of fourth coxae 403μ ; all coxal groups separated (Fig. 20); genital acetabula arranged in an arc or triangle; acetabula occupying only a small portion of the surface of the acetabular plates; genital field 137μ in width; largest acetabulum 29μ in width; central piece of petiole tubular, much longer than lateral piece, upcurved, and not tapering to a point (Fig. 26); lateral piece of petiole only slightly curved and gradually tapering distally.

Dorsal lengths of the palpal segments: P-I, 33μ ; P-II, 120μ ; P-III, 88μ ; P-IV, 222μ ; P-V, 59μ ; P-V decidedly curved ventrally; Figure 25 shows the proportions and chaetotaxy of the palp; dorsal lengths of the distal segments of the first leg: I-Leg-4, 236μ ; I-Leg-5, 281μ ; I-Leg-6, 342μ ; dorsal lengths of the distal segments of the third leg: III-Leg-4, 205μ ; III-Leg-5, 274μ ; III-Leg-6, 380μ ; Figure 23 shows the modification of III-Leg-4; ventral seta immediately proximal to the curved ventral seta shortened and thickened; all legs very long and provided with swimming hairs; swimming hairs longer and more numerous on posterior legs.

Female: Length between anterior end of capitulum and posterior end of fourth coxae 441μ (441μ - 516μ); all coxal groups separated; genital bay relatively small; genital field 192μ



Hydrochoreutes michiganensis n. sp. Fig. 14, ventral view, male; Fig. 15, ventral view, female; Fig. 16, medial view of palp, male; Fig. 17, lateral view of III-Leg-4, male; Fig. 18, posterodorsal view of petiole area, male (A, genital field; B, lateral piece of petiole; C, central piece of petiole); Fig. 19, lateral view of body, male.



Hydrochoreutes microporus n. sp. Fig. 20, ventral view, male; Fig. 21, ventral view, female; Fig. 23, lateral view of III-Leg-4, male; Fig. 24, P-IV and V, female; Fig. 25, medial view of palp, male; Fig. 26, lateral view of petiole, male.
Hydrochoreutes ungulatus (Koch). Fig. 22, lateral view of petiole, male.
Hydrochoreutes krameri Piersig. Fig. 27, lateral view of petiole, male.

(192 μ -214 μ) in width; acetabular plates sickle-shaped, nearly touching postgenital sclerite posteriorly and pregenital sclerite anteriorly (Fig. 21); genital acetabula comparatively small, arranged in an arc, and with the anterior pair well removed from the middle pair.

Dorsal lengths of the palpal segments: P-I, 49 μ (49 μ -57 μ); P-II, 167 μ (167 μ -190 μ); P-III, 132 μ (132 μ -136 μ); P-IV, 312 μ (312 μ -364 μ); P-V, 74 μ (74 μ -88 μ); P-V curved downwards; Figure 24 illustrates P-IV and V; dorsal lengths of the distal segments of the first leg: I-Leg-4, 365 μ (365 μ -422 μ); I-Leg-5, 373 μ (373 μ -430 μ); I-Leg-6, 312 μ (312 μ -319 μ); swimming hairs as in male.

Holotype: Adult male, collected in the southeast end of Pontiac Lake, Oakland County, Michigan (T3N/R8E/S14), May 13, 1960.

Allotype: Adult female, same data as holotype.

Paratype: 1 female, same area as holotype on May 24, 1969.

Discussion: The male of the present species differs from males of all other known species in lacking fusion of the coxal groups. Also, the large, simple, tubular, upcurved central piece of the petiole (Fig. 26) is unique in the genus. The presence of a small genital bay and sickle-shaped acetabular plates with widely separated acetabula is diagnostic for the female of *microporus*.

Hydrochoreutes schizopetiolatus, n. sp.

(Figs. 28-33)

Male: Length between anterior end of capitulum and posterior end of fourth coxae 395 μ (380 μ -395 μ); all coxal groups fused medially but with a separation laterally between the second and third coxae (Fig. 28); genital field 118 μ (118 μ -122 μ) in width; genital acetabula arranged in an arc; central piece of petiole with an upturned distal portion (Fig. 30); this upturned distal portion of central piece with a median cleft; lateral pieces of petiole only slightly curved and gradually tapering distally.

Dorsal lengths of the palpal segments: P-I, 42 μ (39 μ -42 μ); P-II, 141 μ (133 μ -141 μ); P-III, 102 μ (102 μ -104 μ); P-IV, 261 μ (252 μ -261 μ); P-V, 67 μ (66 μ -67 μ); a small setal tubercle bearing a thin seta present ventrally in proximal portion of P-IV; Figure 32 illustrates the proportions and chaetotaxy of the palp; dorsal lengths of the distal segments of the first leg: I-Leg-4, 274 μ ; I-Leg-5, 304 μ -312 μ ; I-Leg-6, 362 μ -365 μ ; dorsal lengths of the distal segments of the third leg: III-Leg-4, 182 μ -190 μ ; III-Leg-5, 304 μ -309 μ ; III-Leg-6, 380 μ -410 μ ; two thickened, curved setae present on ventral side of III-Leg-4 (Fig. 31); dorsally-located curved seta of III-Leg-4, 89 μ -96 μ in length; all legs long and with swimming hairs; swimming hairs on posterior legs longer and more numerous.

Female: Length between anterior end of capitulum and posterior end of fourth coxae 471 μ (456 μ -494 μ); all coxal groups separated; genital field 166 μ (155 μ -178 μ) in width; acetabular plates slightly sickle-shaped with the posterior ends of the acetabular plates extending medially relatively near the postgenital sclerite (Fig. 29).

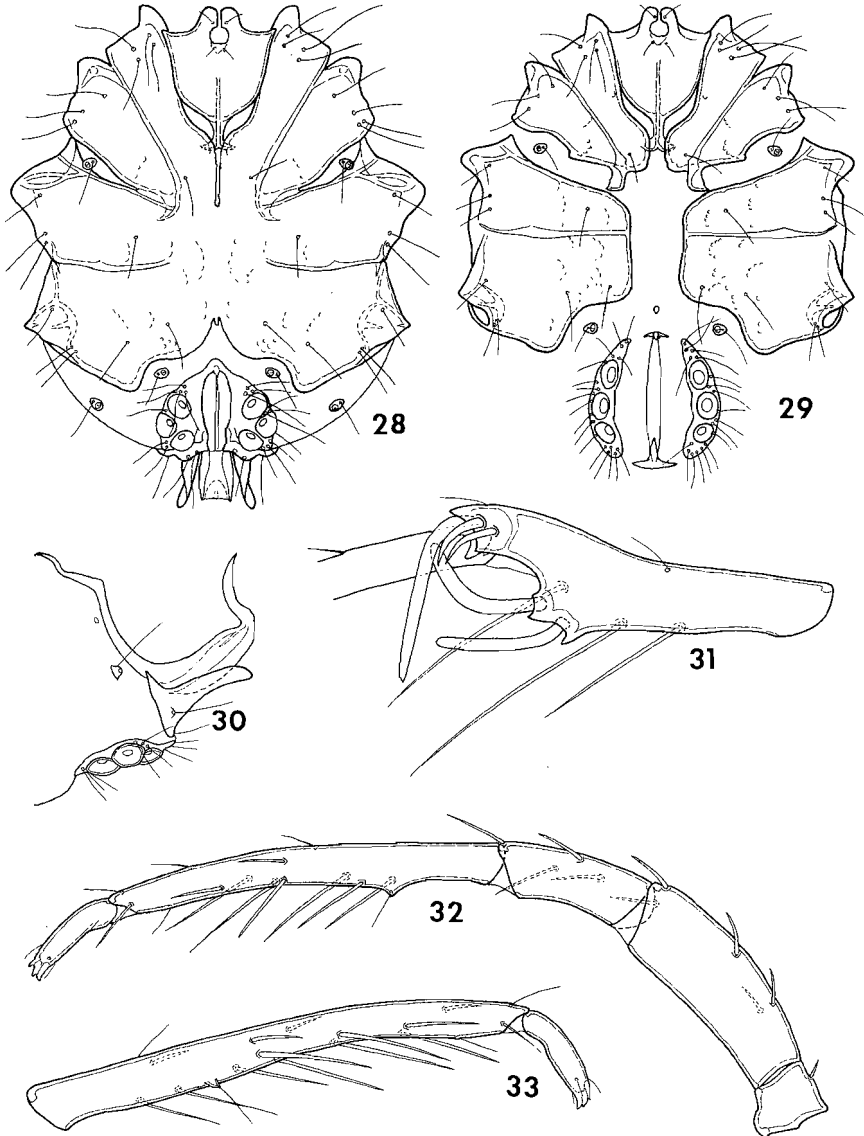
Dorsal lengths of the palpal segments: P-I, 53 μ (50 μ -61 μ); P-II, 197 μ (175 μ -204 μ); P-III, 137 μ (137 μ -152 μ); P-IV, 361 μ (342 μ -373 μ); P-V, 84 μ (76 μ -84 μ); a small setal tubercle bearing a thin seta present ventrally in proximal portion of P-IV; Figure 33 shows P-IV and V; dorsal lengths of the distal segments of the first leg: I-Leg-4, 433 μ (403 μ -499 μ); I-Leg-5, 456 μ (430 μ -464 μ); I-Leg-6, 327 μ (304 μ -334 μ); swimming hairs as in male.

Holotype: Adult male, taken in a pond with deeply stained water on US 90 two miles east of Ponce de Leon, Holmes County, Florida, November 8, 1970.

Allotype: Adult female, same data as holotype.

Paratypes: 1 male, 3 females, same data as holotype; 1 male, 2 females, from a roadside pond with deeply stained water on US 441 near junction with highway 122, Clinch County, Georgia, November 21, 1970.

Discussion: Males of the present species may be easily distinguished by their possession of a medially-cleft upturned portion at the distal end of the central piece of the petiole (Fig. 30). III-Leg-4 of the male is also unique in that there are two heavy, curved setae on the ventral side (Fig. 31). Females of *schizopetiolatus*, as well as the males, have a well developed setal tubercle on the ventral side of P-IV (Fig. 33).



Hydrochoreutes schizopetiolatus n. sp. Fig. 28, ventral view, male; Fig. 29, ventral view, female; Fig. 30, lateral view of petiole, male; Fig. 31, lateral view of III-Leg-4, male; Fig. 32, medial view of palp, male; Fig. 33, P-IV and V, female.

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BOOK REVIEW

A SHORT HISTORY OF THE BROWN-TAIL MOTH (1782). William Curtis. London: The Curwen Press, 1969. [v], 18, [ii], 13 pp. \$9.30. Entomological Reprint Specialists, Los Angeles, California.

This slim volume is easily one of the most attractive entomological reprints that has appeared to date. Most American entomologists are familiar with the story of the "brown-tail moth," *Nygmia phaeorrhoea* Donovan, the European species which was introduced into Massachusetts in the 1890s and became a serious pest in the northeastern United States and adjoining Canada until appropriate control measures were taken. The Brown-tail is a defoliator of forests, orchards and hedgerows, and as D. S. Fletcher explains in his entomological notes to this reprint, populations of the species periodically build up to epidemic levels and create havoc. Such an outbreak occurred near London in 1782, and caused widespread fear of a 'plague'. Curtis' pamphlet was written to quiet these fears and in it he described the life history of the moth, the nature of its depredations, and a suggested method of control: removing the webs in autumn or winter, and burning them.

Curtis' pioneer effort in economic entomology is one of the rarest of entomological books. Less than a half-dozen copies are presently located, and the Curwen reprint will be very welcome if for this reason alone. Yet this volume in the "Classica Entomologica" series must be praised for another feature. Esthetic quality has too often been the last consideration of publishers of scientific reprints, but Curwen has taken the greatest care to assure a physically attractive book. The introductory material is printed on a good wove paper, utilizing a very pleasing typeface and ample margins. In the facsimile portion, an off-white machine-made laid paper has been used for closer approximation to the original. Comparison with my own copy of the first edition shows that Curwen has realized superb reproduction of the colored plate, which for technical reasons must have been a difficult task.

There is an interesting introduction concerning Curtis by the well-known historian of botany W. T. Stearn. Curtis is best known for his *Flora Londinensis* (1775-98) and *Botanical Magazine* (1787-), but his entomological publications included papers and three books. In addition to the present one, these were *Instructions for Collecting and Preserving Insects* (1771), and a volume that Stearn does not mention, an important English translation of Andrew John Bladh's *Fundamenta Entomologiae* (1772), from the Latin version printed in the seventh volume of Linnaeus' *Amoenitates Academicae*, with the addition of plates prepared for Curtis. The only fault that can be found with Stearn's introduction is that he gives too little space to Curtis' entomological publications, a subject which would have been more appropriate for this reprint than an explanation (however interesting) of his botanical contributions. For example, the Bladh translation was an excellent and somewhat popular English introduction to Linnean entomology, with a useful bibliography of entomological books, and the *Instructions* was the first separate handbook of entomological techniques in English, if we except the printed sheets of James Petiver and Benjamin Wilkes. These points could have been made, but the absence of a well-balanced discussion of Curtis' entomological work detracts only slightly from the overall quality of this very appealing book.

R. S. Wilkinson