

# A KEY TO THE WATER MITES (*HYDRACARINA*) OF THE FLATFORD AREA

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## INTRODUCTION

THE only comprehensive English work on water mites is Soar and Williamson's *The British Hydracarina*, published in three volumes in 1929. This is difficult for the beginner to use and the present paper, though restricted in scope, is intended to provide a simpler key by way of an introduction to a richly varied group of animals. Within the area examined about a quarter of the known British species have been collected. The key cannot be expected to provide a complete answer outside those localities for which it is intended, although the species listed will occur elsewhere.

Mites form the Class Acari, a group which is divided into three orders. Although all the orders contain aquatic members, the true water mites are to be found only amongst the Trombidiformes and constitute a sub-order, the Hydracarina. A full classification will be found with the species list following the Introduction.

## *Structure (Plate I)*

Water mites are small, often brightly coloured, animals, varying in length from about 0.3 mm. to 7.0 mm. In common with the terrestrial mites they show no subdivision of the body. They are usually oval in outline when viewed from above, and many species are strongly dorso-ventrally flattened. Some genera possess a hard, chitinous exoskeleton, but most are soft-bodied, sometimes with isolated chitinous plates on the dorsum and always with such plates on the ventral surface. The eyes consist of two pairs, usually disposed near the lateral borders of the anterior region, and containing a black or red pigment. Sometimes a colourless median eye is present.

The mouthparts are of the piercing and sucking type, enclosed in a hard, chitinous capsule, the capitulum. This lies on the ventral surface between the palpi and projecting rearwards between the first pair of epimera (q.v.). It is terminated by a rostrum, visible in some species as a short, sharp, pointed structure, but in others (e.g. *Hydrachna*) as a long tubular organ.

From the capitulum arise the two palpi which are five-segmented, the distal segment being often small and claw-like. The morphology of the palpi is of great importance in taxonomy and a considerable degree of variation exists between genera.

Behind the capitulum, sometimes partially fused to it, lie the sclerotized epimera, occupying a large or small area of the ventral surface. These serve to attach the legs to the body and are eight in number. In most genera they form four blocks, the anterior pair being 1st and 2nd epimera and the posterior pair

being 3rd and 4th epimera. In other genera (e.g. *Lebertia*) the epimera are fused into a single large plate exhibiting partial sutures between what remains of the individual epimera. That part of the ventral body surface occupied by the epimera is known as the epimeral area.

The genital aperture is also on the ventral surface, either within the epimeral area or behind it. It is a cleft orientated from front to rear, often flanked by tumid lips, and usually accompanied laterally by one or more sclerotized plates, the genital plates. These plates bear a number of small discs, the acetabula. Sometimes the genital plates are fused around the genital cleft and may indeed obscure it (*Hydrachna*). Some species do not possess plates, and acetabula, if present, may then lie freely on the skin near the cleft.

The legs, of which there are eight in the adult, consist of six segments, the most distal segment carrying two, sometimes three, claws. They are well armed with spines and hairs and, in addition, may bear longer, thinner, more flexible swimming hairs. Swimming hairs are absent in stream dwelling species but are found in most still water forms. When present they usually arise close together, a character which distinguishes them from other types of more widely spaced spines.

The above description is of general application and takes no account of specialized features which occur in some species only. Some mention should be made of these. Males of the genus *Arrenurus* depart from the normal body shape in possessing a prolongation of the posterior end of the body called the cauda (Fig. 14). The cauda may bear a further extension, the petiolus, usually of a hyaline nature. A petiolus is also present in males of the genus *Hydrochoreutes*. In some genera (e.g. *Tiphys* and *Piona*) males may show modifications of one or more leg segments (Figs. 55 and 68). In *Eylais* an important classificatory character is the sclerotized strip, known as the ocular bridge, which connects the eye capsules across the anterior end of the body (Fig. 106).

#### *Life History*

The life history of the water mites consists of four stages: egg, larva, nymph and adult. The eggs are laid in masses on plants or stones and are usually reddish in colour. The larvae are usually elongated, with an exceptionally large capitulum, giving the appearance of a head. They are parasitic on aquatic insects. Often they will be found as resting pupal stages on such insects as Corixid bugs, *Nepa cinerea* (the Water Scorpion) and water beetles. The pupae are small oval structures, frequently red or white in colour, attached to the integument of the host. From such pupae arise the nymphs which are similar to the adult except for the absence of a genital cleft. The nymphs are free-living carnivores like the adults and pass through a second pupal stage before reaching sexual maturity.

Water mites prey on a variety of small aquatic animals which they seize with the first pair of limbs and pierce with the rostrum. Enzymes are pumped into the prey and then the liquefied food is sucked back. The prey includes Cladocera (Water Fleas), Copepoda, Chironomid larvae, Annelids and other mites. One genus possesses parasitic adults. This is the genus *Unionicola* some of whose members (e.g. *U. intermedia*) may be found in the mantle cavity of the bivalve mollusc *Anodonta*.

### Distribution

Water mites occur in most aquatic habitats, but the richest variety is found in standing or slow-flowing waters. In the Flatford area the River Stour has provided the longest species list, although only a few species can be considered abundant. Typical species here are *Limnesia maculata* (possibly the commonest water mite in the spring), *Piona longipalpis* and species of *Eylais* and *Hydrachna*. In the richly organic waters of the cattle ponds are *Arrenurus*, *Piona* and *Tiphys*. These also occur in the weedy dykes of the flood meadows, supplemented by *Brachypoda versicolor* and *Neumania vernalis*. The shallow tributaries of the Stour support large numbers of *Hygrobatas longipalpis*, while the faster streams contain *Hygrobatas fluviatilis*, *Lebertia glabra* and species of *Atractides* and *Sperchon*. In spring sources and small headstreams a group of cold-loving species occurs, such as *Sperchon glandulosus*, *Lebertia stigmatifera* and *Ljanja bipapillata*; these are recorded elsewhere from mountainous regions. *A-Thienemannia schermeri* and *Arrenurus fontinalis* inhabit seepage waters where small springs well out and trickle through ground debris. It has not been possible to indicate in all cases the range of distribution, but where a species does seem to be confined to a certain habitat mention is made of this in the key.

Not all the species of water mite will be found throughout the year. Many of them make seasonal appearances. For example, *Hydryphantes ruber* appears in ponds in the early spring, by May it has disappeared; *Piona nodata* appears in numbers from April to May, while *Piona conglobata* is somewhat later; species of *Eylais* and *Hydrachna* reach their largest numbers in the summer (*Eylais hamata* is an exception, being an early spring species); *Limnesia maculata* occurs in the River Stour throughout the year, and most stream species are to be found in all months.

### Preservation and Examination

Various fluids have been suggested for the preservation of whole specimens. One of the most satisfactory is a mixture of 10 vols. glycerine, 3 vols. acetic acid and 6 vols. distilled water (Viets, 1936). It will be found that specimens will shrink or collapse within an hour of entering the fluid, but after several days will return to their original shape. Dissected parts can be mounted for examination in Gum Chloral or Glycerine Jelly.

Mites may be killed by immersion for a few minutes in the preservative fluid described above, or by adding a drop of chloroform to the water containing them. If chloroform is used care must be taken that the substance does not actually come into contact with the specimens or it will form a skin around them, bunching the appendages and rendering observation difficult. Soda water can be used as a temporary anaesthetic but has the disadvantage of producing bubbles which cling to the appendages.

As far as possible the key has been based on anatomical characters not requiring dissection but in some instances this is not enough. Palpi and legs may have to be examined separately; these should be pressed off with fine needles from the dorsal side as under such conditions there will be a firm surface beneath these appendages. For detailed examination a high power objective will be necessary; the appendages may be mounted temporarily in Viets' fluid or glycerine. Sometimes difficulty may be experienced in distinguishing

details of epimera or genitalia, especially if these are of the same colour as the remainder of the ventral surface. By inserting a needle into the base of the capitulum and pulling this member out an opening into the body cavity is produced. The internal contents can then be pressed out, preferably in lactic acid or Viets' fluid, rendering the specimen transparent; the details of the sclerotized parts will then become apparent.

Colour and size are noted in the descriptive sections of the key, but these are unreliable characters for identification purposes. The colour pattern is highly variable in each species. Much of it is produced by pigmentation of the internal organs, especially the Y-shaped dorsal excretory organ. Size, too, is inconstant and the dimensions given are only those most commonly met. Variations in anatomical features are much rarer, although a few genera (e.g. *Limnesia*, *Pionopsis*) exhibit slight inconsistencies more often than others.

### Nymphs

The key is designed for the identification of adults. The student must therefore be able to distinguish between these and other stages in the life history. The larvae are all very small and possess only three pairs of legs; they are not likely to be confused with adult forms. Nymphs, however, show much greater resemblances to their adults, being distinguishable mainly by the appearance of the genital area. There is no genital cleft and in most genera there are four acetabula, a number which is not otherwise found in any of the mites described in the key. In *Hydrachna* many acetabula are present on two genital plates lying apart from each other, each one resting in a bay formed by the median borders of the 3rd and 4th epimera. In the genus *Eylais* the ocular bridge is often absent. Nymphs of *Arrenurus* lack the dorsal groove (this may also be indistinct in young adults).

### SPECIES LIST

Eighty-one species of Hydracarina have been identified in the Flatford area and these are listed below. The area has been extended to cover all localities visited regularly by Field Centre students and it includes Shingle Street and Wicken Fen. The sub-order has recently been revised by Viets (1956) and his nomenclature is used. Where this differs from Soar and Williamson (1929) the latter's nomenclature has been indented below the more recently accepted name.

Phylum	<i>ARTHROPODA</i>
Sub-phylum	<i>ARACHNIDA</i>
Class	<i>Acari</i>
Order	<i>Trombidiformes</i>
Sub-order	<i>Hydracarina (=Hydrachnellae)</i>
1. Family HYDRACHNIDAE	3. Family EYLAIIDAE
<i>Hydrachna globosa</i> (Geer)	<i>Eylais hamata</i> Koen.
<i>Hydrachna paludosa</i> Thor	<i>Eylais infundibulifera</i> Koen.
<i>Hydrachna cruenta</i> (Müll.)	<i>Eylais triarcuata</i> Piers.
<i>Hydrachna scutata</i> Piers	<i>Eylais rimosa</i> Piers.
<i>Hydrachna leegei</i> (Koen.)	<i>Eylais extendens</i> (Müll.)
	<i>Eylais soari</i> Piers.
2. Family LIMNOCHARIDAE	4. Family HYDRYPHANTIDAE
<i>Limnocharis aquatica</i> (L.)	<i>Hydryphantes ruber</i> (Geer)

5. Family THYASIDAE  
*Euthyas truncata* (Neum.)  
*Thyas truncata* (Neum.)  
*Thyopsis cancellata* (Protz)  
*Thyas rivalis* Koen.
6. Family HYDRODROMIDAE  
*Hydrodroma despiciens* (Müll.)  
*Diplodontus despiciens* (Müll.)
7. Family SPERCHONIDAE  
*Sperchonopsis verrucosa* (Protz)  
*Pseudosperchon verrucosa* Piers.  
*Sperchon longissimus* Viets  
*Sperchon squamosus* Kram.  
*Sperchon glandulosus* Koen.  
*Sperchon setiger* Thor  
*Sperchon clupeifer* Piers.
8. Family LEBERTIIDAE  
*Lebertia porosa* Thor  
*Lebertia insignis* Neum.  
*Lebertia celtica* Thor  
*Lebertia glabra* Thor  
*Lebertia inaequalis* (Koch)  
*Lebertia stigmatifera* Thor
9. Family LIMNESIIDAE  
*Limnesia maculata* (Müll.)  
*Limnesia fulgida* Koch  
*Limnesia undulata* (Müll.)  
*Limnesia koenikei* Piers.  
*Limnesia connata* Koen.
10. Family HYGROBATIDAE  
*Hygrobatas nigromaculatus* (Leb.)  
*Hygrobatas fluviatilis* (Strom.)  
*Hygrobatas naicus* (Johnst.)  
*Hygrobatas longipalpis* (Herm.)  
*Hygrobatas norvegicus* (Thor)  
*Atractides spinipes* (Koch)  
*Megapus spinipes* (Koch)  
*Atractides nodipalpis* (Thor)  
*Megapus nodipalpis* Thor
11. Family UNIONICOLIDAE  
*Unionicola intermedia* (Koen.)  
*Unionicola figuralis* (Koch)  
*Unionicola aculeata* (Koen.)  
*Unionicola crassipes* (Müll.)  
*Neumania vernalis* (Müll.)  
*Neumania deltoides* (Piers.)  
*Neumania triangularis* (Piers.)  
*Neumania spinipes* (Müll.)
12. Family FELTRIIDAE  
*Feltria minuta* Koen.
13. Family PIONIDAE  
*Wettina podagrica* (Koch)  
*Hydrochoreutes unguilatus* (Koch)  
*Hydrochoreutes krameri* Piers.  
*Tiphys torris* (Müll.)  
*Acercus torris* (Müll.)  
*Tiphys ornatus* Koch  
*Acercus ornatus* (Müll.)  
*Tiphys latipes* (Müll.)  
*Acercus latipes* (Müll.)  
*Pionopsis lutescens* (Herm.)  
*Acercus lutescens* (Herm.)  
*Piona conglobata* (Koch)  
*Piona nodata* (Müll.)  
*Piona rotunda* (Kram.)  
*Piona rotundoides* (Thor)  
*Piona carnea* (Koch)  
*Piona longipalpis* (Krend.)  
*Piona coccinea* (Koch)  
*Piona uncata* (Koen.)  
*Piona variabilis* (Koch)  
*Forelia liliacea* (Müll.)
14. Family AXONOPSIDAE  
*Brachypoda versicolor* (Müll.)  
*Ljanja bipapillata* Thor
15. Family MIDEIDAE  
*Midea orbiculata* (Müll.)
16. Family MIDEOPSISIDAE  
*Mideopsis orbicularis* (Müll.)
17. Family A-THIENEMANNIIDAE  
*A-Thienemanna schermeri* Viets
18. Family ARRENURIDAE  
*Arrenurus albator* (Müll.)  
*Arrenurus crassicaudatus* Kram.  
*Arrenurus cuspidifer* Piers.  
*Arrenurus cylindratu* Piers.  
*Arrenurus buccinator* (Müll.)  
*Arrenurus caudatus* (Geer)  
*Arrenurus securiformis* Piers.  
*Arrenurus globator* (Müll.)  
*Arrenurus mediorotundatus* Thor  
*Arrenurus biscissus* Leb.  
*Arrenurus novus* George  
*Arrenurus inexploratus* Viets  
*Arrenurus fontinalis* Viets.

## ACKNOWLEDGEMENTS

I would like to express my gratitude to Mr. F. J. Bingley for his help and encouragement in the preparation of this paper, and to Miss Rachel le Fleming for her careful typing of the MS. My thanks are due also to Mr. T. Gledhill for his expert advice and to Professor Dr. O. Lundblad, Dr. F. A. Turk and Mr. Ian Efford for their help in identification.

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## KEY TO SPECIES

1. Epimera fused together into a single plate with mostly incomplete sutures; suture between 2nd and 3rd epimera always incomplete (Figs. 4 and 6). 2  
 Complete sutures between all epimera (first pair may be fused to capitulum); epimera usually in 4 blocks (Figs. 37, 56 and 63). 9
2. Genital area lying within deep recess in hind border of epimeral mass; 2nd epimera of each side separated from each other by a median suture (Fig. 12) (**Lebertia**). 3  
 Genital area not lying in deep recess in hind border of epimeral mass; 2nd epimera of each side fused to each other (Figs. 4, 5 and 6); very small, length 0.6-0.7 mm. 8
3. Swimming hairs obvious on 3rd and 4th legs and usually on 2nd legs; 3rd segment of palp with 5 long spines on inner surface (Fig. 10). 4  
 Swimming hairs absent or rudimentary; 3rd segment of palp with 5-6 long spines on inner surface (Fig. 11). 6
4. Middlemost of the 3 distal spines on inner surface of 3rd segment of palp standing close to lowest (Fig. 10). **Lebertia insignis**  
 Green-brown with yellow dorsal T; length about 1.0 mm., ♂ smaller. Slow-moving water.  
 All 3 distal spines on inner surface of 3rd segment of palp more or less equidistant (Fig. 9). 5
5. Ventral border of 4th segment of palp divided into 3 equal lengths by the two small hair pores (Fig. 9); the two distalmost spines on dorsal border of 2nd segment of palp standing well back from distal edge of segment. **Lebertia porosa**  
 Green-brown with yellow dorsal T; length 1.0-2.0 mm. Standing and slow-moving water.  
 Ventral border of 4th segment of palp not divided into 3 equal lengths by the two small hair pores, the proximalmost of these standing at the middle of the border (Fig. 7); the two distalmost spines on dorsal border of 2nd segment of palp standing on distal edge of segment. **Lebertia inaequalis**  
 Green-brown with yellow dorsal T; length 1.0 mm. Streams.

6. 3rd segment of palp with 6 long spines on its inner surface (Fig. 11); dorsal surface of skin covered with pattern of narrow ridges (Fig. 26).

***Lebertia stigmatifera***

Post-epimeral pore\* fused with 4th epimera; anus surrounded by a sclerotized ring; in ♂ 4th epimera extend to and partly curve round posterior end of genital plates (Fig. 12); in ♀ they do not extend as far; length 1.0 mm., ♂ smaller. Cold head streams.

3rd segment of palp with 5 long spines on its inner surface; dorsal surface of skin smooth or ridged.

7

7. Body round-oval; skin covered with pattern of narrow ridges (Fig. 26).

***Lebertia glabra***

Proximal pair of spines on inner surface of 3rd segment of palp widely separated (Fig. 8); dark yellow with brown patches to dark brown; length 1.0 mm., ♂ smaller. Brooks, especially in cold water.

Body elongate, flanks nearly parallel (Fig. 13); skin smooth.

***Lebertia celtica***

Epimeral mass long and narrow so that length between capitulum bay and genital bay obviously greater than half the width of epimeral mass; epimera occupying just over half to well over half ventral surface; dark red; length 1.0 mm., ♂ smaller. Brooks.

8. Epimeral sutures almost complete (Fig. 6); outlines of 4th epimera clearly visible; no swimming hairs.

***Ljanja bipapillata***

Acetabula near posterior end of body, triangle of 3 on each side of genital cleft; 4th epimera deeply bayed; 3 large papillae around posterior border of body, central one surrounding anus; yellowish to red or brown; length 0.7 mm., ♂ smaller. Cold brooks.

Epimeral sutures very incomplete (Fig. 4); outlines of 4th epimera lost; swimming hairs present.

***Brachypoda versicolor***

4th legs arising anterior to middle of ventral surface; plate on each side of genital cleft carrying 3 acetabula, in ♀ (Fig. 4) near posterior end of body, in ♂ (Fig. 5) further forward; greenish with yellow dorsal T and red blotches; length about 0.6 mm. Slow-moving water with thick vegetation.

9. Dorsum covered by a hard or leathery exoskeleton of small plates or papillae easily visible with low power (e.g.  $\times 2.75$ ) objective (Figs. 14 and 99).

10

Dorsum not completely covered by such plates.

34

10. Body leathery; skin covered with large, flat papillae; groups of larger plates on dorsum (Fig. 99); no swimming hairs. ***Thyopsis cancellata***

Epimera rather small, blocks widely spaced; 3 small acetabula on each side of genital cleft as in Fig. 89; sluggish; red to yellow-brown; length 1.4 mm. Very scarce.

Body hard; dorsum covered by small hard plates; dorsal groove more or less surrounding central region of dorsum (Fig. 14); swimming hairs usually present (***Arrenurus***).

11

11. Hind end of body more or less elongated into a cauda (Figs. 14 and 31), or carrying small posterior projections (Fig. 17); genital cleft short with narrow lips (Fig. 32). (♂♂)

12

Hind end of body more or less rounded or truncate; genital cleft longer, with thick lips (Fig. 27). (♀♀)

23

\* Post-epimeral pore in most species lies on skin just behind 4th epimera.

12. Epimera close together, separated only by sutures (Fig. 32); no swimming hairs. **Arrenurus fontinalis**  
Cauda very short; sluggish; reddish; length about 0·8 mm. Springs and secpages.  
Epimera clearly in 4 blocks, well separated (Fig. 27); swimming hairs present. 13
13. Posterior ends of dorsal groove closing in towards mid-line, not passing down sides of cauda; cauda short (Figs. 17, 18, 30 and 31). 14  
Posterior ends of dorsal groove closing no further than sides of cauda (Fig. 15). 18
14. Cauda represented by a sudden narrowing of posterior end of body (Fig. 31); no obvious caudal appendages. **Arrenurus inexploratus**  
4th segment of palp longer than 2nd\*; dark blue green; length about 1·0 mm. Ponds and dykes with thick vegetation.  
Cauda otherwise; large central projection (petiolus) at end of cauda. 15
15. Cauda cleft up mid-line (Figs. 18 and 30); petiolus lying in cleft. 16  
Cauda represented by two widely spaced lobes on either side of mid-line; between the lobes a central petiolus resting on a small projection (Figs. 17 and 39). 17
16. Petiolus slender, more or less pointed (Fig. 18). **Arrenurus biscissus**  
Dorsal groove surrounding very small area of dorsum, almost closing posteriorly; green with brown patches; length about 0·8 mm. Very scarce.  
Petiolus thicker, forked (Fig. 30). **Arrenurus novus**  
Dorsal groove closed posteriorly; greenish; length about 0·9 mm. Very scarce.
17. Petiolus pen-nib shaped (Fig. 39). **Arrenurus crassicaudatus**  
Green; length about 0·8 mm. Thick vegetation.  
Petiolus anchor-shaped (Fig. 17). **Arrenurus albator**  
Petiolus projecting very little, if at all, beyond caudal lobes; yellowish green; length up to 0·8 mm.
18. Cauda short and wide (Fig. 16). **Arrenurus cuspidifer**  
Postero-lateral corners of cauda projecting; central petiolus arising from convexly rounded central portion of caudal hind border; petiolus widest distally, tip somewhat rounded; blue-green with darker patches; length up to 1·2 mm. Reedy dykes.  
Cauda long and narrow (Fig. 14). 19
19. Hind border of cauda truncate, sides rounded (Fig. 15). **Arrenurus globator**  
Very small; green; length up to 0·8 mm. Ponds and larger waters with thick vegetation.  
Hind border of cauda sinuous or lobed (Figs. 14 and 34). 20
20. Hind border of cauda with 3 lobes (Fig. 34). **Arrenurus mediorotundatus**  
Sides of cauda slightly bulging; green; length about 1·2 mm. Ponds and reedy dykes.  
Hind border of cauda with 4 lobes. 21

\* *A. integrator* (Müll.) similar in body outline, but 4th segment of palp shorter than 2nd.

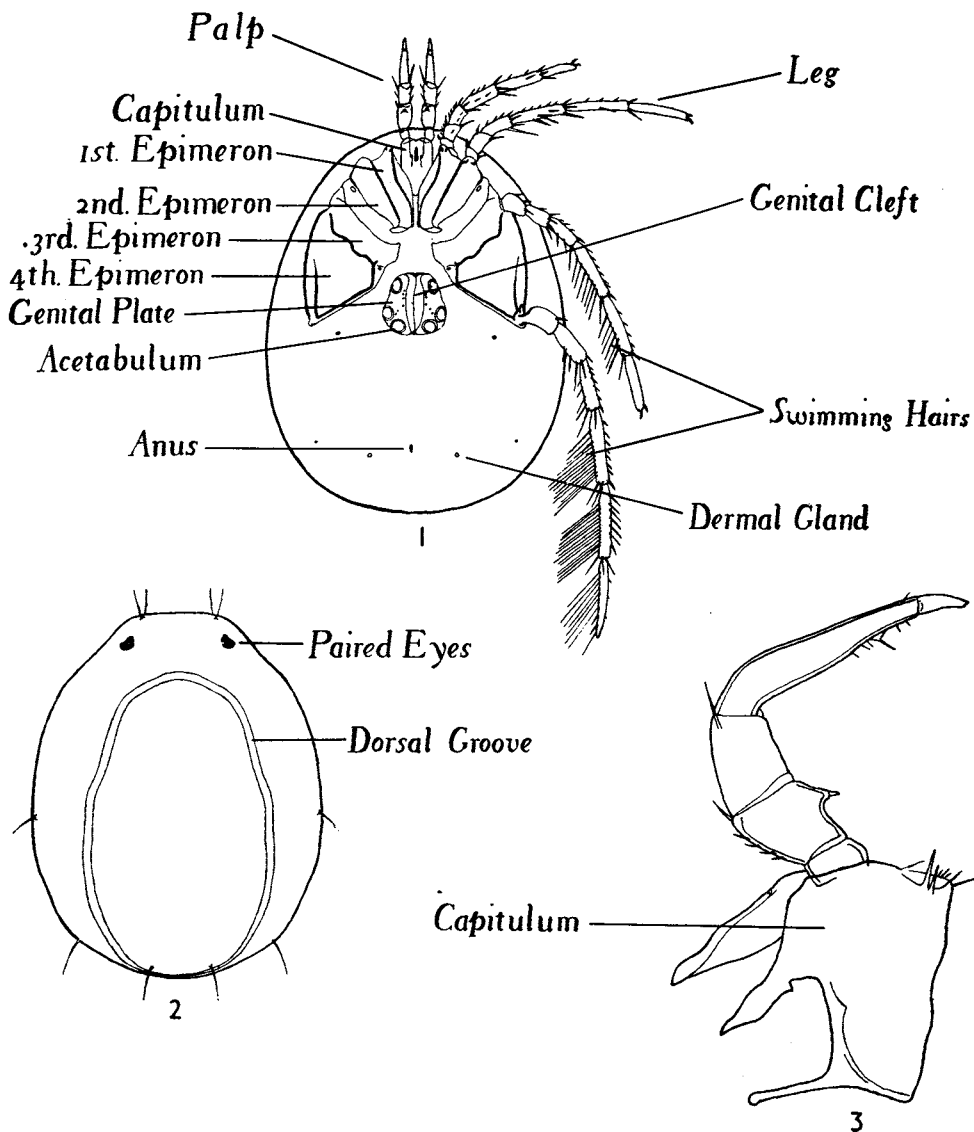


PLATE I. 1. *Limnesia maculata*, ventral; 2. *Arrenurus buccinator* ♀, dorsal; 3. *Limnesia maculata*, capitulum and palp side view.

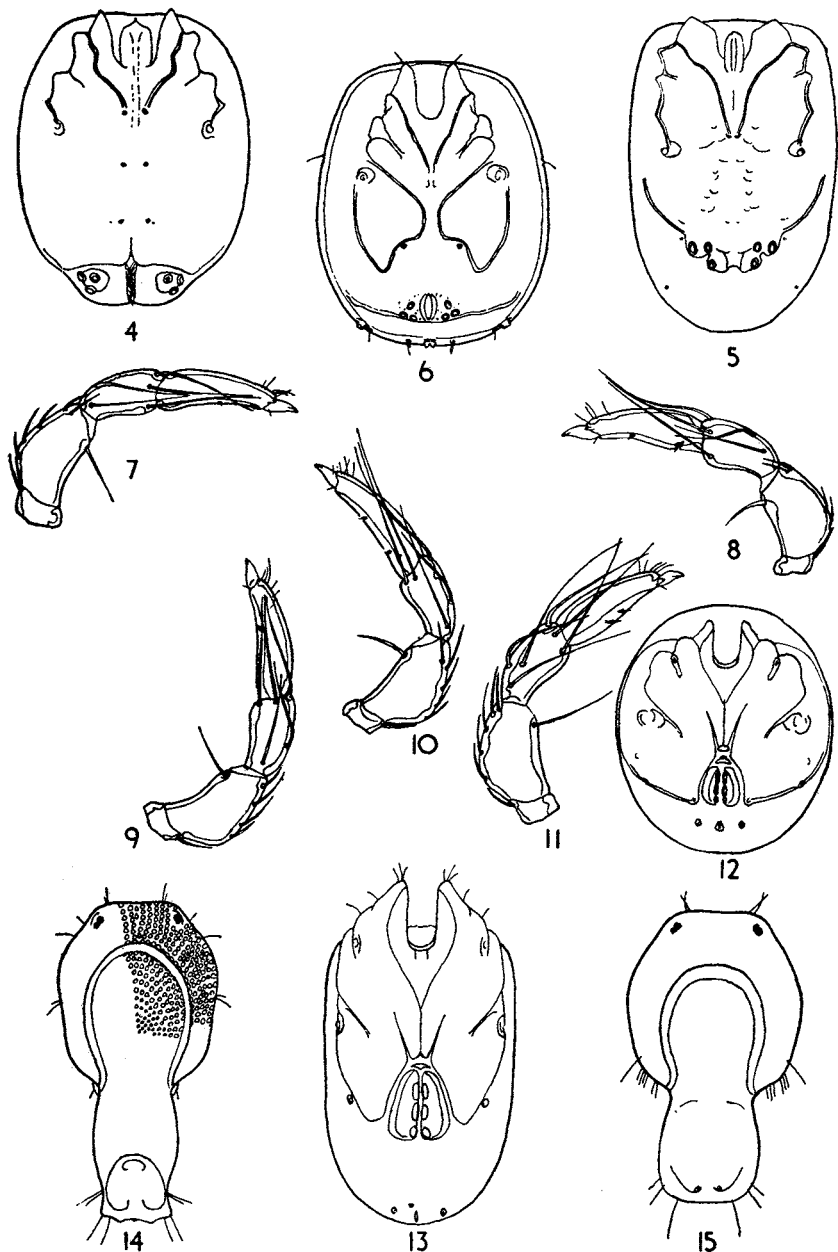
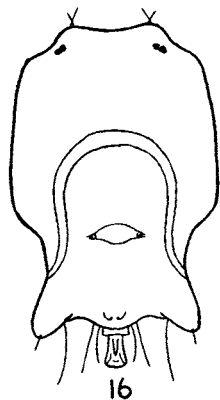
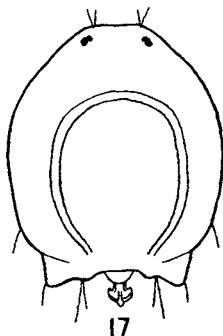


PLATE II. 4. *Brachypoda versicolor* ♀, ventral; 5. *B. versicolor* ♂, ventral; 6. *Ljanina bipapillata* ♂, ventral; 7. *Lebertia inaequalis*, left palp; 8. *L. glabra*, right palp; 9. *L. porosa*, right palp; 10. *L. insignis*, right palp; 11. *L. stigmatifera*, left palp; 12. *L. stigmatifera* ♂, ventral; 13. *L. celtica*, ventral; 14. *Arrenurus cylindratus* ♂, dorsal; 15. *A. globator* ♂, dorsal.

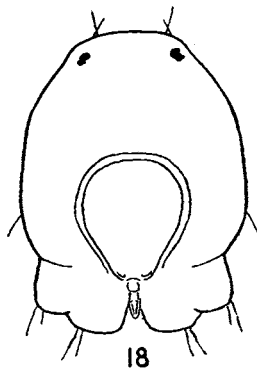
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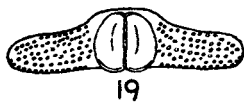
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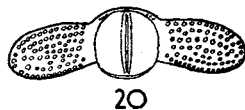
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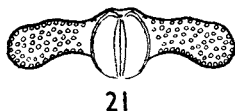
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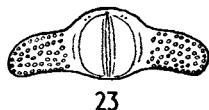
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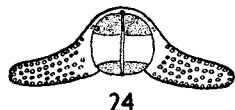
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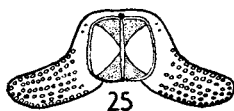
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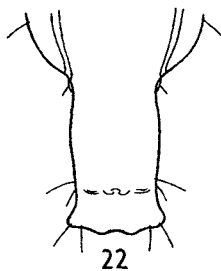
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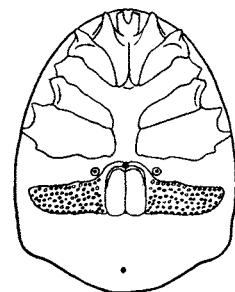
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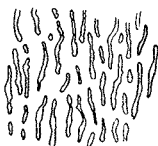
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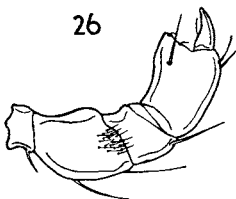
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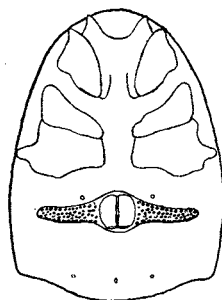
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PLATE III. 16. *Arrenurus cuspidifer* ♂, dorsal; 17. *A. albator* ♂, dorsal; 18. *A. biscissus* ♂, dorsal; 19. *A. mediorotundatus* ♀, genitalia; 20. *A. buccinator* ♀, genitalia; 21. *A. securiformis* ♀, genitalia; 22. *A. securiformis* ♂, dorsal cauda; 23. *A. cylindratus* ♀, genitalia; 24. *A. globator* ♀, genitalia; 25. *A. cuspidifer* ♀, genitalia; 26. *Lebertia glabra*, dorsal skin markings; 27. *A. albator* ♀, ventral; 28. *A. albator* ♀, right palp; 29. *A. crassicaudatus* ♀, ventral.

(Not to scale)

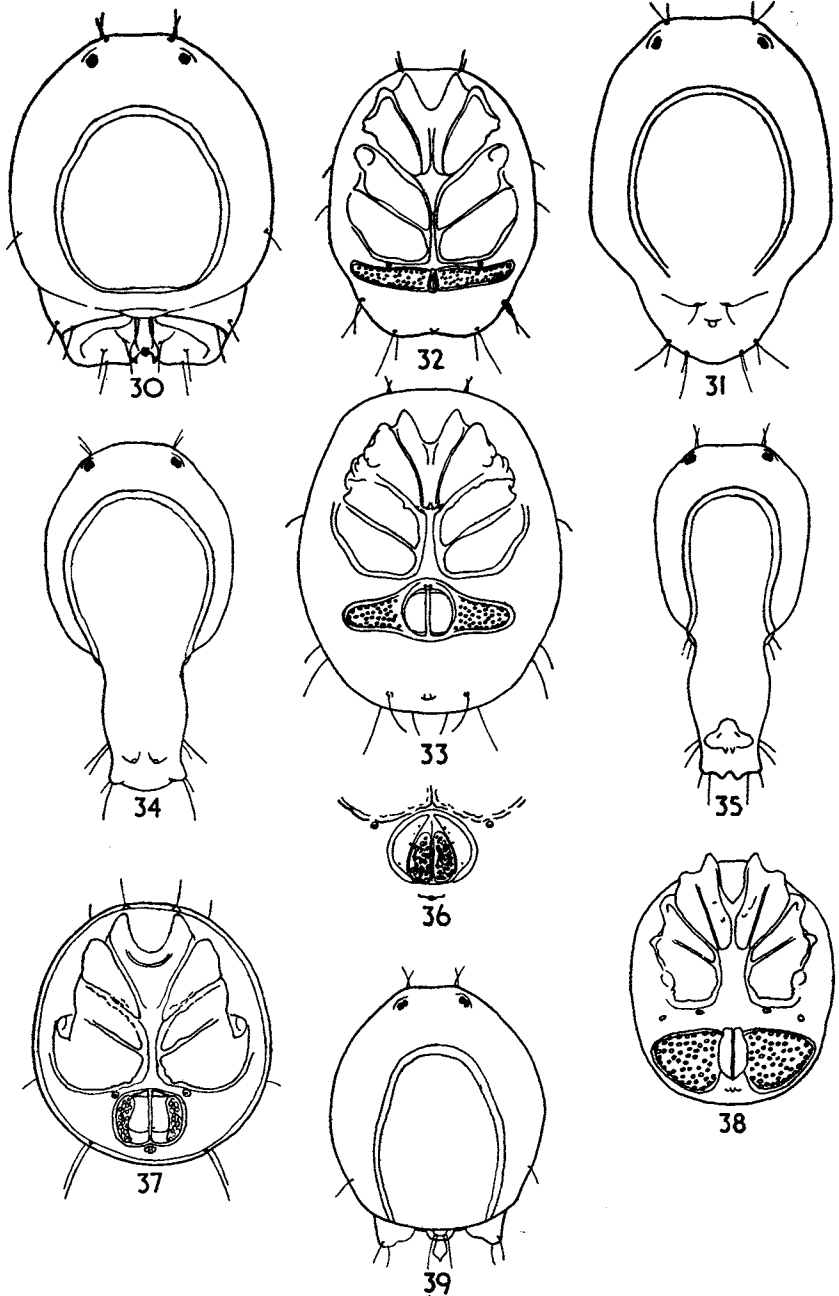


PLATE IV. 30. *Arrenurus novus* ♂, dorsal; 31. *A. inexploratus* ♂, dorsal; 32. *A. fontinalis* ♂, ventral; 33. *A. fontinalis* ♀, ventral; 34. *A. mediorotundatus* ♂, dorsal; 35. *A. buccinator* ♂, dorsal; 36. *A-Thienemannia schermeri* ♂, genitalia; 37. *A-Th. schermeri* ♀, ventral; 38. *Feltria minuta* ♀, ventral; 39. *Arrenurus crassicaudatus* ♂, dorsal.

(Not to scale)

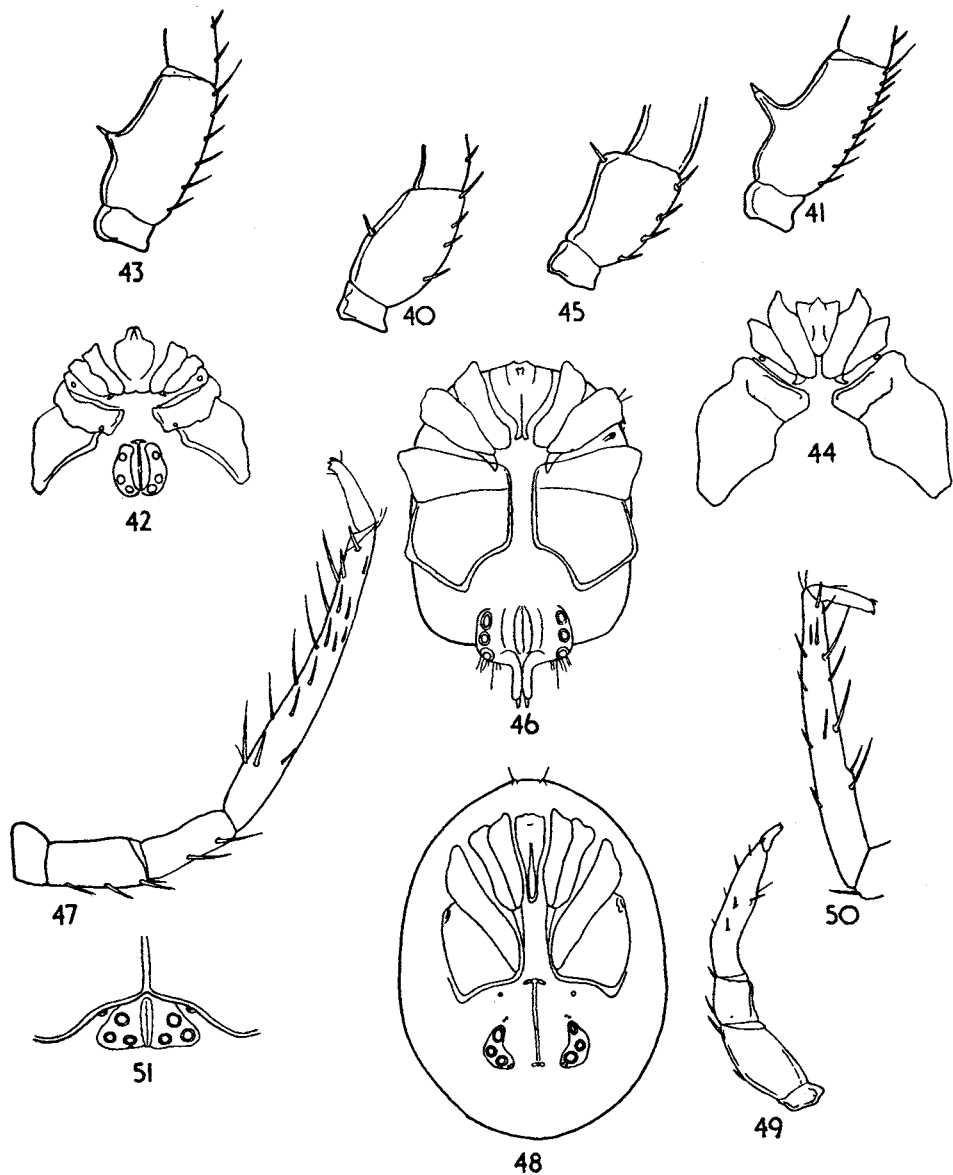


PLATE V. 40. *Limnesia connata*, palp segments 1-2; 41. *L. undulata*, palp segments 1-2; 42. *L. undulata* ♀ epimera and genitalia; 43. *L. fulgida*, palp segments 1-2; 44. *L. koenikei*, epimera; 45. *L. koenikei*, palp segments 1-2; 46. *Hydrochoreutes krameri* ♂, ventral; 47. *H. unguatus* ♀, palp; 48. *Wettina podagraca* ♀, ventral; 49. *Pionopsis lutescens* ♀, palp; 50. *Hydrochoreutes krameri* ♀, palp segments 4-5; 51. *Pionopsis lutescens* ♂, genitalia.

(Not to scale)

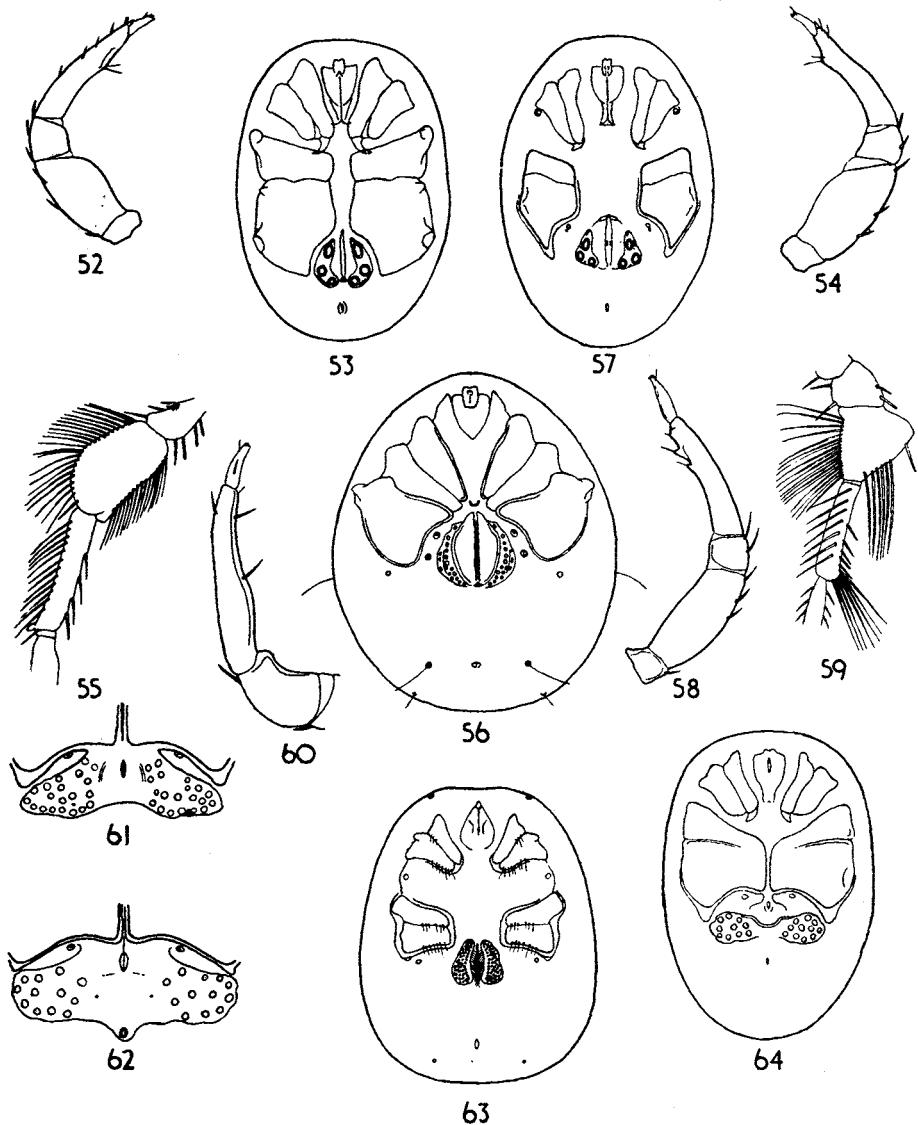


PLATE VI. 52. *Tiphys ornatus* ♀, palp; 53. *T. ornatus* ♀, ventral; 54. *T. torris* ♀, palp; 55. *T. ornatus* ♂, part of 4th leg; 56. *Midea orbiculata* ♀, ventral; 57. *Pionopsis lutescens* ♀, ventral; 58. *Piona coccinea* ♀, palp; 59. *Tiphys latipes* ♂, part of 4th leg; 60. *Piona carnea* ♀, palp; 61. *P. rotunda* ♂, genitalia; 62. *P. conglobata* ♂, genitalia; 63. *Hydrodroma despiciens*, ventral; 64. *Piona nodata* ♂, ventral.

(Not to scale)

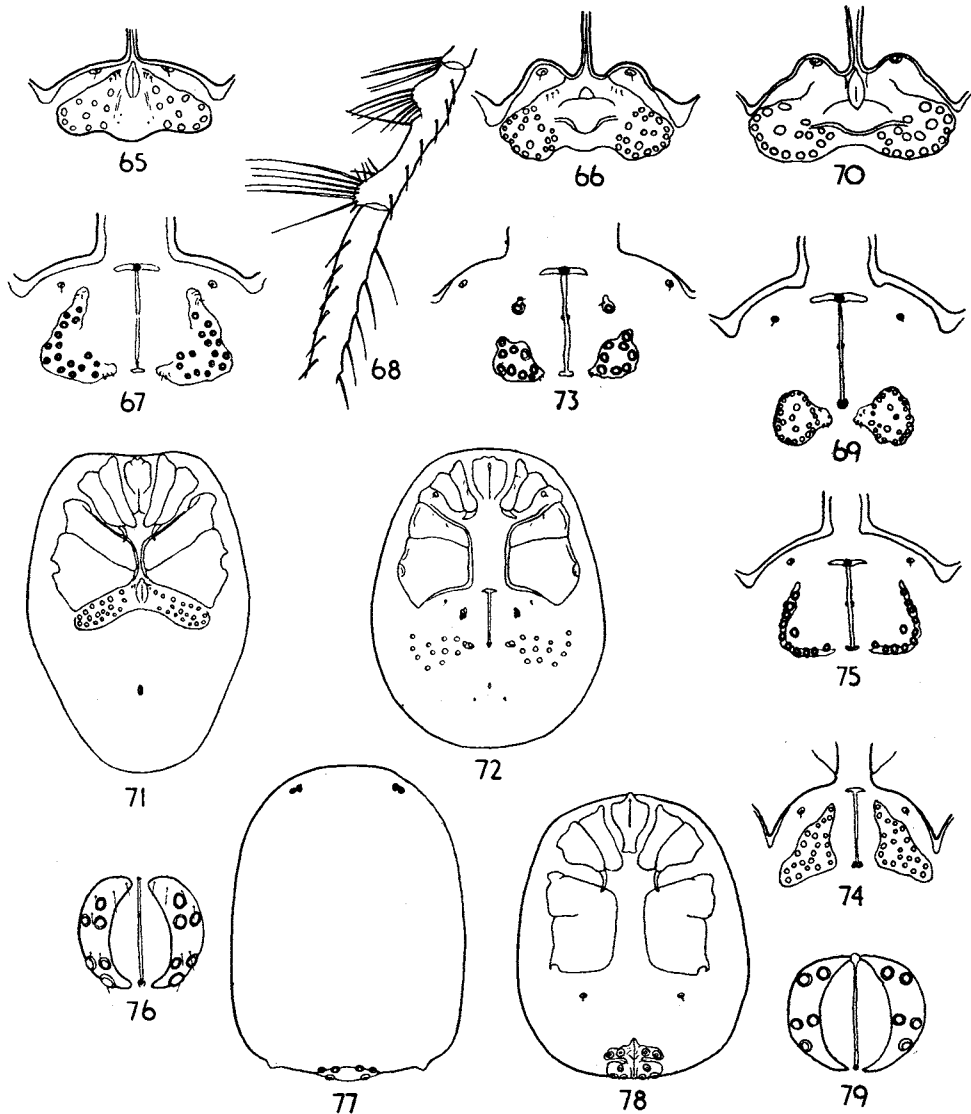


PLATE VII. 65. *Piona variabilis* ♂, genitalia; 66. *P. uncata* ♂, genitalia; 67. *P. rotunda* ♀, genitalia; 68. *P. coccinea* ♂, part of 4th leg; 69. *P. uncata* ♀, genitalia; 70. *P. carnea* ♂, genitalia; 71. *Forelia liliacea* ♂, ventral; 72. *Piona conglobata* ♀, ventral; 73. *P. variabilis* ♀, genitalia; 74. *Forelia liliacea* ♀, genitalia; 75. *Piona nodata* ♀, genitalia; 76. *Unionicola crassipes* ♂, genitalia; 77. *U. crassipes* ♀, dorsal; 78. *U. intermedia* ♀, ventral; 79. *U. figuralis* ♂, genitalia.

(Not to scale)

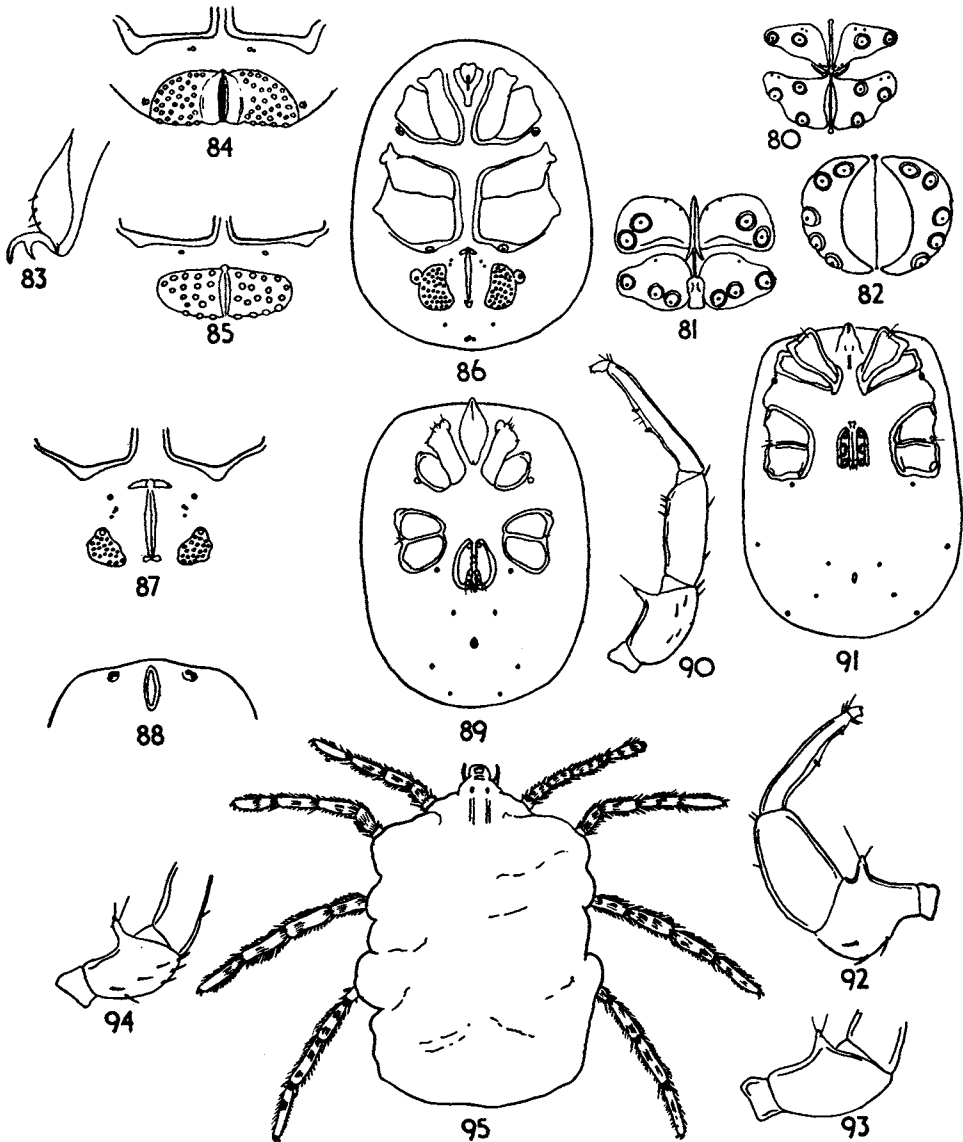


PLATE VIII. 80. *Unionicola figuralis* ♀, genitalia; 81. *U. aculeata* ♀, genitalia; 82. *U. aculeata* ♂, genitalia; 83. *U. intermedia*, foot claw; 84. *Neumania vernalis* ♂, genitalia; 85. *N. spinipes* ♂, genitalia; 86. *N. vernalis* ♀, ventral; 87. *N. spinipes* ♀, genitalia; 88. *Euthyas truncata*, dorsal cephalic region; 89. *E. truncata*, ventral; 90. *Sperchon setiger*, palp; 91. *S. setiger*, ventral; 92. *S. squamosus*, palp; 93. *S. glandulosus*, palp segments 1-2; 94. *S. clupeifer*, palp segments 1-2; 95. *Limnochaeres aquatica*, dorsal.

(Not to scale)

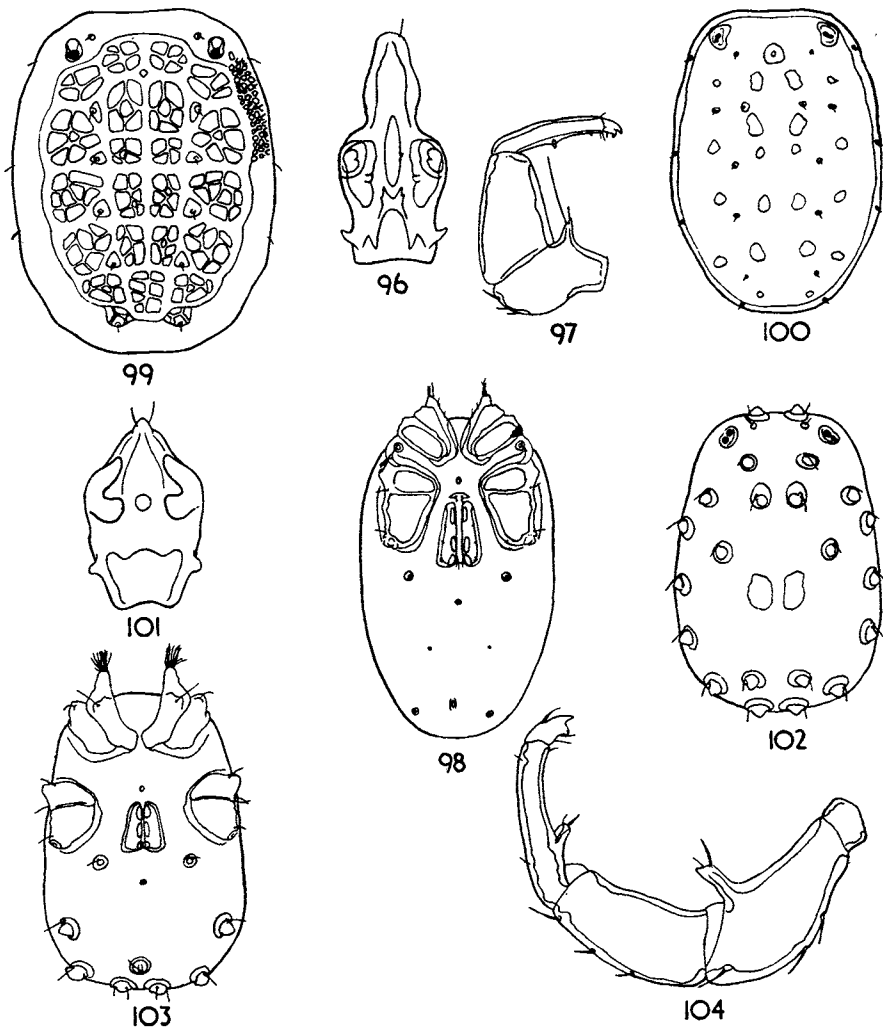


PLATE IX. 96. *Sperchon longissimus*, capitulum; 97. *S. longissimus* palp; 98. *S. longissimus*, ventral; 99. *Thyopsis cancellata*, dorsal; 100. *Thyas rivalis*, dorsal; 101. *Sperchon setiger*, capitulum; 102. *Sperchonopsis verrucosa*, dorsal; 103. *S. verrucosa*, ventral; 104. *S. verrucosa*, palp.

(Not to scale)

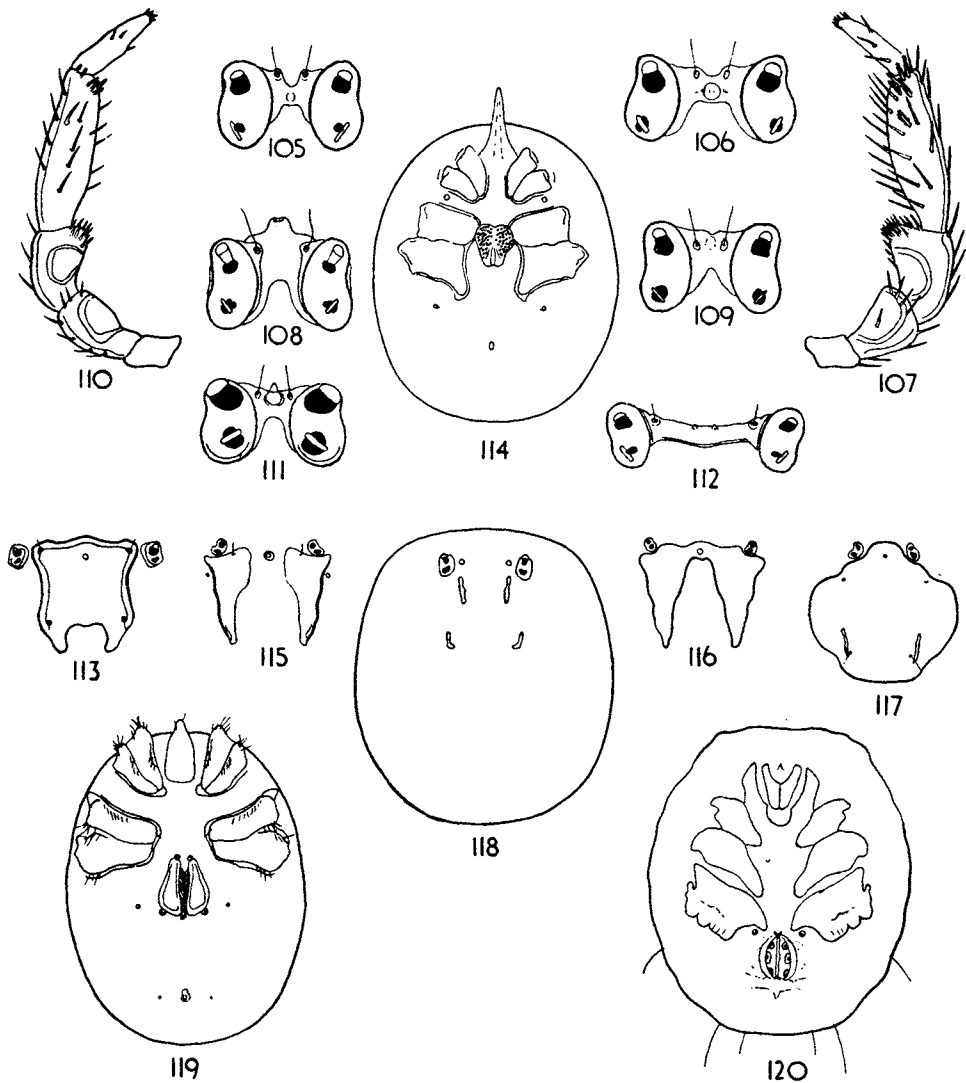


PLATE X. 105. *Eylais rimosa*, eye-plate; 106. *E. soari*, eye-plate; 107. *E. soari*, palp; 108. *E. infundibulifera*, eye-plate; 109. *E. extendens*, eye-plate; 110. *E. extendens*, palp; 111. *E. triarcuata*, eye-plate; 112. *E. hamata*, eye-plate; 113. *Hydryphantes ruber*, dorsal plate; 114. *Hydrachna paludosa*, ventral; 115. *H. globosa*, dorsal plate; 116. *H. paludosa*, dorsal plate; 117. *H. cruenta*, dorsal plate; 118. *H. leegei*, dorsal; 119. *Hydryphantes ruber*, ventral; 120. *Mideopsis orbicularis*, ventral.

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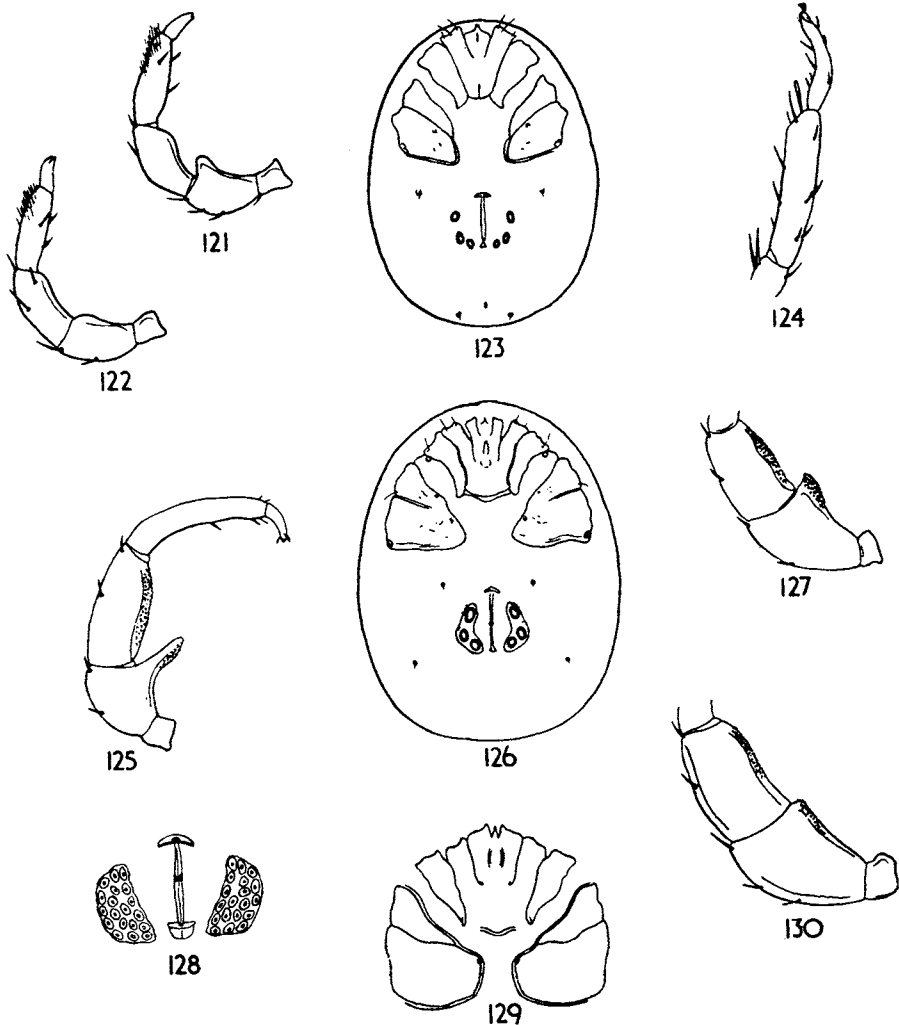


PLATE XI. 121. *Atractides nodipalpis* ♂, palp; 122. *A. spinipes*, palp; 123. *A. spinipes* ♀, ventral; 124. *A. spinipes*, 1st leg segments 5-6; 125. *Hygrobatas fluviatilis*, palp; 126. *H. fluviatilis* ♀, genitalia; 127. *H. longipalpis*, palp segments 1-3; 128. *H. norvegicus* ♀, genitalia; 129. *H. longipalpis*, epimera; 130. *H. nigromaculatus*, palp segments 1-3.

(Not to scale)

21. Postero-lateral corners of cauda produced ("fish-tail") (Fig. 22).  
**Arrenurus securiformis**  
Sides of cauda almost straight, wider at postero-lateral corners; dark green with blue tint along lateral borders; length about 1.2 mm. Thick vegetation.  
Postero-lateral corners of cauda little produced (Figs. 14 and 35). 22
22. Two central projections of hind border of cauda large, separated from each other by an interval about equal to width of each projection (Fig. 35).  
**Arrenurus buccinator**  
Dark green, usually with yellow blotch on fore-part of dorsum and at base of cauda; length about 1.3 mm. Ponds.  
Two central projections of hind border of cauda small, separated from each other by an interval greater than width of each projection (Fig. 14).  
**Arrenurus cylindratus**  
Green, cauda yellow; length about 1.0 mm. Thick vegetation, not usually in ponds.
23. Epimera close together, separated more or less only by their sutures (Fig. 33); no swimming hairs.  
**Arrenurus fontinalis**  
Sluggish; reddish; length about 1.0 mm.  
Epimera clearly in 4 blocks, well separated (Fig. 27); swimming hairs present. 24
24. Lips around genital cleft carrying small, dark, chitinous patches (Fig. 24). 25  
Lips without patches. 27
25. Patches on genital lips confined to either end of lips, not reaching towards each other (Fig. 24); small, not exceeding about 0.9 mm.  
**Arrenurus globator**  
Genital plates rather long, slightly recurved; body oval; green; length 0.7-0.9 mm.  
Patches at either end of genital lips reaching out towards each other at centre (Fig. 25); length greater than 1.0 mm. 26
26. Sides of genital lip patches concave (Fig. 25). **Arrenurus cuspidifer**  
Genital plates long, slightly recurved; slight projecting lobes at postero-lateral corners of body; length about 1.3 mm.  
Sides of genital lip patches convex. **Arrenurus novus**  
Genital plates long, directed postero-laterally, not recurved; body oval; length about 1.2 mm.
27. 2nd segment of palp with mat of short bristles on inner surface (Fig. 28). 28  
2nd segment of palp without mat of short bristles, though bearing 1-6 long spines. 30
28. Mat of bristles on 2nd segment of palp small, containing up to 20 bristles (Fig. 28). **Arrenurus albator**  
Genital plates extending almost to body margin (Fig. 27), directed straight out to flanks; body with pronounced posterior bays in outline; length about 0.8 mm.  
Mat of bristles on 2nd segment of palp large, containing numerous bristles. 29

29. Genital plates directed straight out towards body margin (similar to *A. albator*). **Arrenurus biscissus**  
 Genital plates extending over half-way to body margin; length about 0.8 mm.  
 Genital plates directed slightly postero-laterally (Fig. 19). **Arrenurus mediorotundatus**  
 Genital plates not extending more than half-way to body margin; length about 1.1 mm.
30. Genital plates long and recurved (Fig. 29). **Arrenurus crassicaudatus**  
 Median border of 4th epimera only slightly longer than that of 3rd; distance between the two 4th epimera large; genital area close to epimera; length about 0.9 mm.  
 Genital plates shorter, not recurved (Figs. 20, 21 and 23). 31
31. Genital plates club-shaped with a narrow neck proximally (Fig. 21). **Arrenurus securiformis**  
 Median border of 4th epimera considerably longer than that of 3rd; genital area about mid-way between epimera and hind body margin; length about 1.1 mm.  
 Genital plates not obviously club-shaped. 32
32. Median border of 4th epimeron hardly longer than that of 3rd; genital plates short, meeting each other behind genital cleft. **Arrenurus inexploratus**  
 Body oval; length about 1.1 mm.  
 Median border of 4th epimeron much longer than that of 3rd; genital plates longer, not or hardly meeting behind genital cleft (Figs. 20 and 23). 33
33. Genital plates obviously narrowed proximally (Fig. 20). **Arrenurus buccinator\***  
 Genital area mid-way between epimera and hind body margin; body oval; length up to 1.3 mm.  
 Genital plates not narrowed proximally (Fig. 23). **Arrenurus cylindratus\***  
 Genital area closer to epimera; body oval; length about 1.1 mm.
34. Swimming hairs present. 35  
 Swimming hairs absent (long spines on the legs may be present). 95
35. Rostrum long, nearly as long as palpi (Fig. 114); genital plates with many tiny acetabula; sclerotized dorsal plates present behind the eyes (**Hydrachna**). 36  
 Rostrum much shorter than the palpi; genital plates variable. 39
36. A single, wide, dorsal plate across the forward quarter of the body immediately behind the eyes and with its central portion extending between the eyes (Fig. 117). **Hydrachna cruenta**  
 A thickened ridge in line with each eye capsule, lying near posterior border of dorsal plate; bright red; length about 3.0 mm.  
 Dorsal plate otherwise. 37

\* The females of these two species are almost impossible to separate satisfactorily; identification should be done on the males

37. Dorsal plate represented by 4 sclerotized strips distributed as in Fig. 118.  
**Hydrachna leegei**  
 Posterior plates somewhat curved, each with a hair papilla within the curve; dark red; length 2.0-2.4 mm.  
 Dorsal plates otherwise, much larger. 38
38. One elongate, almost hatchet-shaped plate behind each eye capsule, the anterior end extending forwards median to the eye (Fig. 115).  
**Hydrachna globosa**  
 Small median eye present between anterior ends of plates; bright red; length up to 2.3 mm.  
 Dorsal plates as in *H. globosa* but joined across the anterior ends (Fig. 116); central portion of bridge so formed extending in front of the level of the eyes.  
**Hydrachna paludosa**  
 Median eye present on bridge between plates; bright red; length about 2.5 mm.
39. Eye capsules close together on dorsal surface, connected by a sclerotized bridge (ocular bridge); genital area without acetabula, lying between anterior epimeral blocks; 4th legs without swimming hairs and trailing during locomotion (**Eylais\***). 40  
 Eyes far apart (Fig. 2); genital area variable. 45
40. Ocular bridge narrow, longer than width of either eye capsule (Fig. 112).  
**Eylais hamata**  
 Front and hind borders of bridge irregularly sinuous; hair papilla at each end of bridge, close to capsules; red; length up to 4 mm.  
 Ocular bridge shorter than width of either eye capsule, usually with a deep bay posteriorly. 41
41. Anterior border of ocular bridge projecting in front of level of eye capsules (Fig. 108). 42  
 Anterior border of ocular bridge not projecting in front of eye capsules, but more or less bayed centrally (Fig. 105). 43
42. Central projection of anterior border of ocular bridge large, wide based (Fig. 108); ventral border of 4th segment of palp straight or slightly concave with a slight neck proximally.  
**Eylais infundibulifera**  
 Length up to 7.0 mm.  
 Central projection of anterior border of ocular bridge small, barely projecting beyond level of eye capsules (Fig. 111); ventral border of 4th segment of palp slightly convex with an obvious neck proximally.  
**Eylais triarcuata**  
 Small bulge with hair papilla on either side of more prominent central projection of ocular bridge; length up to 5.0 mm.
43. Anterior border of ocular bridge with a deep bay such that sclerotized hind border of bay narrower than bay itself (Fig. 105).  
**Eylais rimosa**  
 Bulge with hair papilla on either side of bay in ocular bridge; length up to 3.5 mm.  
 Anterior bay of ocular bridge less deep than its sclerotized hind border (Fig. 106). 44

\* The ocular area of *Eylais* should be examined with the sclerotized parts absolutely horizontal. Ideally the ocular bridge should be dissected off and mounted, but it can usually be examined satisfactorily if the specimen is tilted backwards and propped in some way.

44. Bay in anterior border of ocular bridge usually shallow not extending between the hair papillae (Fig. 109); thickened oval region (for muscle attachment) in centre of bridge; 3rd segment of palp with ventrolateral bulge distally, carrying 10-13 short spines (Fig. 110). **Eylais extendens**  
Outer flank of 4th segment of palp with a row of about 5 long spines, with a few pectinate spines distally; length up to 4.0 mm.
- Bay in anterior border of ocular bridge usually deeper, extending somewhat between the hair papillae (Fig. 106); thickened circular muscle attachment in centre of bridge, usually more obvious than in *E. extendens*; 3rd segment of palp with ventro-lateral bulge distally, carrying 13-16 short spines (Fig. 107). **Eylais soari**  
Outer flank of 4th segment of palp with a row of about 8 long spines, with a few pectinate spines distally; length about 4.5 mm.
45. One genital plate on each side of genital cleft, carrying 3 acetabula (Figs. 1, 57, 119). 46  
More than 3 acetabula on each side of genital cleft. 65
46. 1st pair of epimera fused to a ventral plate so that they appear to have no posterior margins (Fig. 120); epimera not divided into 4 blocks. **Mideopsis orbicularis**  
Body almost circular in dorsal view; hard exoskeleton with soft dorsal groove around edge of body; palpi short; buff with brown dorsal blotches and a pale dorsal Y; length up to 1.0 mm. Rivers.  
1st pair of epimera not fused to a ventral plate; epimera usually in 4 blocks. 47
47. Acetabula very small and difficult to see; body bright red; epimeral blocks widely spaced, their outlines sometimes difficult to trace (Fig. 119). **Hydryphantes ruber**  
Sclerotized plate over anterior region of dorsum (Fig. 113), its anterior part extending between the eyes; posterior border of plate concave, the concavity not extending more than quarter the length of whole plate; length up to 2.0 mm. Ponds.  
Acetabula large. 48
48. 4th epimera triangular; legs arising from their postero-lateral apices (Fig. 1) (**Limnesia**). 49  
4th epimera otherwise (Figs. 48 and 57). 53
49. 1st epimera drawn in behind capitulum, their median borders then turning to extend posteriorly parallel with each other (Fig. 1). 50  
1st epimera not as above (Fig. 42). 51
50. Posterior halves of median borders of 1st epimera extending parallel with each other (Fig. 1). **Limnesia maculata**  
Projection on ventral surface of 2nd segment of palp directed slightly posteriorly (Fig. 3); size of epimera rather variable, normally covering less than half ventral surface; ♂ with longer legs and palpi than ♀; usually red with blue legs and epimera; length up to 2.0 mm.  
Posterior quarters of median borders of 1st epimera extending parallel with each other (Fig. 44). **Limnesia koenikei**  
Ventral surface of 2nd segment of palp bulging somewhat distally, carrying a stiff, spinous projection (Fig. 45); yellowish with dark dorsal blotches; length up to 1.2 mm.

51. Ventral surface of 2nd segment of palp with no projection except for small spine (Fig. 40). **Limnesia connata**  
 Very small; buff; length about 0.7 mm.  
 Ventral surface of 2nd segment of palp with projection ending in chitinous point. 52
52. Chitinous point at tip of ventral projection on palp obviously shorter than rest of projection (Fig. 41); pair of small chitinous plates usually present in centre line of posterior dorsal region. **Limnesia undulata**  
 1st epimera united subcutaneously behind capitulum; pale to dark red, sometimes greenish; length up to 2.0 mm.  
 Chitinous point at tip of ventral projection on palp as long as rest of projection (Fig. 43); small dorsal plates usually absent. **Limnesia fulgida**  
 1st epimera not united subcutaneously behind capitulum; red; length up to 2.0 mm.
53. 4th epimera having no median borders (Fig. 48). **Wettina podagrica**  
 Median border of posterior epimeral block formed entirely of median border of 3rd epimera; posterior extension of capitulum long; pair of small projections between eyes, each bearing a bristle; genital plates of ♀ not extending beyond half length of cleft; genital plates of ♂ united at each end of cleft; length up to 0.8 mm.  
 4th epimera having median borders, often large, hind border concave. 54
54. Palpi long and slender; 4th segment of palp with many long bristles (Fig. 47) (**Hydrochoreutes**). 55  
 Palpi shorter; 4th segment bearing few bristles, often bearing distally a short thick spine on inner surface (Fig. 49) (**Tiphys** and **Pionopsis**). 58
55. Posterior extremity of body bearing a slender projection, the petiolus (Fig. 46). ♂♂. 56  
 Petiolus absent. ♀♀. 57
56. Petiolus extending considerably further than the sheathing structure along its flanks. **Hydrochoreutes unguatus**  
 Tip of petiolus more or less truncate; yellowish with brown blotches dorsally, epimera blue; length about 0.7 mm.  
 Petiolus barely extending beyond its sheath (Fig. 46). **Hydrochoreutes krameri**  
 Tip of petiolus carrying two teeth; yellowish with brown dorsal blotches, epimera blue; length about 0.6 mm.
57. 4th segment of palp with about 15 long spines on the ventro-median surface (Fig. 47), the most proximal spine not arising from a projection. **Hydrochoreutes unguatus**  
 Palpi sometimes as long as the body; length up to 2.0 mm.  
 4th segment of palp with about 8 long spines on the ventro-median surface (Fig. 50), the most proximal spine arising from a small projection. **Hydrochoreutes krameri**  
 Palpi shorter than in *H. unguatus*; length about 1.4 mm.
58. 4th epimera very large, almost or quite meeting in mid-line; genital area usually lying partly in a bay formed by hind borders of 4th epimera (Fig. 51). ♂♂. 59  
 4th epimera smaller, appreciably separated (Fig. 57). ♀♀. 62

59. 4th segment of 4th leg same width as adjacent segments.

**Pionopsis lutescens**

4th segment of palp without obvious ventral projections, rather slender; genital area almost entirely within bay formed by hind borders of 4th epimera; genital plates meeting at both ends of genital cleft (Fig. 51); dark green with dorsum yellower centrally; length about 0.7 mm. Ponds and lakes.

4th segment of 4th leg considerably wider than adjacent segments, triangular or more or less rectangular (**Tiphys**).

60

60. 4th segment of 4th leg triangular (Fig. 59).

**Tiphys latipes**

4th segment of palp short and broad with two ventral projections, each bearing a bristle; genital area near hind end of body, not within bay formed by hind borders of 4th epimera; dark buff with brown flecks, or reddish; length about 0.7 mm. Ponds.

4th segment of 4th leg more or less rectangular (Fig. 55).

61

61. 4th segment of palp bearing obvious ventral projection, segment short and broad (Fig. 54).

**Tiphys torris**

Genital area within bay formed by hind borders of 4th epimera; genital plates triangular; length about 0.6 mm.

4th segment of palp not bearing obvious ventral projection, longer and more slender (Fig. 52).

**Tiphys ornatus**

Genital area within bay formed by hind borders of 4th epimera; genital plates less regularly triangular; length up to 1.0 mm.

62. 4th segment of palp bearing very small projections ventrally (Fig. 52); segment slender.

63

4th segment of palp bearing two large projections ventrally (Fig. 54); segment broader.

64

63. 4th epimera large, rather close together (Fig. 53); genital plates extending almost whole length of genital cleft.

**Tiphys ornatus**

Reddish; length about 2.0 mm.

4th epimera smaller, far apart (Fig. 57); genital plates seldom extending more than half-way along genital cleft, more triangular.

**Pionopsis lutescens**

Grey-brown with yellow dorsal T; length up to 2.0 mm.

64. Genital plates triangular, not extending half-way along genital cleft.

**Tiphys torris**

Hind borders of 4th epimera deeply concave; buff with brown dorsal patches, legs and epimera bluish; length about 0.8 mm.

Genital plates elongate, extending at least half-way along genital cleft.

**Tiphys latipes**

Hind borders of 4th epimera shallowly concave; reddish, with darker dorsal patches; length up to 1.0 mm.

65. 1st pair of epimera united behind capitulum without dividing suture; other epimera in contact with each other on each side, but demarcated by sutures (Fig. 56).

**Midea orbiculata**

Genital area partly within bay formed by hind borders of 4th epimera; genital plates of ♀ regularly curved, extending whole length of genital cleft, bearing several small acetabula; genital plates of male somewhat irregular, extending from just behind genital cleft to about half-way along cleft, bearing about 6 small acetabula on inner margin, 2-3 acetabula anterior to plates; 6th segment of ♂ 3rd leg having concavity.

Epimera not as above; 1st pair of epimera not united behind capitulum.

66

66. Epimera small and narrow; epimeral blocks widely separated (Fig. 63).  
**Hydrodroma despiciens**  
 Genital plates compact, slightly curved, extending whole length of genital cleft, bearing about 80 small acetabula; usually bright red, occasionally brownish; length up to 2.0 mm.  
 Epimera large, especially 4th; 4th epimera more or less rectangular, with or without concave hind border, or triangular (Figs. 71 and 72). 67
67. Hind border of 4th epimera strongly concave (Fig. 72), with long median border (**Piona**). 68  
 Hind border of 4th epimera more or less straight (Fig. 78), or 4th epimera triangular with no median border (Fig. 71). 85
68. 4th epimera almost or quite meeting in mid-line; genital plates usually fused anteriorly to epimera; genital cleft small (Fig. 70); 4th segment of 4th leg with a cavity (Fig. 68). ♂♂. 69  
 4th epimera appreciably separated; genital plates not fused to epimera; genital cleft long (Fig. 67); 4th segment of 4th leg normal. ♀♀. 77
69. Genital area with deep cavity immediately behind genital cleft (Fig. 66). 70  
 Genital area without such a cavity. 74
70. Genital plates very large, each bearing about 90 acetabula.  
**Piona longipalpis**  
 Large; length up to 3.0 mm.  
 Genital plates smaller, bearing 30 or less acetabula. 71
71. 4th segment of palp bulging slightly ventrally, without chitinous papillae (Fig. 60). **Piona carnea**  
 Each genital plate with 12-15 acetabula (Fig. 70); distal end of 4th segment of 4th leg with nine swimming hairs; buff or reddish with brown dorsal patches; length up to 2.0 mm.  
 4th segment of palp with 2 or more papillae ventrally (Fig. 58). 72
72. Each genital plate with 8-12 acetabula (Fig. 64). **Piona nodata**  
 4th segment of palp with two strong papillae ventrally; distal end of 4th segment of 4th leg with 3 swimming hairs; reddish; length about 0.8 mm.  
 Each genital plate with 20-35 acetabula. 73
73. 4th segment of palp with 3 strong papillae ventrally (Fig. 58). **Piona coccinea**  
 Each genital plate with 24-35 acetabula; reddish, often with blue legs and epimera; length about 1.5 mm.  
 4th segment of palp with at least 4 papillae. **Piona uncatata**  
 Each genital plate with 20-25 acetabula (Fig. 66); buff to red with dark dorsal patches; length about 1.0 mm.
74. Each genital plate with 30-35 acetabula. **Piona rotundoides**  
 Length up to 1.8 mm.  
 Each genital plate with 26 or less acetabula. 75
75. Anus resting on an extension of genital plates (Fig. 62); claws of 6th segment of 3rd leg short. **Piona conglobata**  
 Each genital plate with 12-15 acetabula; length about 0.6 mm.  
 Anus free from genital plates; one claw of 6th segment of 3rd leg very long. 76

76. Genital plates united with 4th epimera medially (Fig. 61), each plate with 12-20 acetabula. **Piona rotunda**  
Length about 0.8 mm.  
Genital plates not united with 4th epimera, each plate with 8-12 acetabula (Fig. 65). **Piona variabilis**  
Length about 0.6 mm.
77. Most of acetabula resting freely on skin, not on plates (Fig. 72). **Piona conglobata**  
About 15-18 acetabula, some of these grouped together on small plates; brown; length up to 1.2 mm.  
Most or all of acetabula on genital plates (Fig. 73). 78
78. Genital plates weakly or strongly curved, extending almost complete length of genital cleft (Figs. 67 and 75). 79  
Genital plates not as above, shape irregular, situated on either side of hind end of genital cleft; one or two acetabula may be forward on separate plates (Fig. 73). 81
79. Genital plates strongly curved, each bearing 30-40 acetabula; 2-3 acetabula lying free on skin within curve of plate. **Piona rotundoides**  
Length up to 1.8 mm. 80  
Genital plates each bearing 8-20 acetabula.
80. Genital plates strongly curved (Fig. 67), each bearing 15-20 acetabula. **Piona rotunda**  
Acetabula small, one or two lying free on skin inside curve of plate; buff; length up to 1.1 mm.  
Genital plates weakly curved (Fig. 75), each bearing 8-12 (rarely up to 18) acetabula. **Piona nodata**  
Common form bears acetabula in single row along each plate, with 1-2 lying free on skin inside curve of plate; acetabula larger than in *P. rotunda*; subspecies *P.n. laminata* has central area of genital plates wider, accommodating more than single row of acetabula; length up to 2.0 mm.
81. One large genital plate on each side of cleft, bearing about 10 acetabula; small plate forward of each, bearing 1-2 acetabula (Fig. 73). **Piona variabilis**  
Buff to red; length about 1.3 mm.  
Only one genital plate on each side of genital cleft. 82
82. 4th segment of palp without chitinous projections ventrally (Fig. 60). **Piona carnea**  
Each genital plate with 18-24 acetabula; buff; length up to 3.0 mm.  
4th segment of palp with chitinous projections ventrally (Fig. 58). 83
83. Each genital plate with 60-80 acetabula. **Piona longipalpis**  
Red with darker dorsal blotches; length up to 3.0 mm.  
Each genital plate with 15-25 acetabula. 84
84. 4th segment of palp with two strong ventral projections (Fig. 58). **Piona coccinea**  
On each plate 2 acetabula larger than others; narrow extension of genital plate medio-anteriorly carrying group of hairs; red; length about 3.0 mm.  
4th segment of palp with two strong ventral projections and several smaller projections. **Piona uncata**  
Buff to red, epimera and legs bluish; length about 1.5 mm.; (genital area Fig. 69).

85. 4th epimera triangular, with no median border (Fig. 71); genital plates elongate, extending obliquely from cleft, united to each other at either end of cleft in ♂, not united in ♀. **Forelia liliacea**  
 Each genital plate with 17-25 acetabula; posterior epimeral block close together in ♂, far apart in ♀ (Fig. 74); body pyriform in ♂, oval in ♀.
- 4th epimera more or less rectangular, with long median border (Fig. 78). 86
86. 5-6 large acetabula on each side of genital cleft; 2 sickle-shaped genital plates extending whole length of cleft, or 4 small plates not extending whole length of cleft (Figs. 79 and 81) (**Unionicola**). 87
- 15-40 small acetabula on each side of genital cleft; 2 wide genital plates (Figs 84 and 86) (**Neumania**). 90
87. 6 acetabula on each side of genital cleft. **Unionicola crassipes**  
 ♂. 2 sickle-shaped genital plates, each with 2 triangles of 3 acetabula (Fig. 76);  
 ♀. 4 small genital plates, each with triangle of 3 acetabula; legs long and slender, very spinous; buff with dark dorsal patches and yellow dorsal T; length up to 1.5 mm.
- 5 acetabula on each side of genital cleft. 88
88. 4th segment of palp with insignificant papillae ventrally; foot claws with strong accessory claws (Fig. 83); parasitic in mussel *Anodonta*.  
**Unionicola intermedia**  
 ♂. 2 sickle-shaped genital plates, each with row of 5 acetabula; ♀. 4 small genital plates, anterior pair with 2 acetabula, posterior pair with triangle of 3 acetabula (Fig. 78); buff with brown dorsal patches; length up to 1.0 mm.
- 4th segment of palp with long papillae ventrally; accessory foot claws insignificant; partially parasitic in mussel *Anodonta*. 89
89. In both sexes posterior 3 acetabula on each side forming a triangle.  
**Unionicola figuralis**  
 ♂. 2 genital plates (Fig. 79); ♀. 4 genital plates, anterior pair with 2 acetabula, posterior pair with 3 acetabula (Fig. 80); buff to bluish with darker dorsal patches; length up to 1.4 mm.
- In both sexes posterior 3 acetabula on each side not forming a triangle.  
**Unionicola aculeata**  
 ♂. 2 genital plates (Fig. 82); ♀. 4 genital plates, anterior pair with 2 acetabula, posterior pair with 3 acetabula in oblique, curved row (Fig. 81); buff with brown dorsal patches; length up to 1.2 mm.
90. Genital plates united at either end of genital cleft (Fig. 85). ♂♂. 91  
 Genital plates not united (Fig. 86) ♀♀. 93
91. Genital area at hind end of body, only partially seen in ventral view (Fig. 84). **Neumania vernalis**  
 Each genital plate with up to 40 acetabula; buff to grey with darker dorsal patches; length about 0.7 mm. Standing water with thick vegetation.
- Genital area somewhat removed from hind end of body. 92
92. 3rd segment of 4th leg thickened; genital plates wider (Fig. 85); all acetabula equal in size. **Neumania spinipes**  
 Buff with dark dorsal patches, epimera greenish; length 1.5 mm. Standing and slow-moving water.
- 3rd segment of 4th leg not thickened; genital plates narrower; two acetabula on each plate larger than remainder. **Neumania deltoides**  
 Yellowish; length up to 1.5 mm. Slow-moving water with thick vegetation.

93. Large gland plate united to lateral border of each genital plate (Fig. 86).  
     Each genital plate with 30-40 acetabula; length 1.3 mm. **Neumania vernalis**  
     Gland plate not united to genital plates. 94
94. Each genital plate with 15-20 acetabula **Neumania spinipes**  
     Length up to 1.5 mm.  
     Each genital plate with 35-45 acetabula. **Neumania deltoides**  
     Length up to 1.5 mm.
95. Eyes close together on narrowly projecting anterior border of body (Fig. 95); body very soft and capable of great changes of shape; legs thick and hairy. **Limnochares aquatica**  
     Epimera often partly hidden by folds of the integument when alive; very sluggish; bright red; length up to 4.0 mm. Muddy rivers.  
     Not as above. 96
96. Acetabula small and numerous (Figs. 37 and 38); less than 0.7 mm. long. 97  
     3 acetabula on each side of genital cleft (Figs. 91 and 119), or acetabula many and length greater than 0.9 mm. 98
97. Genital plates covering large area of posterior ventral surface (Fig. 38); dorsum carrying large central sclerotized plate, flanked by smaller plates. **Feltria minuta**  
     In ♂ genital plates fused across mid-line; small genital cleft at centre; in ♀ genital plates separate (Fig. 38); hind border of body smoothly rounded; length up to 0.5 mm. Brooks.  
     Genital plates confined to small enclosure on posterior ventral surface (Fig. 37). **A-Thienemannia schermeri**  
     ♂ genital area, Fig. 36; ♀ genital area Fig. 37; red; length up to about 0.7 mm. Cold springs and seepages.
98. 3 very small acetabula on each side of genital cleft, one at anterior end, remaining two close together at posterior end (Fig. 119); small sclerotized plates scattered on dorsum. 99  
     3 large acetabula on each side of genital cleft (Fig. 91), or several acetabula on each side (Fig. 128). 100
99. Boat-shaped sclerotized plate between eyes (Fig. 88); black pigmented organ lying on this plate. **Euthyas truncata**  
     Red; length up to 2.5 mm. Ponds with thick vegetation.  
     No boat-shaped plate between eyes; red pigmented organ between eyes, surrounded by thick chitinous ring. **Thyas rivalis**  
     Row of 6 small chitinous plates down either side of centre line of dorsum; a further row of plates towards the flanks, interspersed with hair-plates (Fig. 100); red; length 1.0-1.3 mm. Woodland flushes.
100. Genital area lying between posterior blocks of epimera (Fig. 91). 101  
     Genital area lying behind posterior blocks of epimera (Fig. 126). 106
101. Body very elongate, parallel sided; epimeral area far forward (Fig. 98). **Sperchon longissimus**  
     Rostrum rather long (Fig. 96); red-brown; length up to 1.0 mm., ♂ smaller. Cold spring sources.  
     Body not very elongate. 102

102. Body carrying large papillae (Figs. 102 and 103); 4th segment of palp with long ventral projection (Fig. 104). **Sperchonopsis verrucosa**  
 Shape a long ellipse; brown; length 1.0 mm., ♂ smaller. Cold brooks.  
 Body not carrying large papillae, though small papillae may be present; 4th segment of palp without long ventral projection. 103
103. 3rd segment of palp with 4 short spines ventrally (Fig. 90); small ventral projections of 4th segment close together. **Sperchon setiger**  
 Rostrum short; greyish; sluggish; length up to 2.0 mm. Fast streams and brooks.  
 3rd segment of palp without spines ventrally; ventral projections of 4th segment not so close together (Fig. 92). 104
104. 2nd segment of palp with obvious neck at its junction with 1st segment (Fig. 92); 5th segment of palp about as long as high. **Sperchon squamosus**  
 Long ventral projection on 2nd segment of palp conical with a long hair; hindmost of two small projections on 4th segment situated at about centre of ventral surface; brownish; sluggish; length up to 1.3 mm. Fast streams.  
 2nd segment of palp without neck (Fig. 94); 5th segment longer than high. 105
105. Long ventral projection on 2nd segment of palp conical with short hair (Fig. 93). **Sperchon glandulosus**  
 Hindmost of two small projections on 4th segment distal to centre of ventral surface; dermal glands of body more enlarged than in other species; greyish to brown; sluggish; length up to 1.2 mm. Fast streams.  
 Long ventral projection of 2nd segment of palp parallel sided, with long hair (Fig. 94). **Sperchon clupeiifer**  
 Hindmost of two small projections on 4th segment about or slightly proximal to centre of ventral surface; yellowish to brown; sluggish; length up to 0.9 mm. Fast streams.
106. 1st pair of legs longer than 2nd, 5th segment thickened distally; 6th segment curved and somewhat spinous (Fig. 124) (**Atractides**). 107  
 1st pair of legs shorter than 2nd, 5th segment not thickened, 6th segment straight and not spinous (**Hygrobates**). 108
107. 2nd segment of palp with short, strong ventral projection (Fig. 121), longer in ♂ than ♀. **Atractides nodipalpis**  
 Brown with yellow, branching dorsal channels; length about 0.7 mm. Fast streams.  
 2nd segment of palp without ventral projection (Fig. 122). **Atractides spinipes**  
 Yellowish with brown dorsal patches and paler dorsal channels; length up to 1.0 mm. Fast streams.
108. 2nd segment of palp without obvious projection ventrally; small denticles on ventral surface of 2nd and 3rd segments (Fig. 130). **Hygrobates nigromaculatus**  
 4th epimera triangular; length up to 2.0 mm. Fast streams.  
 2nd segment of palp with strong projection ventrally, this and ventral surface of 3rd segment bearing small denticles. 109

109. About 17 acetabula on each side of genital cleft (Fig. 128).

**Hygrobates norvegicus**

Yellowish brown with yellow dorsal flecks; length up to 1.3 mm., ♂ smaller.  
Cold spring sources.

3 acetabula on each side of genital cleft.

110

110. 2nd segment of palp with rounded bulge ventrally (Fig. 127).

**Hygrobates longipalpis**

4th epimera more or less rectangular with rounded median borders (Fig. 129); brown with yellow dorsal channels; length up to 2.5 mm. Streams, rivers, standing water.

2nd segment of palp with long, acute projection ventrally (Fig. 125).

**Hygrobates fluviatilis**

4th epimera more or less triangular, median borders tending to be acute (Fig. 126); brown with yellow dorsal channels; length up to 2.0 mm. Fast streams and brooks.