

## A KEY TO THE NYMPHS OF THE BRITISH SPECIES OF THE FAMILY CAENIDAE (EPHEM.)

By T. T. MACAN

There are now six species in this family recorded from Britain:

*Brachycercus harrisella* Curtis, 1834.

*Caenis macrura* Stephens, 1836

*C. moesta* Bengtsson, 1917

*C. robusta* Eaton, 1884

*C. horaria* (Linnaeus), 1758

*C. rivulorum* Eaton, 1884.

*C. robusta* was found for the first time in 1951 (Kimmins 1954), *C. moesta* ten years earlier (Kimmins 1943).

Differences between the nymphs of *C. horaria*, *C. moesta* and *C. rivulorum* are described by Kimmins (1943); Schoenemund's (1930) key includes the first two but not the last of these three and *C. macrura* as well. The drawings of the pronota by these two authors are somewhat strikingly dissimilar and therefore, all being taken into consideration, there seemed good grounds for a fresh taxonomic study of the nymphs of this family as soon as material of all the species was available.

The basis of any such study is clearly a set of cast nymphal skins and the male adults that emerged from them, since only in this way can the identity be established with certainty. These cast skins were examined for characters of shape and pattern with a low-power stereoscopic microscope, and some were then dissected and mounted for examination under higher magnification. When differences between these skins of known identity had been established, whole nymphs were examined to ascertain how far characters that could be seen without dissection and mounting were reliable.

It soon became clear that the shape of certain parts varied a good deal according to the angle from which they were viewed; such differences as those noted between the drawings of Kimmins and Schoenemund might well be due to slight differences in method of dissection before mounting. Accordingly it was decided to draw a complete nymph of each species since the exact way in which any given part was lying could then be seen much more clearly than if it were drawn isolated. There is always the problem when drawings of this kind are being made of deciding whether to draw exactly what is seen, or whether to produce a series of perfectly symmetrical drawings each exactly like the others except in those features on which the species can be distinguished. The latter is more impressive, the former more accurate. The first alternative was chosen. The result is that some of the species appear to have heads of different shape, but this is because the heads are at a different angle; it was of course necessary to kill the nymphs before drawing them. Every effort was made, however, to arrange the nymphs so that pronotum and mesonotum of

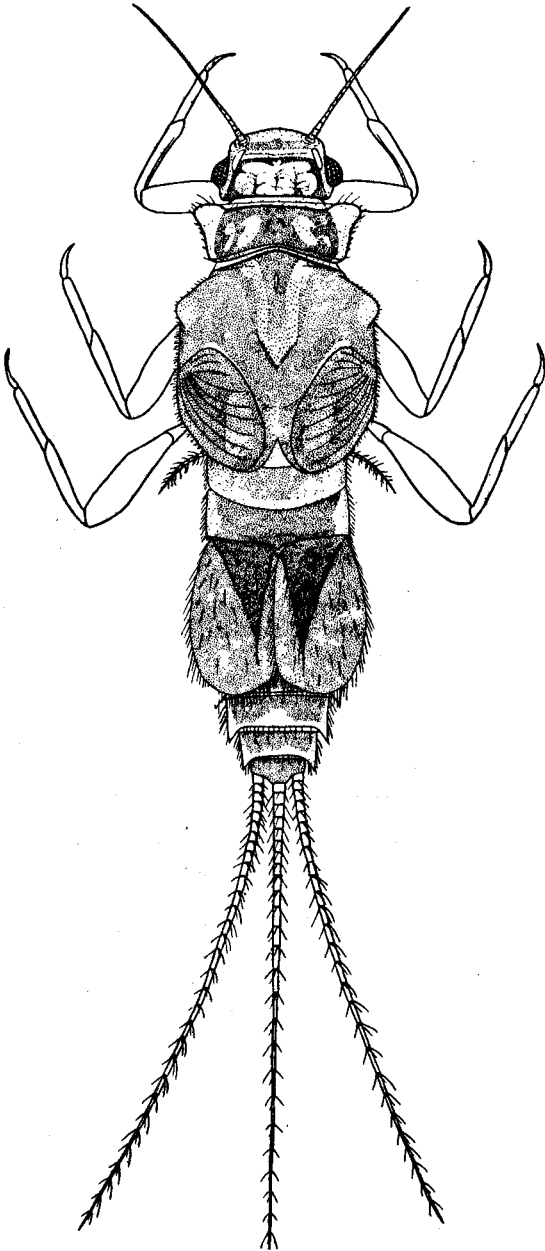


Fig. 1. *Caenis horaria*, 10 mm long, including cerci.

each one were in a similar position. The gill covers (which are the second gills) are slightly foreshortened from side to side in most of the pictures, which however do show the slight differences that characterize each species.

*Caenis horaria*

*Material:* L. Aigeil NS 3 cast skins; Windermere WL 2 cast skins; Esthwaite Water WL 9 cast skins and 7 whole nymphs; Wise Een Tarn WL 1 cast skin and 2 whole nymphs; L. Sheelin CV 3 cast skins.

The pronotum is produced into lateral points a feature which, though the exact shape varies, distinguishes this species at once from all others but *C. robusta*. The central area is darker than the sides and in this dark area there are lighter marks as in fig. 1, but often the contrast between the two is very slight.

The hairs on the wings are longer and more numerous than in any other species except *C. robusta*.

The second gills are somewhat round. On the underside, parallel with the outer margin and gradually converging to meet the distal margin at the inner corner, is a band of scales each of which is shaped rather like a cockade. They cannot be seen except on a mounted specimen and are so tiny that a 1/6th inch objective is needed to examine them, but they stand out quite clearly if these conditions are fulfilled and provide one of the easiest and most certain of the diagnostic features of this species. In each row of the band, that is at right angles to the margin of the gill, there are 2, 3, or 4 cockades. Usually 3 is the commonest number but occasionally there are 2 or 4 in most of the rows. (fig. 2.)

The sides of the last few abdominal segments seen from above are flatter than those of other species and have longer points. The pattern on them is often difficult to make out, but generally the segments are uniformly dark except for a light strip distally. Sometimes this light strip is prolonged forwards along the middle line and then the pattern is rather like that of *C. moesta*.

The fore femora are relatively thin with an evenly curving outline. A characteristic feature is the line of fine spines that runs transversely across them about a quarter of the way from the tip. These spines, which may conveniently be referred to as the paling spines since they resemble a paling on *C. moesta*, fall into an upper and a lower group, those terms being applied to a leg in the position shown in fig. 2. There are 3-5 spines in the lower group.

The margin of the tibia is beset with rather long sharp spines generally set close together, though the actual number varies a good deal and ranges from 11 to double that number or more. Inside them there is a row of slightly finer spines. The tarsus bears marginal spines similar both in shape and number to those along the tibial margin. When they are numerous, they are generally in two irregular rows, and, when few, in one row. The mid and hind legs are similar except

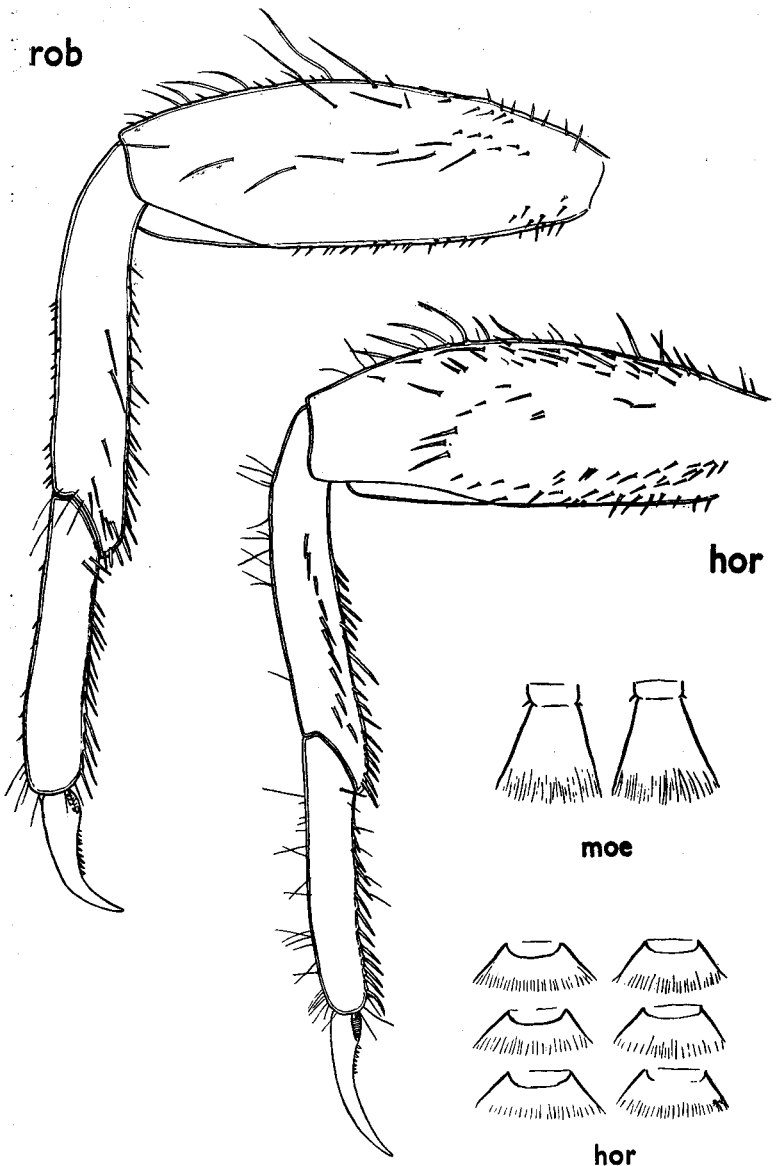


Fig. 2. Front legs of *robusta* (rob) and *horaria* (hor). The femur of *robusta* is 1.1 mm long. Free-hand sketch of cockade-like scales on wing covers of *moesta* (moe) and *horaria* (hor). A scale of *moesta* is a little over 0.01 mm long.

that the femora bear no paling spines, and the tarsi generally have two rows of marginal spines, with the distal ones of the inner row obviously pinnate. Some of the other spines are finely frayed but this character is not easy to make out unless the spine is seen from just the right angle, and they are not nearly as conspicuous as the pinnate spines.

Though some show little pattern, in general the legs of *C. horaria* are marked more conspicuously than those of other species. There are black bands near the tip of the femora and in the middle of the tibiae and tarsi. The bands on these last two segments may extend almost from one end to the other or may cover only about a third of the length.

The claws are notably long and slender.

*Length.* Males are 4.5-5 mm long and females up to 6 mm long, from front of head to tip of abdomen.

*Ecological notes.* All the present records are from still water, but Schoenemund (1930) records this species from rivers too. It is an inhabitant of soft mud and, in the Lake District, it was abundant not only in the rich black mud of Esthwaite Water but also in the peaty substratum of Three Dubs Tarn (Macan 1949).

#### *Caenis robusta*

*Material:* Wheatfen Broad EN 9 cast skins and 5 whole nymphs; Ranworth Broad EN 1 whole nymph; Scoulton Mere WN 1 whole nymph.

This species (fig. 3) is one of the most distinct of all. The diagnostic features of a whole nymph are:

1. Large size; full-grown specimens may be as much as 9 mm long from front of head to tip of abdomen, and are considerably bigger than any other British member of the genus.

2. Shape of the pronotum. The fact that there is a point at all on the side of the pronotum immediately distinguishes this species from all but *C. horaria* and the precise shape of the point serves to separate it from that one too. In *C. horaria* the side of the pronotum tends to start diverging outwards near the middle and the front curves down to meet it (fig. 1). The side of the pronotum of *C. robusta* does not start to diverge outwards till near the front and the fore margin runs straight (fig. 3).

3. The pattern. The light central line on head, pronotum, and mesonotum, the dots on the mesonotum, and the arrangement of dark bands on the legs are all peculiar.

*C. robusta* resembles *C. horaria* in its rounded gill covers and slim fore femora. The abdominal segments are produced into shorter spines.

Higher magnification of a dissected specimen reveals several more distinguishing characters:

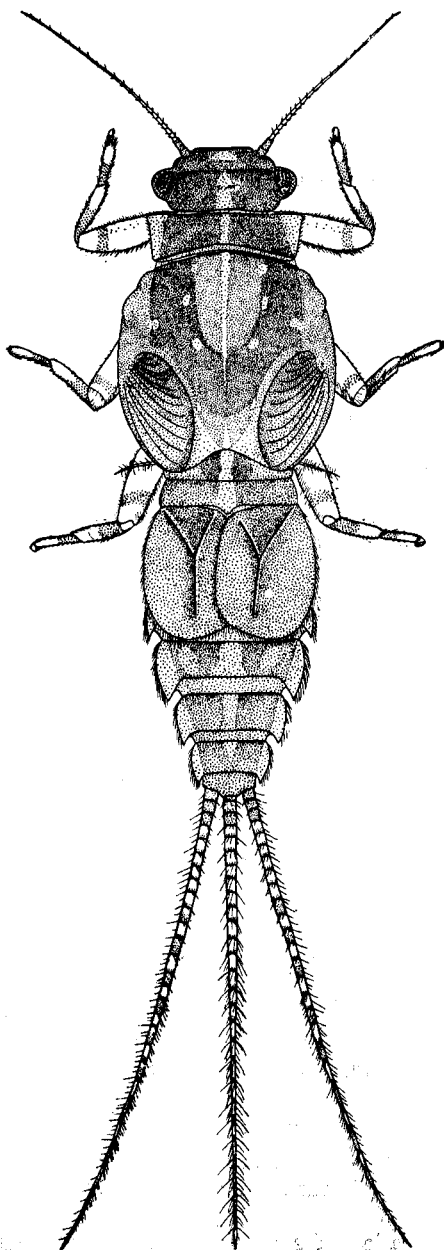


Fig. 3. *Caenis robusta*, 15 mm long, including cerci.

1. There is no transverse row of spines on the fore femur; about six long spines are set in line longitudinally down the segment (fig. 2).
2. There are six to eight cockade scales in each row.
3. The spines on the tibiae and tarsi are more numerous than on other species and the claws are bent in a characteristic way (fig. 2).

*Ecological notes:* This species has been found only in the Norfolk Broads and in Scoulton Mere which is not far away from them.

*Caenis moesta*

*Material:* Whitefield Loch WT 2 cast skins 1 whole nymph; Lough Veagh ED 1 cast skin; Lough Sheelin CV 1 cast skin; Wise Ean Tarn WL 12 cast skins and 3 whole nymphs; River Dee at Llan-gollen DB 2 cast skins and 1 whole nymph; R. Wye BR 1 cast skin; R. Nene at Oundle NO 4 whole nymphs.

There are two characters of a whole nymph that separate this species from the two preceding. The first is the shape of the pronotum, which has no angles projecting sideways and is a little broader in front than behind (fig. 4). The second is the shape of the forelegs, which are broad, almost clubbed at the distal end, and often somewhat sinuate in outline (fig. 5). Pattern is generally not very clearly marked and of limited value in the provision of diagnostic characters. The pronotum has light edges and lighter markings within the dark central area, sometimes as shown in fig. 4 but more often with a larger comma-shaped mark near the centre and little other pattern. The abdominal segments may be marked as in the figure but more frequently the central light line flares distally. The leg markings are usually ill-defined but, when they can be made out, they are similar to those of *C. horaria*. The wing covers are rather more quadrate than in the two preceding species.

Examination of a dissected specimen under higher power reveals other differences. First there is only one cockade in each row of the line of scales on the gill-covers (fig. 2). The other important difference is that the paling spines are closer together, in a more regular line and more numerous, there being 6 to 8 in the lower group (fig. 5). They have a characteristic shape, being robust, broader at the tip than at the base, cut off straight at the top, and bifid. Under high power it is seen that they are finely frayed.

Other noteworthy features of a dissected specimen are as follows. There is a group of 5-14 spines on the forward projections of the pronotum, and most of them are on the edge of the plate. There are fewer spines along the tibiae and tarsi of all legs than in the preceding species and they are shorter (fig. 5). Exact numbers are discussed under *C. macrura*, which is described next.

*Length:* Male nymphs range from 4.5-5.5 mm, females from 5.5-6.5.

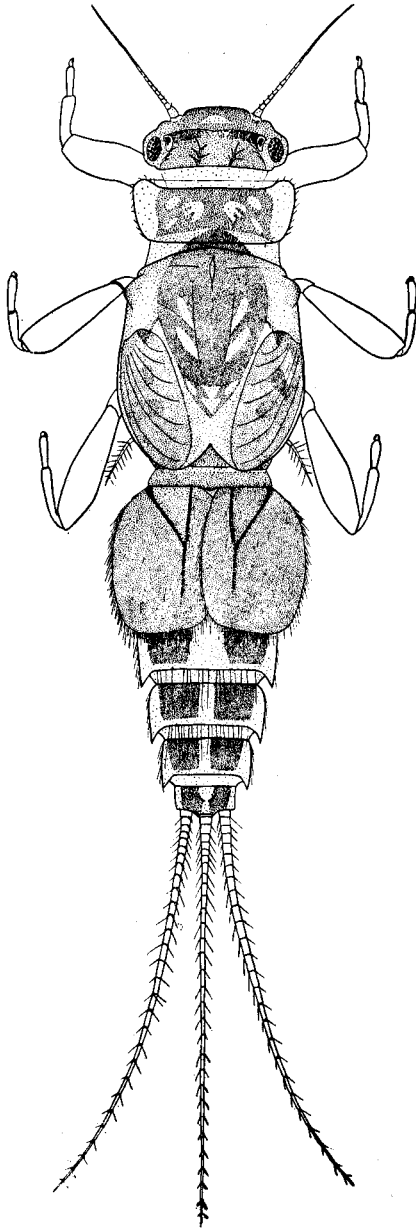


Fig. 4. *Caenis moesta*, 8 mm long, including cerci.

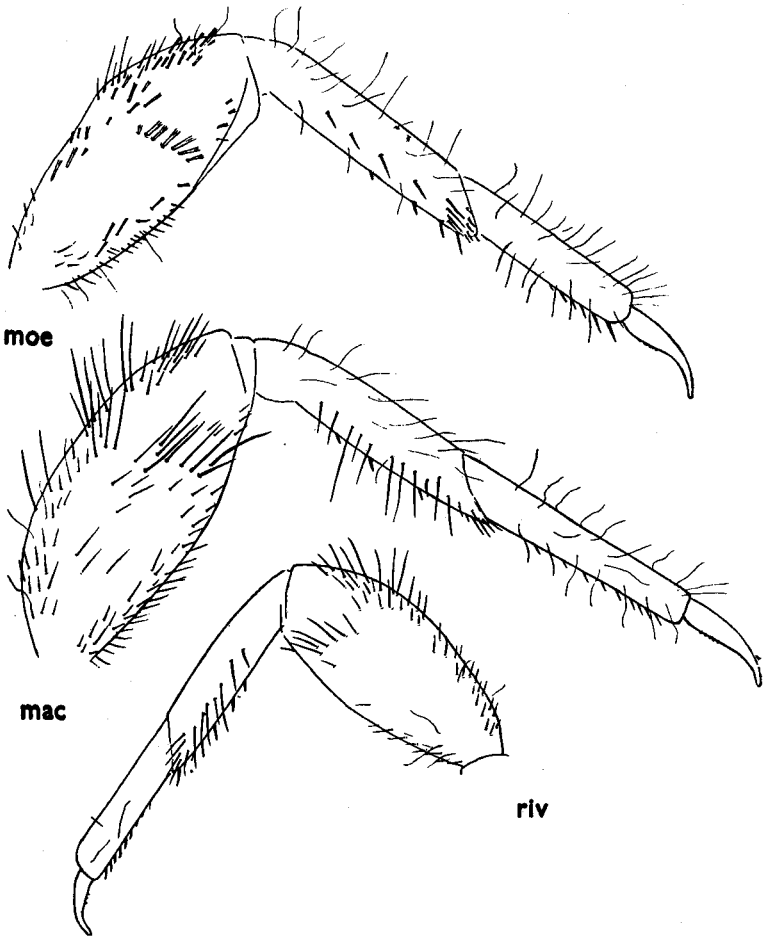


Fig. 5. Front legs of *moesta* (moe), *macrura* (mac) and *rivulorum* (riv). The femur of *moesta* is 0.75 mm long, that of *rivulorum* 0.45 mm long.

*Ecological notes:* Generally on a substratum of gravel or of large stones with fine material between them, in rivers, lakes and ponds.

*Caenis macrura*

*Material:* River Clyde at Hyndford Bridge LA 10 cast skins and 8 whole nymphs; River Cart LA 5 cast skins and 1 whole nymph; River Wye BR 4 cast skins and 2 whole nymphs.

*Caenis macrura* is very like *C. moesta* and may be distinguished from *C. horaria* and *C. robusta* in the same way as that species. The main problem is to separate the two. Generally whole nymphs can be distinguished on the shape of the pronotum, which has parallel sides in *C. macrura* (fig. 6). A few specimens, however, have pronota which are slightly broader in front than behind and these can easily be confused with *C. moesta*, in which the difference in width of back and front is not always as great as shown in fig. 4. Pattern does not provide any certain criteria though it is not completely valueless. Generally there is less contrast between light and dark than on *C. moesta* but, when this is not so, the markings of the pronotum may be very much as in that species. On the abdomen, however, there is a difference, which, though not completely reliable, will serve to distinguish many specimens. Whereas on *C. moesta* the central light line tends to flare distally, on *C. macrura* it tends to flare proximally so that it is the inner part of the segment that has a triangular or often, as on the one but last segment in fig. 6, a round light mark.

The most clear-cut difference between the two is provided by the spines on the legs, though unfortunately it is sometimes difficult to make out the features on a specimen that has not been cleaned and mounted. The paling spines of *C. macrura* are more slender, longer, less regularly aligned and generally more numerous than those of *C. moesta*, there being 8-11 in the lower group (fig. 5). Under low power ( $\times 120$ ) all appear to be simple pointed spines but under high magnification ( $\times 480$ ) it is seen that some are finely frayed and bifid at the tip. The numbers of spines along the margins of the legs of the two species are as follows:—

	Fore tibia	Fore tarsus	Mid tibia	Mid tarsus	Hind tibia	Hind tarsus	Number of legs examined
<i>moesta</i>	1-9	5-10	8-17	10-16	10-19	16-24	15
<i>macrura</i>	0-9	5-10	2-11	6-11	4-15	8-14	17

The fore legs are identical but on the other two there tend to be more spines on *C. moesta* and the hind tarsi provide an absolute difference. Incidentally some of the spines on the tibiae are very small and it is often difficult to make out how many there are; the principle adopted for the present study has been to count only those that are visible under a magnification of  $\times 120$ . In a count of 10 or 11 there will probably be 4-6 tiny spines, whereas, on a specimen of *C. horaria* with the same number, most will be of the same size, which is longer than the longest of *C. moesta* and *C. macrura*. These spines therefore

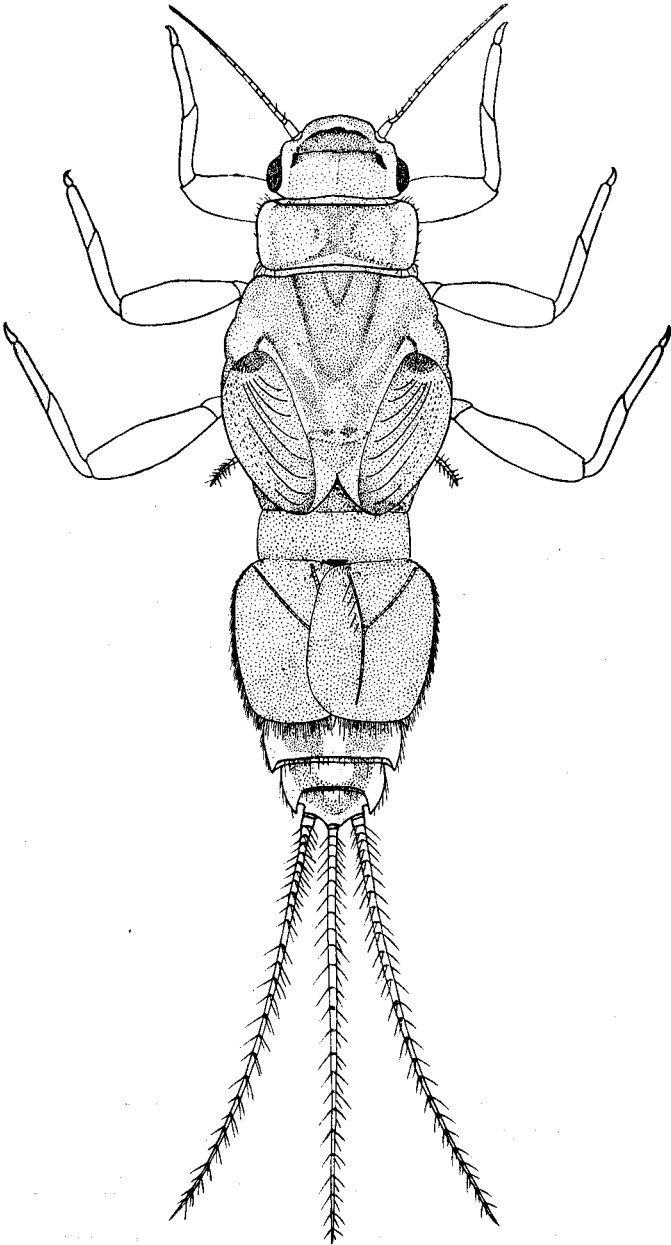


Fig. 6. *Caenis macrura*, 7 mm long, including cerci.

provide another distinguishing feature between this pair on the one hand and *C. horaria* and *C. robusta* on the other. There are always several pinnate spines on the mid tarsi and more than five pinnate spines on the hind tarsi of *C. moesta* but, of the seventeen specimens of *C. macrura* examined, not one had a pinnate spine on the mid tarsi nor more than three pinnate spines on the hind tarsi.

It will be noted that in the figures there are more spines to the inner row of the tibia on *C. macrura* than on *C. moesta* and they are longer. Both size and length however are variable, and it is not easy to base certain distinction on this character.

There are 14 to 20 or more spines in a group at the tip of the forward projection of the pronotum of *C. macrura* and they are more bunched together than those of *C. moesta*, some of them being inside the margin.

*Ecological notes:* *C. macrura* has been found on the same sort of substratum as *C. moesta* but so far only in rivers.

#### *Caenis rivulorum*

*Material:* River Clyde at Hyndford Bridge LA 1 cast skin and 3 whole nymphs; River Cart LA 7 cast skins and 4 whole nymphs; Wilfin Beck WL 6 cast skins and 5 whole nymphs; Stock Ghyll WL 1 cast skin; River Bela WL 1 cast skin.

This species resembles *C. macrura*, but when full-grown is distinctly smaller, males being no more than 3.5, females 4.5 mm long. It can often be picked out at once by the naked eye because of its pied appearance (fig. 7). The pronotum and mesonotum are dark and with less pattern than on the other species. The gill covers or at least the distal portion of them are also dark but, in between, the abdominal segments and sometimes the adjacent area of the gill covers are light. Beyond the gill covers there is a light abdominal segment, and then a dark tip to the abdomen completes the contrasting pattern of dark and light. The distal abdominal tergites are generally uniformly dark except at the sides. Generally the last two are quite dark, the next lighter, and the next quite light; sometimes each one counting from the last is lighter than the one before; or only the very last may be really dark. The leg markings are frequently obscure but sometimes it is evident that the basal two thirds of the femora are light and the rest of the femora and the whole of the tibiae and tarsi slightly darker. The gill covers are distinctly quadrate.

The best distinguishing feature of a mounted nymph is the fore femur which has but 3-6 piling spines in the lower group (fig. 5). Otherwise the legs are very like those of *C. macrura*. All but one of the fifteen specimens examined had a pinnate spine on the middle tarsus.

The cockade scales on the wing covers are single as in the preceding two species and usually difficult to see. There are up to 8 spines in the group at the tip of the forward projection of the pronotum. This species is less hairy than the rest, correlated with which may be its

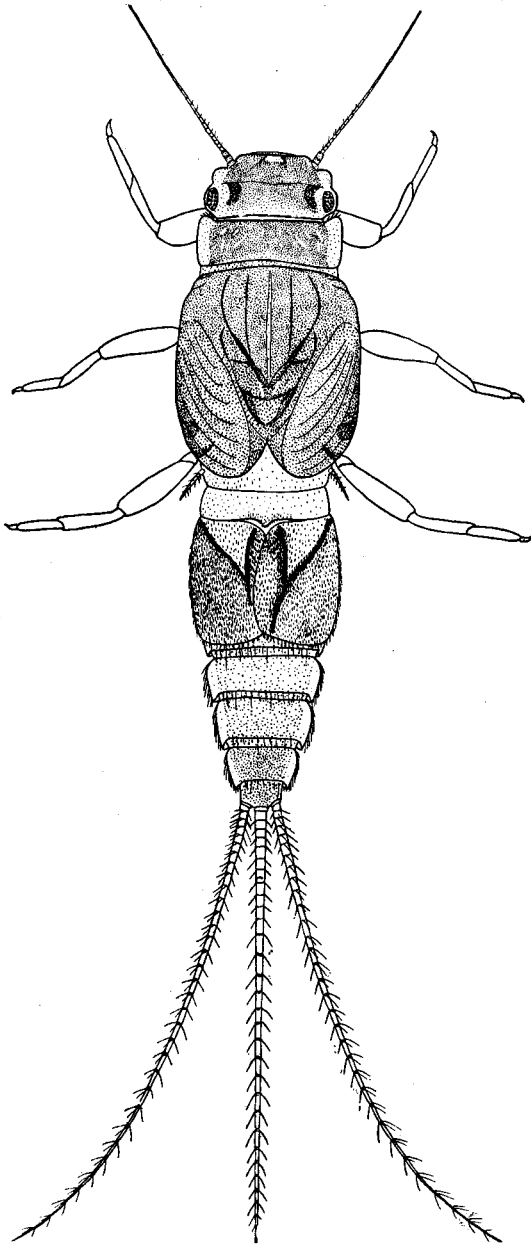


Fig. 7. *Caenis rivulorum*, 5.5 mm long, including cerci.

noticeable lack of a covering of debris when compared with the others.

*Ecological notes:* This species is found on a stony substratum in small streams and rivers and can possibly tolerate more flow than the others.

*Brachycercus harrisella*

*Material:* R. Clyde at Hyndford Bridge LA 8 whole nymphs.

This nymph, which is figured by Eaton (1884) and Schoenemund (1930), has a number of unique features, notably: the long second joint to the antennae; the three conical processes on the head; the shape of the pronotum; the slender legs; and the long processes of the sides of abdominal segments 3-7. A full-grown specimen is about as long as a full-grown *C. robusta* (fig. 8).

On a dissected and mounted specimen it is seen that there are no cockade scales on the gill covers, but in their place a band of tiny spines. The legs are covered with long hairs, or long very fine spines, with a row of spines along the margin of the tibiae and tarsi. There are no little teeth on the claws.

KEY

- 1 Three protuberances on the head; curved backwardly-directed processes on the sides of abdominal segments 3-7 (Fig. 8) ..... **Brachycercus harrisella.**
- Without either ..... 2.
- 2 Pronotum produced laterally into a point (Figs. 1, 3); more than one row of cockade-like scales in the band that runs along the underside of the gill covers, parallel with the outer and gradually converging to meet the distal margin (Fig. 2); fore femora relatively narrow (Fig. 2) ..... 3.
- Pronotum not produced laterally into a point (Figs. 4, 6, 7); one row of cockade-like scales in the band that runs along the underside of the gill covers (Fig. 2); fore femora relatively broad particularly towards the tip (Fig. 5) ..... 4.
- 3 Point of pronotum larger and not in line with the fore margin (Fig. 1); no central light line on head, prothorax and mesonotum nor dots on the last; full-grown nymphs up to 6 mm long from front of head to tip of abdomen; a transverse row of spines towards the tip of the fore femora (Fig. 2); 2 to 4 cockade-like scales in the band that runs along the under side of the gill covers (Fig. 2); claws long and relatively straight (Fig. 2) ..... **horaria**
- Point of pronotum smaller and in line with the fore margin (Fig. 3); a central light line running from the top of the head across the pronotum to the fore part of the mesonotum; light dots on the mesonotum (Fig. 3); full-grown nymphs up to 9 mm long; no transverse row of spines on the femora (Fig. 2); 6 to 8 cockade-like scales; claws more robust and abruptly bent (Fig. 2) **robusta**
- 4 A small (up to 4.5 mm long) species with a characteristic pied appearance, the abdominal segments immediately before and behind the wing covers being light and the rest of the upper surface rather dark (Fig. 7); 3-6 long pointed spines in the lower group of the row that runs transversely across the distal part of the fore femora (Fig. 5) ..... **rivulorum**

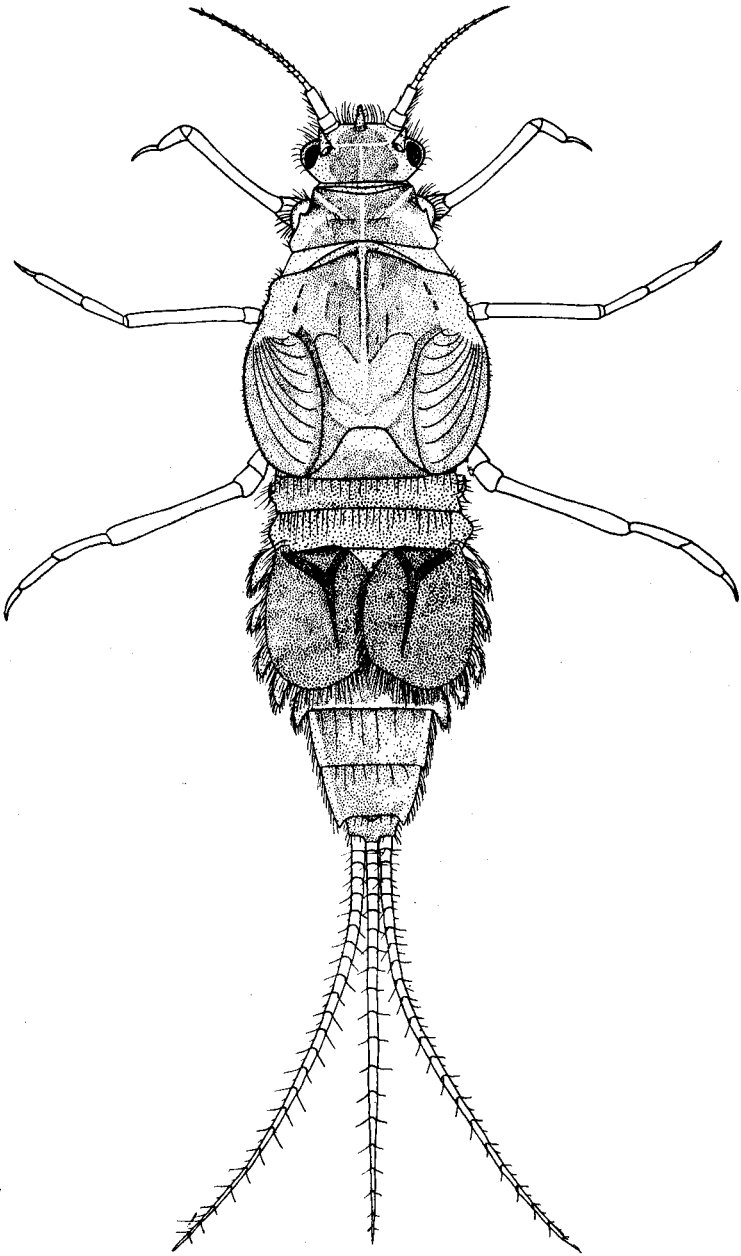


Fig. 8. *Brachycercus harrisella*, 14 mm long, including cerci.  
From head to tip of abdomen, 8.5 mm.

- Larger species (up to 6.5 mm long) without a conspicuous pattern; 6-11 spines in the lower group of the row that runs transversely across the distal part of the fore femora (Fig. 5) (if only 6 or 7 spines they are short and truncate) .....5.
- 5 Pronotum broader in front than behind (Fig. 4); spines running transversely across the fore femora broad, close together, in a straight line, and 6-8 in number in the lower group (Fig. 5); 16-24 spines along the margin of the hind tarsus ..... **moesta**
- Pronotum generally parallel-sided (Fig. 6) though sometimes it is a little broader in front than behind; spines running transversely across the fore femora longer, finer, further apart, in a less regular line, and 8-11 in number in the lower group (Fig. 5); 8-14 spines on the hind tarsi ..... **macrura**

#### ACKNOWLEDGMENTS

Mr. Frank L. Sinclair first discovered the nymphs of *Caenis macrura* and *Brachycercus harrisella* and took me to the places to make collections. Mr. D. E. Kimmins has helped in various ways and put all his own notes at my disposal. To Dr. H. B. N. Hynes I am indebted for specimens from various places and for an opportunity to collect in the R. Wye. Mrs. Jean Mackereth has drawn most of the illustrations and helped with the collecting and breeding out. I tender sincere thanks for all this assistance.

NS North Sutherland, LA Lanark, WT Wigtown, Scotland; CV Cavan, ED East Donegal, Ireland; DB Denbigh, BR Brecknock, Wales; WL Westmorland, NO Northampton, EN, WN East and West Norfolk, England.

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