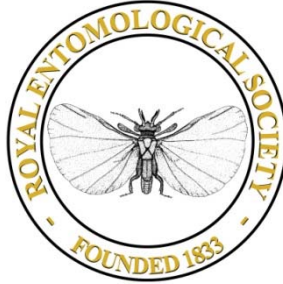


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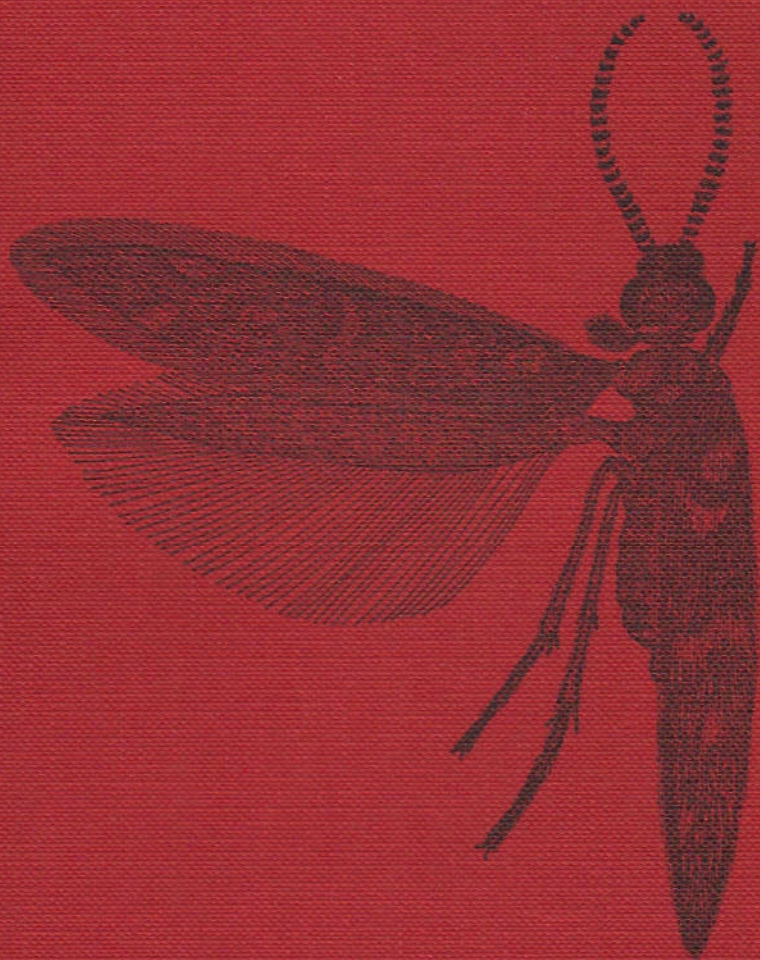
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Handbooks for the Identification of British Insects
Vol. 1, Part 14(a)

TRICHOPTERA

HYDROPTILIDAE

J. E. Marshall



ROYAL ENTOMOLOGICAL SOCIETY OF LONDON

TRICHOPTERA HYDROPTILIDAE

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TRICHOPTERA : HYDROPTILIDAE

J. E. MARSHALL

Introduction

The last major review of the British Hydroptilidae was made by Mosely (1939), who described the males and ten females of the 27 species then known in his handbook to the British Trichoptera. *Hydroptila lotensis* Mosely and *Ithytrichia clavata* Morton have since been added to the list, while Kimmins (1958) reviewed the British species of the genus *Oxyethira* (excluding *mirabilis* Morton), re-illustrating the male genitalia and describing the females of all but *distinctella* McLachlan for the first time. Apart from Kimmins's (1966) checklist, and Macan's (1973) key to the British Trichoptera, which simply reproduces Mosely's (1939) and Kimmins's (1958, 1961) original figures, very little has been published lately on adult hydroptilids. Recent studies on the family (Marshall, 1977) have added two more species to the British list, *Hydroptila martini* Marshall and *H. valesiaca* Schmid, which were both previously confused with *H. occulta* (Eaton), so that the total number now stands at 31.

In this handbook the genitalia of both sexes of all the British species, with the sole exception of the female of *H. tigurina* Ris, have been refigured, or described for the first time. In cases where very little British material was available, the genitalia were drawn from continental specimens except those of the male of *I. clavata* which were adapted from Tjeder (1930). Most of the material examined is in the British Museum (Natural History) although certain specimens of the rarer species were borrowed from the Continent.

Larval descriptions and keys to species have not been included here because, although the genera are easily distinguished by the general appearance of the larvae and their cases, no reliable specific characters have yet been found except in *Agraylea* where markings of the head and thorax appear to be constant for each of the two British species. However, a brief generic key to larvae has been included, as well as a list of selected references to published larval descriptions. The only reliable way to identify larvae to species is to collect associated pupae or to rear the larvae through to the pupal or adult stages. The adults and pupae may be then determined by their genitalia and the larval exuviae may be extracted from the pupal case. It is hoped that this handbook will stimulate the collection, rearing and identification of the larvae of the British Hydroptilidae so that one of the few remaining gaps in our knowledge of the British Trichoptera may soon be filled.

Checklist of Hydroptilidae recorded from Britain

HYDROPTILA Dalman

angulata Mosely
cornuta Mosely
forcipata (Eaton)
lotensis Mosely
martini Marshall
occulta (Eaton)
pulchricornis Pictet
simulans Mosely
sparsa Curtis
sylvestris Morton
tigurina Ris
tineoides Dalman
valesiaca Schmid
vectis Curtis

ORTHOTRICHIA Eaton

angustella (McLachlan)
costalis (Curtis)
tragetti Mosely

AGRAYLEA Curtis

multipunctata Curtis

sexmaculata Curtis

ALLOTRICHIA McLachlan

pallicornis (Eaton)

ITHYTRICHIA Eaton

clavata Morton
lamellaris Eaton

TRICHOLEIOCHITON Kloet &

Hincks
fagesii (Guinard)

OXYETHIRA Eaton

distinctella McLachlan
falcata Morton
flavicornis (Pictet)
frici Klapálek
mirabilis Morton
sagittifera Ris
simplex Ris
tristella Klapálek

General characteristics

Hydroptilids are minute caddis flies which bear a striking superficial resemblance to small mottled moths because of their narrow, tapering wings and dense covering of thickened black or brown and white setae (fig. 1). The average body length is about 3.5 mm, although size can vary from approximately 1.5–6.0 mm throughout the family. Wing venation is usually greatly reduced and is therefore of little taxonomic value. More useful characters are the spur formulae, the presence of ocelli, the dorsal head structures, the shape of the thoracic nota, and the male and female genitalia. The *spur formula* refers to the number of tibial spurs on each of the pro-, meso- and metathoracic legs respectively and includes both apical and pre-apical spurs where present (e.g. 0.2.4, or 0.3.4.). Three *ocelli* are usually present but may be totally absent in some genera such as *Hydroptila* and *Orthotrichia*. At the back of the head there is usually a pair of *post-occipital warts* which in *Hydroptila* males are modified as hinged caps which conceal eversible *scent-organs* (their function has not been positively proven).

The basic plan of the male genitalia is very characteristic for each genus but essentially consists of the following structures. (It should first be noted that the terms applied to these structures are based on their positions relative to one another and that the functions of these organs have not yet been investigated in detail.) The genital capsule is formed by segment IX and from this arise the *dorsal plate* (tergite X) and various paired and unpaired appendages. The *superior appendages* (sometimes termed the *parameres*) lie dorsal to the aedeagus, while the *subgenital appendages* are always ventral to the aedeagus but dorsal to the *inferior appendages* (*gonopods* or *claspers*). Immediately ventral to the subgenital appendages there may be a single *bilobed process* which may be forked and usually bears two apical setae. The aedeagus, which is shown separately in the diagrams, is usually constricted in mid-length, from which region there may arise an unpaired spiral *titillator*.

The female genitalia are of the generalized trichopteran form which is of the

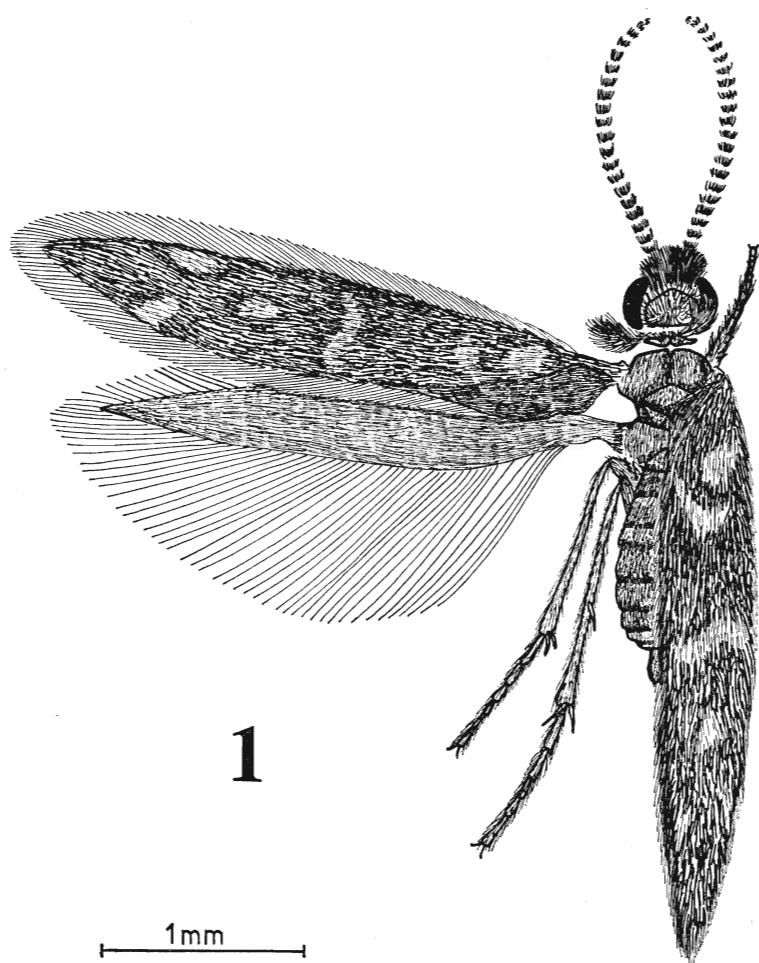


Fig. 1. *Hydroptila tineoides* ♂.

simple *telescopic* (retractile) ovipositor or *oviscapt* type. Characteristic sternites and setae may be present and, in potash-treated specimens, the form of the posterior genital ducts may be discernible, especially the sclerites of the vaginal wall which Mosely (1939) refers to as *trident-like structures*, which have also often been mis-termed the 'bursa' or 'bursa copulatrix' but are here simply termed the *internal apparatus*. The simple oviscapt form is modified in *Orthotrichia* and *Oxyethira* where segment IX has become reduced such that the genitalia are probably no longer retractile.

The aquatic larvae of the Hydroptilidae are often termed the *purse-case* builders but, although this may be appropriate for the better known genera such as *Agraylea* and *Hydroptila*, the family as a whole exhibits a remarkable variety of larval and

case form. The basic purse-type case consists of two closely apposed silken valves with slit-like posterior and anterior openings, and may be held vertically or horizontally. However, certain non-British genera (e.g. *Stactobia*, *Leucotrichia* and *Caledonotrichia*) construct strongly dorso-ventrally flattened cases which may be temporarily or permanently attached to the substrate; others (e.g. *Rhyacopsyche*) build fusiform cases, while *Neotrichia* and *Mayatrichia* have distinctly tubular cases which resemble those of the higher limnephiloid caddis families.

Biology

The hydroptilid life-cycle, where known, basically proceeds as follows. After mating, which usually occurs during a swarming period, the female goes below the surface of the water and lays her eggs on submerged objects and aquatic vegetation. The minute larvae, which resemble planktonic crustacea, soon hatch and the first four instars, which are of very short duration, are passed in the free-living state quite unlike the case-building final fifth instar. This is regarded as a simple type of larval hypermetamorphosis and has so far been recorded only in this family within the Trichoptera. The fifth instar is the principal feeding and growing stage in the life-cycle during which the abdomen becomes characteristically distended as food reserves are deposited for the development of the future adult tissues. One of the functions of the case is probably to protect this large and vulnerable abdomen.

In Britain the larvae usually overwinter as fully fed fifth instar larvae which pupate in the early spring and give rise to an adult generation from late May to June. Some species, according to the latitude and altitude, are bivoltine; the offspring of the spring brood pass through five relatively short larval instars and give rise to a second brood in or around August. Within the family as a whole life-cycles vary considerably with latitude, altitude and climate and may be almost continuous in tropical regions.

The larvae feed essentially on plant material and detritus. The primitive non-British Ptilocolepinae feed macrophytically on mosses and liverworts, while genera such as *Stactobia* (non-British) and *Leucotrichia* (New World) are adapted for grazing on the substrate. The more advanced genera are, however, adapted for feeding on the cell contents of filamentous green algae; such groups include *Agraylea*, *Hydroptila* and *Oxyethira*, but the most specialized genus in this respect is *Orthotrichia*. Of the remaining British genera, *Allotrichia* and *Ithytrichia* are considered to be substrate feeders which have evolved from alga-feeding ancestors (Giudicelli & Vaillant, 1967; Nielsen, 1948). There have been only two reported cases of predation in the Hydroptilidae, by Disney (1972) and Burton & McRae (1972), in which *Orthotrichia* larvae were seen to feed on *Simulium* larvae; however, it is not known whether these were instances of true active predation or whether the Diptera were taken in mistake for algal filaments. Feeding has not been observed in adults although they may be capable of taking small quantities of water.

Hydroptilid larvae exhibit a wide range of adaptations in their morphology and case form in association with their habitat and feeding habits. Habitat preferences range from cool, shaded seeps and springs amongst damp moss in montane regions (e.g. the non-British Ptilocolepinae) to fast-running streams and rivers, often in sections exposed to strong current (e.g. the New World genera, *Rhyacopsyche* and *Neotrichia*). *Stactobia*, for example, prefers thin surface films of water on rocks, often near the splash zones of cascades and waterfalls, and the larvae are consequently specially adapted for this madicolous habitat. The British genera are all

found in the larger, more slowly flowing lowland rivers and streams and the almost static, but rarely stagnant, natural lakes, fens, canals, reservoirs and artificial ponds. Such fresh-water habitats are typical of the British Isles and more favourable to the growth of masses of green filamentous algae on which the larvae feed. It is interesting to note that *Allotrichia pallicornis* and *Ithytrichia lamellaris*, which are both considered to be substrate feeders, tend to prefer the faster-flowing streams and rivers typical of the north and west of Britain.

The adults can be found on rocks, plants, tree-trunks and other objects by the side of the water near the habitat of the larvae, although the favourite daytime resting places appear to be the walls and undersides of bridges. At night the adults are readily attracted to artificial light, e.g. mercury-vapour traps, especially during swarming periods when a single hydroptilid species may easily outnumber any other group of caddis fly present in the same area. Adult hydroptilids are very short-lived and have never been reported to undergo any form of reproductive diapause, nor is it likely that they overwinter in this stage in the temperate regions.

Collecting, preservation and examination techniques

The most effective method of collecting adult hydroptilids is by mercury-vapour light, in a trap positioned close to the water's edge although, contrary to what might be expected from their small size, the imagines can be found several hundred yards away from water. Once in the trap the adults scuttle about and often seek out small cracks and crevices to hide in and are very difficult to see, but once an 'eye' for them has been acquired they can be picked out easily from the rest of the trap material using small tubes or an aspirator. During the daytime the adults can be seen, if sought carefully, in the crevices of the bark of trees and on the walls of bridges and other objects close to the water's edge; the best method of collecting is then to sweep the surrounding vegetation.

Hydroptilids should be preserved in 70% alcohol, in preference to being pinned, since it is then easier to examine genitalia, tibial spurs, ocelli and thoracic structures. Material that has already been pinned should be lightly treated with 10% potassium hydroxide solution (either the whole insect minus its wings, which may be dry mounted if desired, or just the abdomen), examined in glycerol or alcohol and then returned to the pin in a small phial of glycerol. A permanent slide mount can be made if required, staining usually being unnecessary (if potash treatment has not been too harsh) except, perhaps, with females and pupae which have not developed fully sclerotized genitalia.

Collecting fifth instar larvae in their cases is relatively simple and involves searching submerged objects such as stones and the undersides of the leaves of aquatic plants, especially water-lilies, and also thickets of water weeds. The caseless, free-living early instars, however, are very small and inconspicuous and are rarely encountered using standard aquatic collecting techniques. To avoid wasting valuable collecting time searching for the fifth instar larvae in the field, it is often advisable simply to collect masses of vegetation in plastic bags; these may then be sorted through at leisure in the laboratory. Wallace (pers. comm.) has collected a number of larvae of *Ithytrichia* and *Orthotrichia* from among submerged willow roots in silt. The larvae are best preserved in alcohol and extraction of larval exuviae from pupal cases may proceed as follows: dehydrate the whole case through alcohols; soak in Euparal; transfer to Euparal on slide; open case and carefully extract exuviae, adding Euparal essence when necessary; retain or discard case as required, arrange exuviae on slide and position coverslip.

World distribution and relationships of the Hydroptilidae

The family Hydroptilidae contains approximately 50 genera and 600 species with an almost cosmopolitan distribution, but excluding the polar regions. Only seven genera are represented in the British Isles and so, before embarking on a more detailed account of the British fauna, a brief introductory account of the relationships and distribution of the Hydroptilidae as a whole is given here.

The primitive subfamily, Ptilocolepinae, contains two small genera, *Palaeagapetus* and *Ptilocolepus*, which are restricted to isolated montane forest regions in North America and the northern Palaearctic zone respectively. The adults look superficially like small rhyacophilids and glossosomatids, with which they were once classified, but the small, purse-case bearing larvae indicate affinities with the Hydroptilidae.

Within the principal subfamily, the Hydroptilinae, at least five generic groups may be recognized, one of which is almost totally confined to the Old World and three to the New World, while two contain genera with almost cosmopolitan distributions. The principally Old World *Stactobia*-group contains a number of small tropical and subtropical genera, although *Stactobia* itself has a more temperate distribution ranging from Japan to North Africa and the Atlantic Islands, through southern and central Europe up into the montane regions of France. The larvae of *Stactobia* are adapted for living in thin surface films of water, such as on rocks near cascades and rapids and on the almost vertical surfaces beneath waterfalls (the madicolous habitat), while in the New World a similar niche is occupied by the *Leucotrichia*-group. *Leucotrichia* and its allied genera occur throughout the American continent but, so far, the greatest numbers of both taxa and individuals have been found in the Central American and Caribbean regions. The larvae and cases, like those of *Stactobia*, are strongly flattened dorso-ventrally but are readily distinguished by the great distension of the middle larval abdominal segments.

The *Ochrotrichia*-group is also confined to the Americas and contains three small genera of which the possibly substrate-feeding larvae are found in a wide variety of running water habitats and sometimes in temporary streams; the larvae, however, are not dorso-ventrally flattened and build typical purse-type cases. *Neotrichia* and *Mayatrichia* comprise the third exclusively New World group which is distinguished by its tube-case dwelling larvae which live in rapid sections of rivers and streams and are probably substrate feeders.

The two remaining groups contain the more advanced alga-feeding genera to which all the British representatives belong. The *Hydroptila*-group, as well as containing the Holarctic genus *Agraylea* and the cosmopolitan genera *Oxyethira* and *Hydroptila*, consists of a number of smaller genera confined to regions such as Africa (*Dhatrichia*, *Ugandatrichia*), Australia (*Xuthotrichia*) and New Zealand (*Paroxyethira*). The larvae, however, are not as highly specialized for alga feeding as are those of the Holarctic, African and S.E. Asian genus *Orthotrichia* with which the substrate feeding genus *Ithytrichia* has been grouped by Nielsen (1948) on the basis of fundamental morphological features of the larvae. Finally, there are a number of small genera, such as the New Caledonian endemic, *Caledonotrichia*, and the Nearctic genus *Dibusa* that feeds on red alga (fresh-water), which are so specialized or so poorly studied that they have not yet been assigned to any generic group.

Key to genera of British Hydroptilidae (adults)

- | | | |
|---|--|--|
| 1 | Spur formula 0.2.4, ocelli absent | Hydroptila (p. 7) |
| - | Spur formula 0.3.4, ocelli present or absent | 2 |
| 2 | Ocelli absent | Orthotrichia (p. 16) |
| - | Ocelli present | 3 |
| 3 | Forewing length over 4 mm, forewings relatively broad, apices not markedly attenuate | Agraylea and Allotrichia (p. 18) |
| - | Forewing length 3.0-3.5 mm, forewings narrow, attenuate | 4 |
| 4 | Segment IX of ♂ genitalia tapering posteriorly, inferior appendages elongate, lying almost entirely ventral to segment IX; ♀ genitalia an oviscapt, segment IX narrow and elongate | Ithytrichia (p. 19) |
| - | ♂ and ♀ genitalia not as above | 5 |
| 5 | ♂ genital appendages concealed by segment IX, latter oblique in lateral view, aedeagus very large with broad apex (fig. 56); ♀ genitalia an oviscapt but with segment IX short, ventro-posterior margin of segment VIII with median lobe (fig. 57) | Tricholeiochiton (p. 22) |
| - | ♂ genitalia concealed within segment VIII; ♀ genitalia an oviscapt but with segment IX reduced, often fused with VIII, totally membranous, internal apparatus highly sclerotized and complex | Oxyethira (p. 22) |

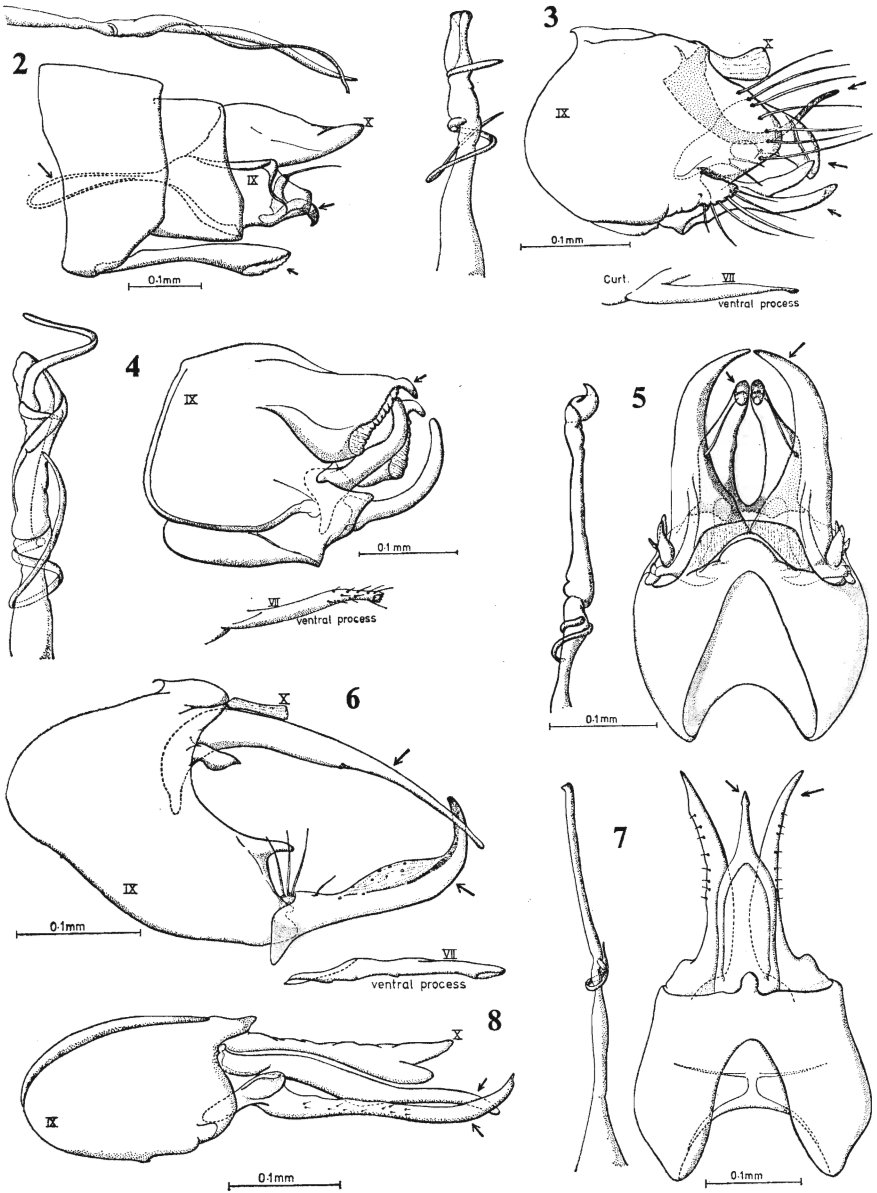
In the keys to species the following data have been given (where known) after the initial mention of the taxon concerned (i.e. in the keys to the males only): larval habitat; months of adult occurrence in the British Isles; world distribution. Distribution maps for each species within the British Isles have been produced in association with the Biological Records Centre and are due to be published separately in the near future. Further data on the European distribution of the British Hydroptilidae may be found in Botosaneanu (1967).

Genus *Hydroptila* Dalman

This is the largest and most widespread genus of the family Hydroptilidae, containing over 150 species from almost every region of the world except the Arctic and the Antarctic. A number of more or less geographically distinct species groups may be recognized by the form of the male and female genitalia and the males are characterized by the modification of the post-occipital warts as hinged caps concealing eversible scent-organs. The larvae build purse-type cases covered with small inorganic particles and prefer running water in lakes, streams and rivers, usually on the bottom substrate in association with the green filamentous algae on which they feed.

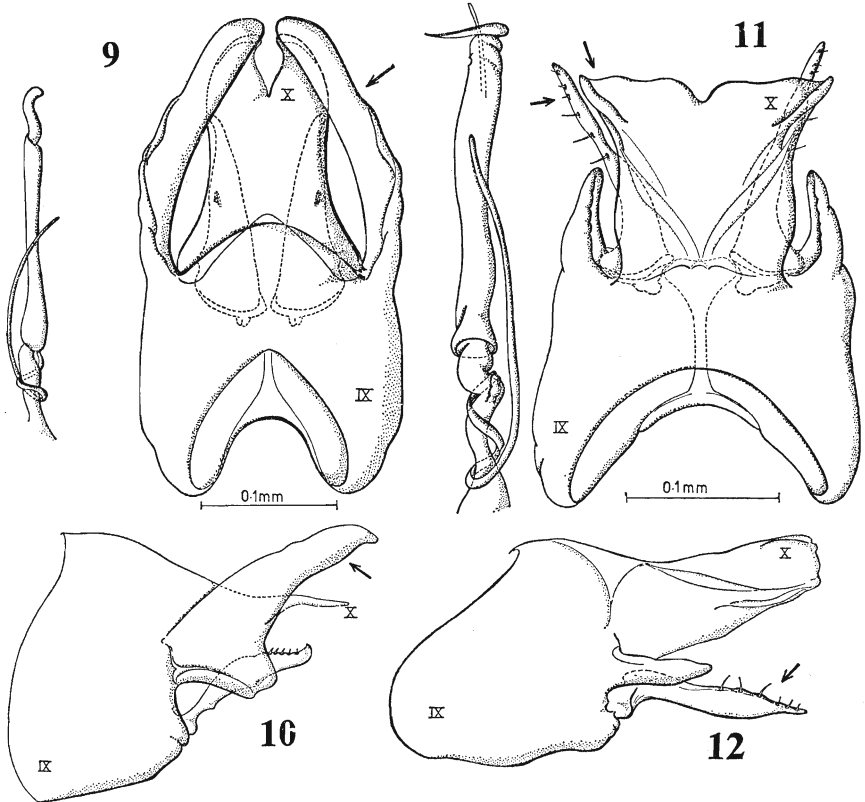
Key to species

- | | | |
|---|---|-------------------------|
| 1 | Males | 2 |
| - | Females | 15 |
| 2 | Fore-femora covered in black hairs; tergite X narrow, constricted at base, tapering to a round apex; inferior appendages small, baso-dorsal process with long apical seta; ventral process of VII long and stout (fig. 2) | tineoides Dalman |
| | <i>Lakes and running water on stones, sometimes on plants; widely distributed and abundant, probably the commonest British species of Hydroptila; northern and central Europe (including the Faroes), Italy, Yugoslavia, Bulgaria, Algeria.</i> | |
| - | Fore-femora without black hairs; genitalia not as above | 3 |
| 3 | A pair of long black sinuous spines projecting from beneath tergite X; subgenital appendages short, broad in lateral view; inferior appendages short, bifurcate, pointed; ventral process of VII long, pointed (fig. 3) | vetis Curtis |
| | <i>Usually in the calmer regions of streams and brooks, often amongst clumps of moss or Ranunculus; (v)vii-ix; widely distributed throughout Great Britain (not, so far,</i> | |



Figs 2-8. ♂ genitalia. 2, *Hydroptila tineoides*, lateral. 3, *H. vectis*, lateral. 4, *H. tigurina*, lateral. 5-6, *H. forcipata*: 5, dorsal; 6, lateral. 7-8, *H. pulchricornis*: 7, dorsal, tergite X removed; 8, lateral.

- recorded from East Anglia, north and central Wales or Ireland); Europe, Atlantic Islands, Iran, Israel and Pakistan; *H. vectis* v. *corsicanus* Mosely occurs in Corsica.
- Genitalia not as above.....4
 - 4 Postero-lateral margins of segment IX truncate, strongly ridged with dorsal black hook; inferior appendages fused basally (U-shaped in ventral view), slender, long and slightly upturned apically (fig. 4) **tigurina** Ris
*Known only from male specimens taken at Ambleside, Cumbria (viii. 1881) and at the type-locality in Zurich, Switzerland (1888).**
 - Genitalia not as above.....5



Figs 9-12. ♂ genitalia. 9-10, *Hydroptila sylvestris*: 9, dorsal; 10, lateral. 11-12, *H. sparsa*: 11, dorsal; 12, lateral.

- 5 Tergite X short, membranous, quadrate; inferior appendages elongate, slender, upturned apically; superior appendages elongate, slender, down-curved apically giving an overall 'forcipate' appearance in lateral view (figs 5, 6) **forcipata** (Eaton)
Fast flowing water in hilly and montane regions; v-ix; widespread and abundant throughout the British Isles, especially Scotland and central England; Scandinavia, central and southern Europe.
- Genitalia not as above.....6

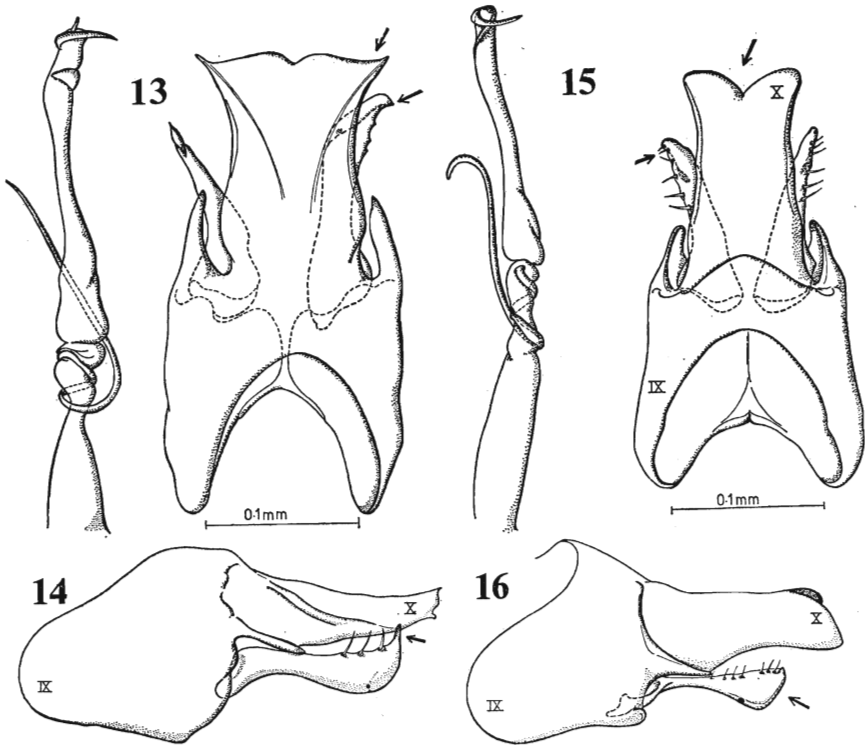
* *H. tigurina* has recently been recorded from Ireland, vide O'Connor, J.P. *Irish Naturalist's Journal* 19 (6): 191-192.

- 6 Genitalia appearing very compressed in lateral view; tergite X elongate, slender; subgenital plate broad for basal two-thirds, apical third narrow, tapering to point; inferior appendages elongate, narrow, apices slightly upturned (figs 7, 8)

pulchricornis Pictet

Lakes, ponds, rivulets and brooks, often amongst riparian vegetation; v-ix; widely distributed throughout the British Isles and recently recorded from Ireland (O'Connor, in litt.) Not common, however, and prefers the larger natural or semi-artificial lakes and slow moving rivers in the Lake District, Yorkshire Dales, Scotland, the Fens and south-east England; north and central Europe, Italy and Israel.

- Genitalia not as above. 7



Figs 13-16. ♂ genitalia. 13-14, *Hydroptila cornuta*: 13, dorsal; 14, lateral. 15-16, *H. simulans*: 15, dorsal; 16, lateral.

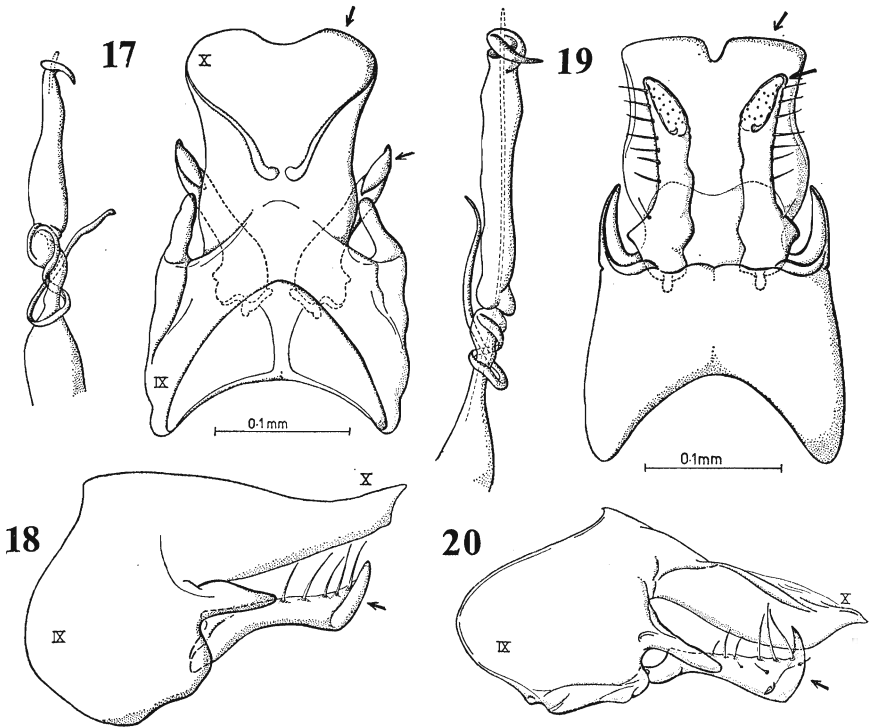
- 7 Tergite X well developed, broad; lateral processes of IX elongate, slender; inferior appendages straight, usually dilated at apex (*sparsa*-group)..... 8
- Tergite X membranous, elongate, narrow; lateral processes of IX short, broad; inferior appendages elongate, slightly dilated and down-turned apically with upper apical margin darkly sclerotized; long, slender parameres present alongside aedeagus, sharply upturned apically (*oculta*-group)..... 13
- 8 Lateral processes of IX elongate, as long as tergite X, broad basally, oblique in lateral view, concealing the genital appendages; tergite X relatively narrow, apex rounded with slight median excision (figs 9, 10) **silvestris** Morton

Known from only five British localities (Inverness-shire: Aviemore, Rothiemurchus and L. Morlich, 1896; Cumbria: Ambleside, 1881 and R. Brathay, 1943; vii-viii); France.

- Lateral processes of IX relatively short; tergite X broad 9
- 9 Posterior margin of tergite X sinuous, lateral angles pointed, angles of median excision rounded 10
- Tergite X not as above. 11
- 10 Inferior appendages with pointed apices (figs 11, 12) 11

sparsa Curtis

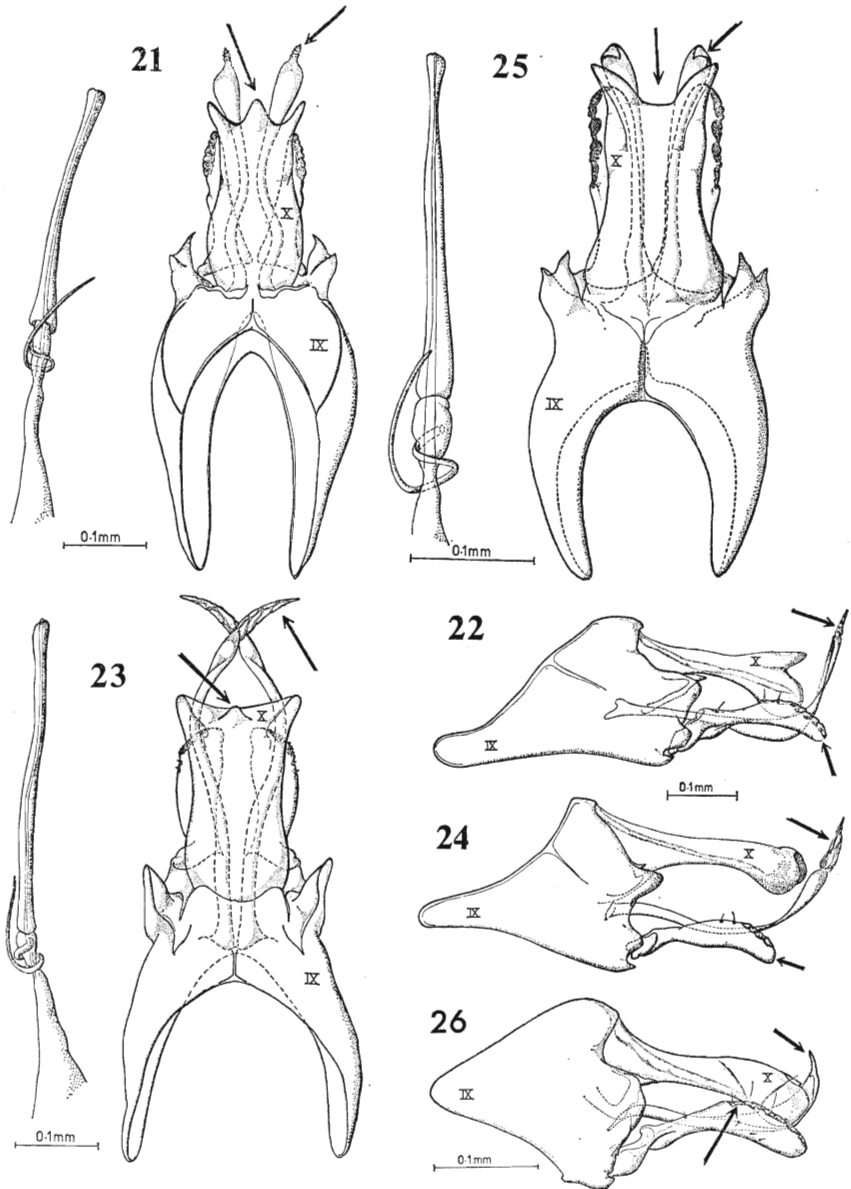
Rivers, streams, lakes, ornamental ponds, reservoirs, etc.; v-x (possibly bivoltine in southern England); widespread and abundant throughout south and central England and Wales but apparently more local in the north of England and Scotland; throughout Europe (rarer in Scandinavia); Iran, Israel, Algeria.



Figs 17-20. ♂ genitalia. 17-18, *Hydroptila angulata*: 17, dorsal; 18, lateral. 19-20, *H. lotensis*: 19, dorsal; 20, lateral.

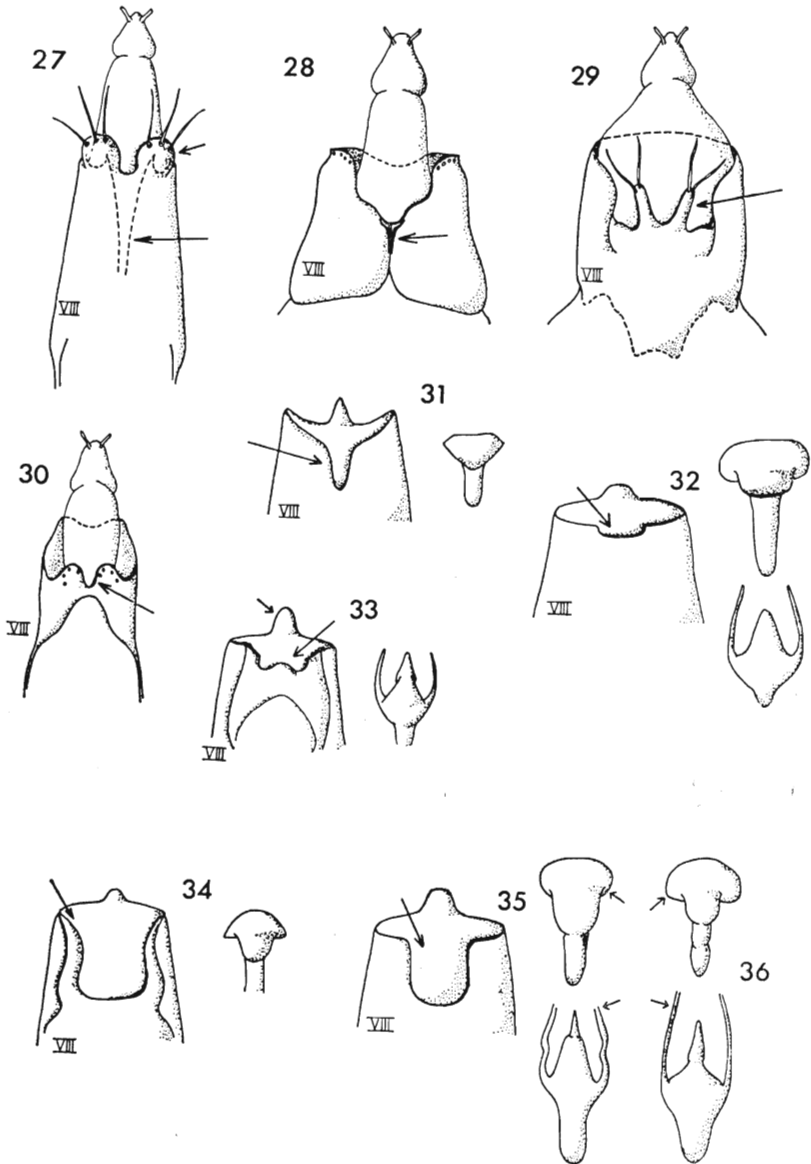
- Inferior appendages with dilated apices (figs 13, 14) **cornuta** Mosely
Rivers and streams; v-ix; local; Shetlands, Hampshire, Suffolk with new records from Ireland (O'Connor, in litt.); north and central Europe, Italy.

- 11 Posterior margin of tergite X with shallow V-shaped median cleft, lateral angles pointed; inferior appendages dilated at apex, truncate in lateral view with distinct spot in ventral corner (figs 15, 16) **simulans** Mosely
Rivers and streams; v-x; more widespread, especially in the north, but less common than *sparsa* with which it often occurs; new records from Sutherland, Inverness-shire and Ireland; throughout Europe, Israel, Iran, Afghanistan.

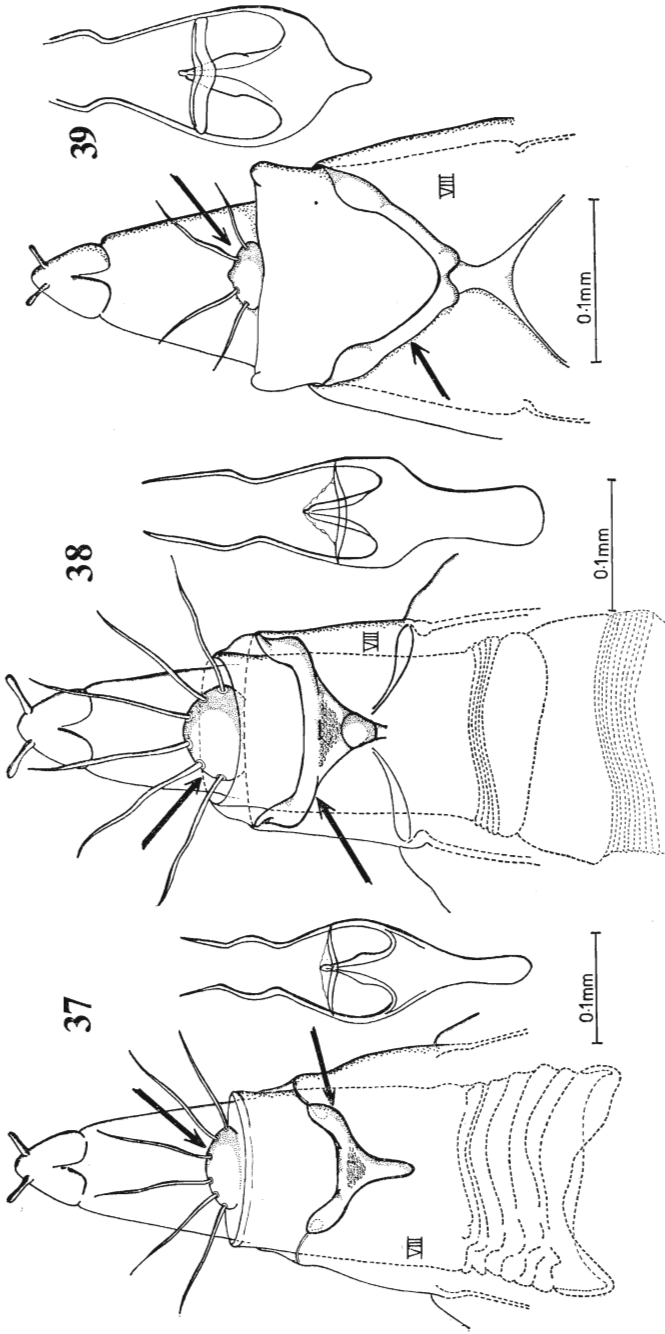


Figs 21-26. ♂ genitalia. 21-22, *Hydroptila martini*: 21, dorsal; 22, lateral. 23-24, *H. occulta*: 23, dorsal; 24, lateral. 25-26, *H. valesiaca*: 25, dorsal; 26, lateral.

- Lateral angles of posterior margin of tergite X rounded; dilated apices of inferior appendages acutely upturned and out-turned. 12
- 12 Posterior margin of tergite X with shallow U-shaped median excision; inferior appendages with bluntly produced dorsal corners (figs 17, 18) **angulata** Mosely
Lakes, larger rivers, still water; vi-viii (x); local; Shetlands, north and south-west England, south Wales, Ireland (new records indicate that this species may be more common than previously thought); found locally throughout Europe and also Iran and Pakistan.
- Posterior margin of tergite X with a slight median 'nick'; apices of inferior appendages each with a strong upturned pointed claw and a small dark spot in the ventral corner (figs 19, 20) **lotensis** Mosely
Rivers; vi-viii; sole British record from a short series from R. Wye, Hampton Bishop, Herefordshire, 12.viii.1959; Finland, Poland, France, Rumania, U.S.S.R., Iran.
- 13 Posterior margin of tergite X with deep quadrate median excision; parameres with simple pointed apices; dorso-apical sclerotization of inferior appendages extending approximately from medio-dorsal setae to dorso-apical angle (figs 25, 26) **valesiaca** Schmid
High altitude streams; Wigtonshire, vii.1899 and L. Awe, Portsonachan, vi. 1935; Swiss and French Alps in and around Valais (vide Marshall, 1977).
- Posterior margin of tergite X with a median lobe; apices of parameres variously sculptured; sclerotization of inferior appendages restricted to apical third. 14
- 14 Median lobe of posterior margin of tergite X well developed, extending beyond lateral angles; apical sculpturing of parameres relatively short, rugose; dorsal arm of lateral process of segment IX slightly longer than ventral arm; sclerotization of inferior appendages extending towards ventro-apical angle (figs 21, 22) **martini** Marshall
Larger, more slowly flowing rivers typical of southern England also Eire and the Shetlands; Yugoslavia and France; vi-vii; a number of past records of 'H. occulta (Eaton)' may in fact refer to this species (Marshall, 1977).
- Median process of posterior margin of tergite X small, inconspicuous or absent; ventral arm of lateral process of IX slightly longer than dorsal arm; apical sculpturing of parameres relatively longer, mosaic-like; apical sclerotization of inferior appendages not extending around tip (figs 23, 24) **occulta** (Eaton)
Faster flowing streams and rivers; vii-x; throughout Scotland, England and Wales but not yet verified from Ireland; Europe (some records may refer to H. martini Marshall or H. valesiaca Schmid (Marshall, 1977)).
- 15 Ventro-posterior margin of segment VIII with two prominent rounded setose lobes, dorsal margin with dark-edged, deep, narrow, anteriorly tapering V-shaped excision (fig. 27) **tineoides** Dalman
- Genitalia not as above. 16
- 16 Ventro-posterior margin of VIII with sub-quadrate excision, the base of which leads to a short median dark line (fig. 28) **vectis** Curtis
- Segment VIII not as above. 17
- 17 Ventro-posterior margin of VIII with short median bifurcate process (fig. 29) **forcipata** (Eaton)
- Genitalia not as above. 18
- 18 Ventro-posterior margin of VIII with a pair of short setate lobes separated by a slight median excision, dorso-posterior margin extending hood-like beyond ventral (fig. 30) **pulchricornis** Pictet
- Genitalia not as above. 19
- 19 Ventro-posterior margin of VIII with short, narrow, rounded lobe; dorso-posterior margin variously excised; sternum VIII with mushroom-shaped sclerite (*sparsa*-group). 20
- Semi-circular sternite between segments VIII and IX; T- to Y-shaped sclerite on sternum VIII (*occulta*-group). 25
- 20 Dorsal excision of VIII narrow, deep (fig. 31) **sylvestris** Morton
- Dorsal excision of VIII not as above. 21
- 21 Dorsal excision of VIII shallow, inconspicuous, slightly quadrate (fig. 32) **simulans** Mosely
- Dorsal excision of VIII not as above. 22
- 22 Dorsal margin of VIII with two lateral shallow convex excisions (fig. 33) **cornuta** Mosely
- Dorsal excision of VIII deep and wide. 23
- 23 Dorsal excision of VIII with marginal ridge, pointed at lateral angles, widening posteriorly to a broad transverse base (fig. 34) **angulata** Mosely



Figs 27-36. ♀ genitalia. 27, *Hydroptila tineoides*, ventral. 28, *H. vectis*, ventral. 29, *H. forcipata*, ventral. 30, *H. pulchricornis*, ventral. 31, *H. sylvestris*, dorsal. 32, *H. simulans*, dorsal. 33, *H. cornuta*, dorsal. 34, *H. angulata*, dorsal. 35, *H. sparsa*, dorsal. 36, *H. lotensis*, ventral sclerite and internal apparatus only.



Figs 37-39. ♀ genitalia, ventral. 37, *Hydroptila martini*. 38, *H. occulta*. 39, *H. valesiaca*.

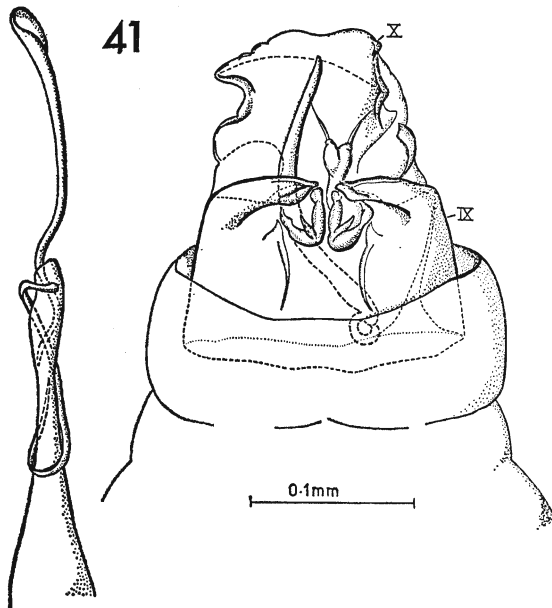
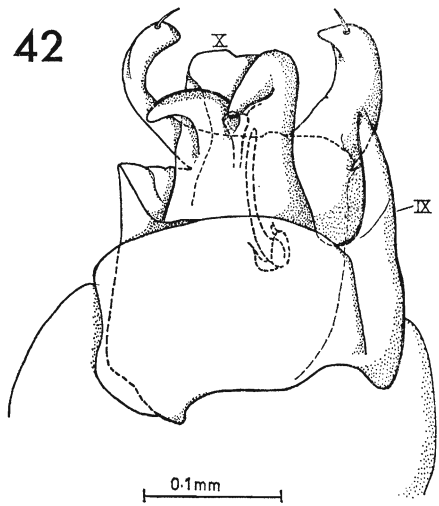
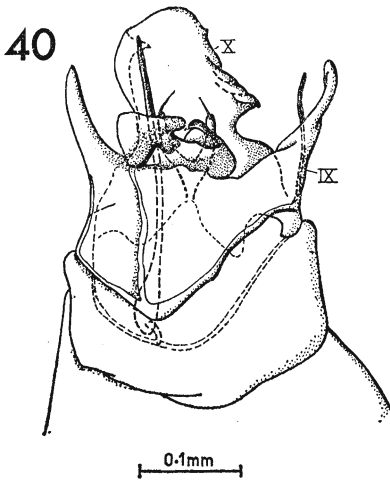
- Dorsal excision quadrate, without marginal thickening 24
- 24 Ventral lobe of VIII short, lateral arms of internal apparatus not extending beyond median process, cross-piece of mushroom-shaped ventral sclerite of VIII with rounded basal angles (fig. 35) sparsa Curtis
- Ventral lobe of VIII relatively long and slender; lateral arms of internal apparatus extending just beyond median process, cross-piece of 'mushroom' with almost right-angled basal corners (fig. 36) lotensis Mosely
- 25 Anterior sternite of segment IX with a small posterior median lobe and four long setae; Y-shaped sternite of segment VIII large with slight apical swellings on lateral arms; internal anterior ridges of segment VIII absent (fig. 39) valesiaca Schmid
- Anterior sternite of segment IX without median lobe and with six long setae; sternite of VIII not as above; internal ridges present on segment VIII 26
- 26 Anterior sternite of segment IX broad, ovoid; sternite of VIII Y-shaped, relatively narrow; two sets of anterior internal ridges present on segment VIII (fig. 37) martini Marshall
- Anterior sternite of segment IX semicircular, narrow; sternite of VIII T-shaped, apical angles of cross-piece with short posterior processes; single set of anterior internal ridges on segment VIII (fig. 38) occulta (Eaton)

Genus *Orthotrichia* Eaton

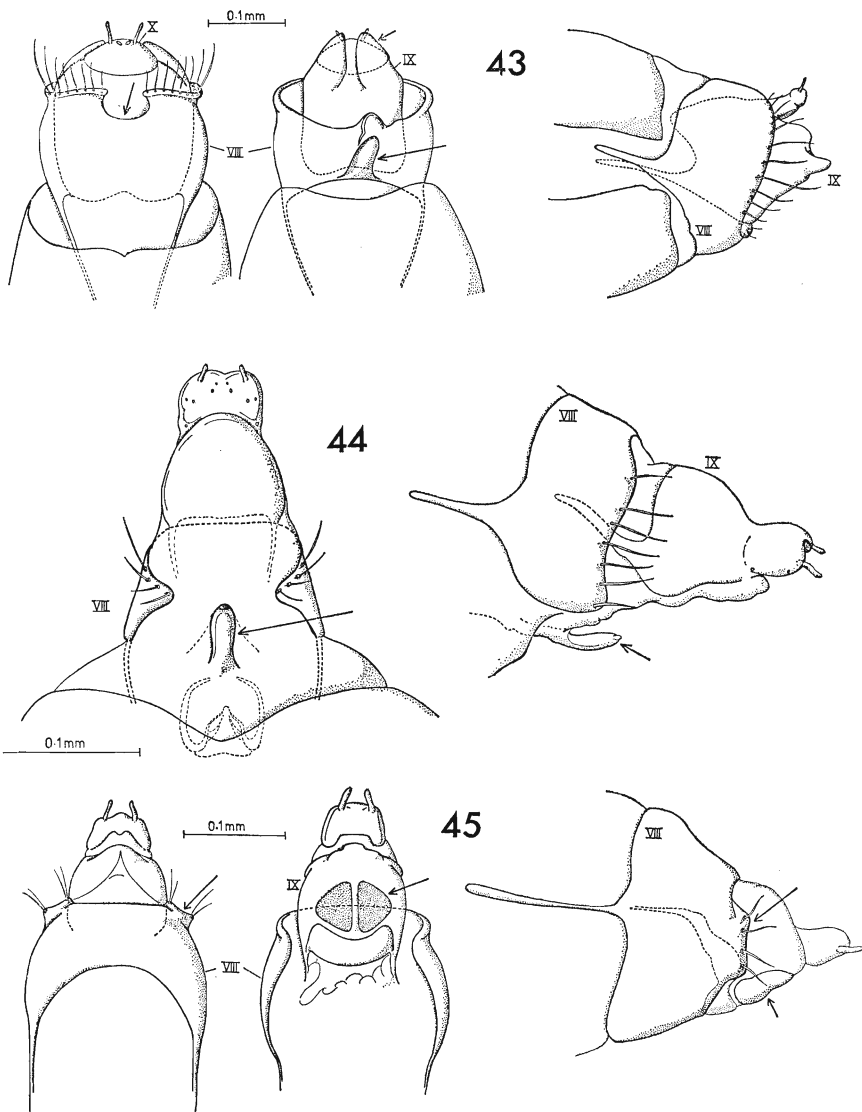
Orthotrichia is a very successful genus with approximately 40 species with an almost continuous world-wide distribution although it has not so far been recorded from Central or South America or the Australian region. The genus is well represented in the Palaeotropical regions of Africa and south-east Asia, through Indonesia to New Guinea and possibly also Fiji. The adults are characterized by the asymmetrical male genitalia and the absence of ocelli. The larvae are associated with aquatic vegetation in standing waters and are highly adapted for feeding on the cell contents of green filamentous algae.

Key to species

- 1 Males 2
- Females 4
- 2 Forewing with a row of black scale-like setae along base of subcosta; lateral processes of segment IX long and slender, almost symmetrical; two slender lateral spines present, left elongate, right short; inferior appendages small, inconspicuous, slightly asymmetrical (fig. 40) angustella (McLachlan)
Standing water and slowly flowing streams; vi-viii; local; south and south-east England to Cumbria and Co. Kerry, Ireland; Norway, Sweden, central Europe, Spain and Italy.
- Forewing without a row of black subcostal setae; genitalia not as above 3
- 3 Lateral process of IX absent or inconspicuous; inferior appendages small, heart-shaped, inconspicuous; tergite X relatively broad (fig. 41) tragetti Mosely
2♂♂ from a private lake near Mottisfont, Hampshire, 31.vii.1915 (probably introduced with aquatic vegetation); very rare; Sweden, Finland, France, Switzerland, Italy, U.S.S.R.
- Lateral process of IX on left side only; inferior appendages large, elongate, strongly curved inwards, asymmetrical; tergite X relatively narrow (fig. 42) costalis (Curtis)
Ponds and lakes, slowly flowing water, often on reeds in the outer part of reed swamps; vi-viii; common throughout England and Scotland (Hampshire to Argylshire) although absent from Wales and south-west England, recent records from Ireland (O'Connor, in litt.); throughout Europe, Iran, Afghanistan, Ethiopia.
- 4 Segment VIII with short but slender ventro-median membranous process (fig. 44) tragetti Mosely
- Ventral process of VIII absent 5
- 5 Dorso-posterior margin of VIII straight, membranous venter with a pair of dark subtriangular patches (fig. 43) costalis (Curtis)
costalis ~~*angustella* (McLachlan)~~
- Tergite and sternite of VIII fused; dorso-posterior margin of VIII with small median ovoid excision, sternite with oblique groove (fig. 45) costalis (Curtis)
~~*angustella*~~



Figs 40-42. ♂ genitalia. 40, *Orthotrichia angustella*, ventral. 41, *O. tragetti*, ventral. 42, *O. costalis*, dorsal.



Figs 43–45. ♀ genitalia. 43, *Orthotrichia angustella*, dorsal, ventral, lateral. 44, *O. tragetti*, ventral, lateral. 45, *O. costalis*, dorsal, ventral, lateral.

Genus *Agraylea* Curtis and genus *Allotrichia* McLachlan

The genera *Agraylea* and *Allotrichia* are grouped here because of the fundamental morphological similarities of both the adult and larval stages. The adults have been distinguished formerly by a minor venational difference in the forewings but this has since proved to be an unreliable character and *Allotrichia pallicornis* may

be distinguished only by its characteristic male and female genitalia. The larvae of *Allotrichia pallicornis* are very much like those of *Agraylea* but, according to Giudicelli & Vaillant (1967), are secondarily adapted for substrate feeding in fast flowing streams. It is evident that these two genera need to be carefully reviewed.

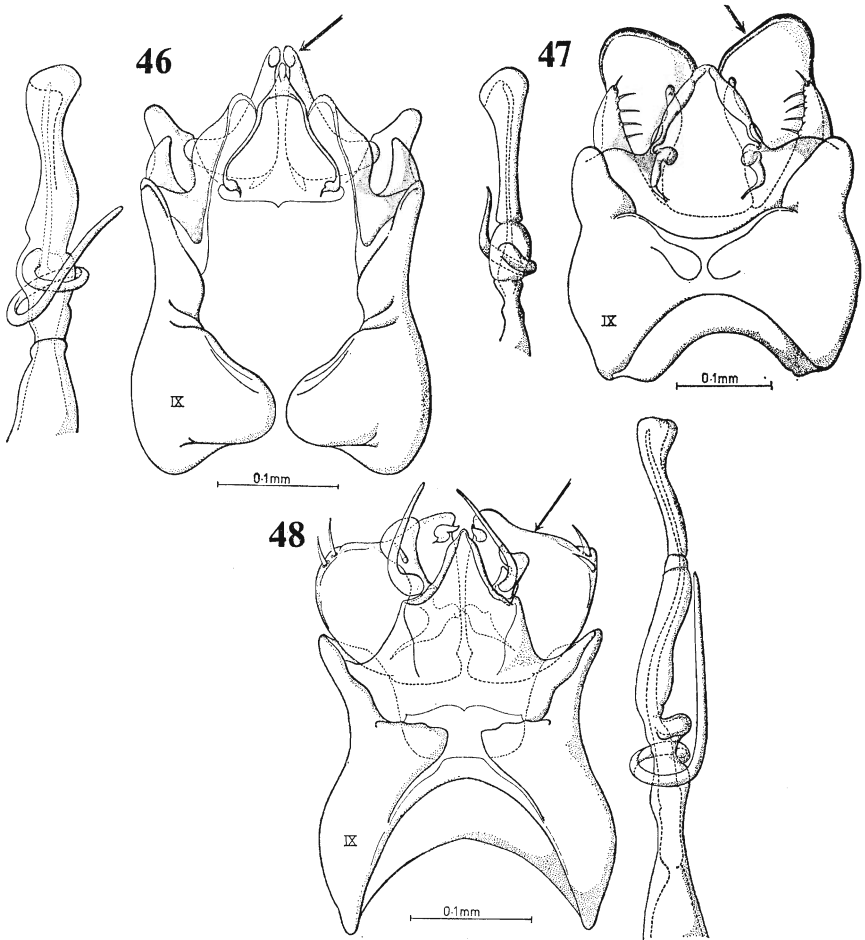
Agraylea is a Holarctic genus containing nine species (some of which may be synonymous) while *Allotrichia* (eight species) is apparently confined to the Palaearctic region. (These two genera are regarded as synonymous by American taxonomists, see Ross (1941) on *Agraylea costello* Ross.) *Agraylea multipunctata* Curtis is at present regarded as a Holarctic species but minor differences in both the male and female indicate that at least two distinct species are involved, one Palaearctic and one Nearctic. cursory studies have also revealed that a number of so-called species of *Allotrichia* are, in fact, synonyms of *A. pallicornis*, but this and the previous problem should be subjected to more critical investigations before any conclusions are drawn. Lastly, although really perhaps beyond the scope of this handbook, attention should be drawn to the possibility of the occurrence of the Scandinavian species *Agraylea cognatella* McLachlan in this country. This species is very closely related to *A. multipunctata* and may have been confused previously with the latter since the original figure of the genitalia of *A. cognatella* is very crude and the abdomen of the type has been lost. A redescription of *A. cognatella* would therefore be very useful.

Key to species

- 1 Males2
- Females4
- 2 Inferior appendages small, L-shaped with broad bases and slender median and parallel apical processes (fig. 46) **Agraylea multipunctata** Curtis
Lakes and ponds in submerged and sheltered vegetation, sometimes in plant thickets in slowly flowing rivers and streams; possibly bivoltine, v-ix; abundant and widespread throughout the British Isles; reputedly Holarctic (see above) with a relatively more northern distribution than Agraylea sexmaculata Curtis.
- Inferior appendages large, broad, plate-like3
- 3 Apical margins of inferior appendages convex, dark-edged; subgenital plate without asymmetrical processes (fig. 47) **Agraylea sexmaculata** Curtis
Lakes, ponds and slowly running water in plant thickets; v-ix; common, especially in central and southern England but not so far recorded from south-west England, Scotland or Ireland; southern Scandinavia, central and southern Europe; Turkestan and Iran.
- Apical margins of inferior appendages concave, slightly more elongate medially, median angles with small, dark, asymmetrical, sclerotized processes; subgenital plate with asymmetrical processes (fig. 48) **Allotrichia pallicornis** (Eaton)
Rapid streams, possibly with little aquatic vegetation or shelter, on substrate; vi-vii; tendency to prefer the more mountainous and hilly regions of northern and western Britain and fast flowing streams in the southern lowland regions - also Ireland (O'Connor, in litt.); central and southern Europe, Iran, Algeria.
- 4 Segment VIII narrow with a ventral, elongate, asymmetrical and slightly oblique groove (fig. 51) **Allotrichia pallicornis** (Eaton)
- Segment VIII broad with a small median ventral sclerite (figs 49, 50)5
- 5 Ventral sclerite of VIII relatively large, anterior margin convex, posterior margin bilobed; internal apparatus elongate (fig. 49) **Agraylea multipunctata** Curtis
- Ventral sclerite of VIII inconspicuous, merely represented by a very narrow, U-shaped, sclerotized ridge; internal apparatus very short with median crown-like ring (fig. 50) **Agraylea sexmaculata** Curtis

Genus *Ithytrichia* Eaton

Ithytrichia is a small Holarctic genus containing four species, of which *I. lamellaris* Eaton is the most common Palaearctic species. *I. clavata* Morton, originally de-



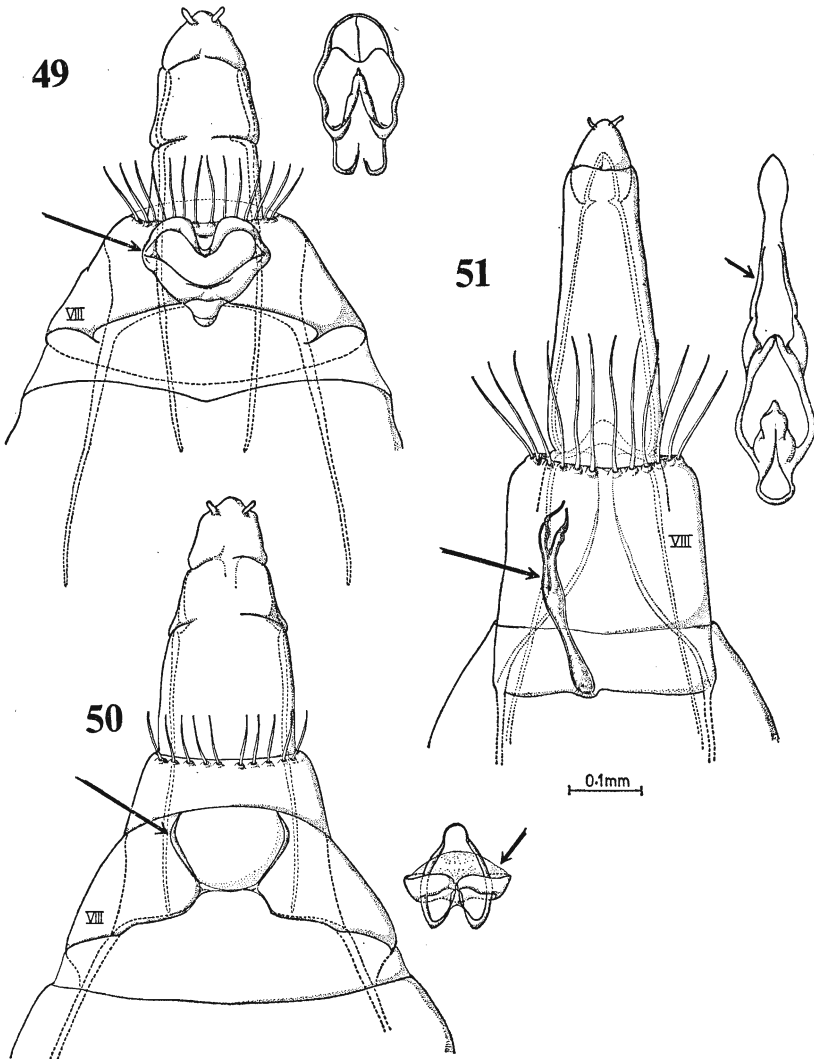
Figs. 46-48. ♂ genitalia, dorsal. 46, *Agraylea multipunctata*. 47, *Agraylea sexmaculata*. 48, *Allotrichia pallicornis*.

scribed from North America, has since been recorded from Europe, including Great Britain. The adults are characterized by the very distinctive basic form of the male genitalia, while the larvae are unique in possessing 'pumpkin-seed-like' cases and having small dorsal and ventral abdominal papillae.

Key to species

- 1 Males2
- Females.....3
- 2 Pair of dark parallel dorsal rods; inferior appendages broad, parallel, apices truncate with a dark spot on outer corner; apex of subgenital plate bilobed (fig. 52)

lamellaris Eaton

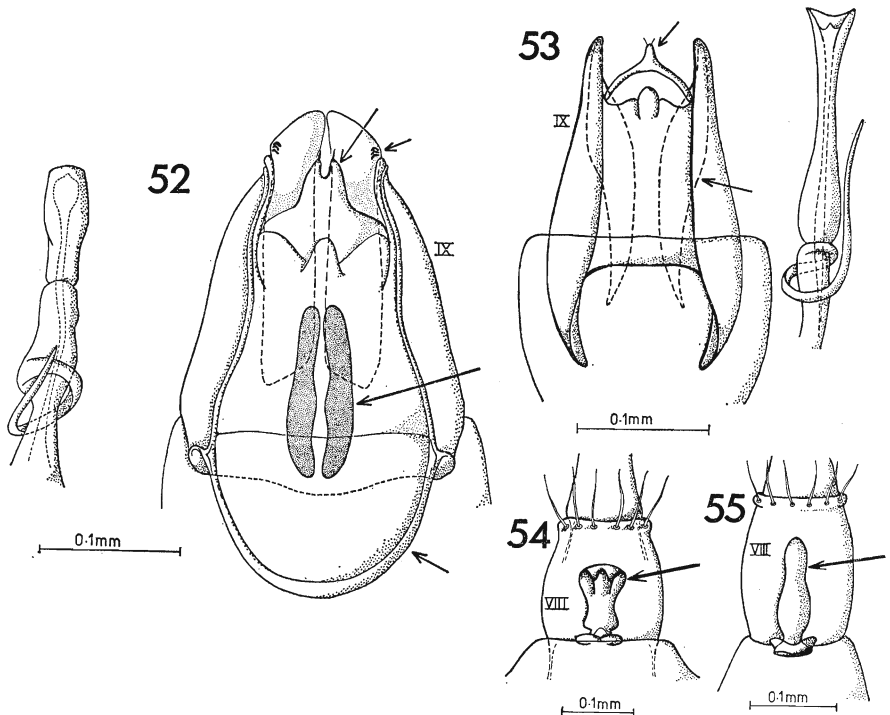


Figs 49-51. ♀ genitalia, ventral. 49, *Agraylea multipunctata*. 50, *Agraylea sexmaculata*. 51, *Allotrichia pallicornis*.

Running water in plant thickets on both sheltered and exposed leaves and also on the bottom substrate; vi-ix; widespread throughout the British Isles but not abundant; north and central Europe, Spain, Israel.

- Dorsal rods absent; inferior appendages sinuous, apices pointed; apex of subgenital plate produced as a single short process (fig. 53, after Tjeder, 1930)

clavata Morton



Figs 52–55. Genitalia. 52, *Ithytrichia lamellaris* ♂, dorsal. 53, *I. clavata* ♂, dorsal (after Tjeder, 1930). 54, *I. lamellaris* ♀, ventral. 55, *I. clavata* ♀, ventral.

Fast flowing streams and small rivers; Merioneth (23.viii.1939), Lancashire (30.vi.1941), Cumbria (30.vii.1943) and in the BMNH collections there is a female from Hampshire labelled Orthotrichia tetensii Kolbe which may represent I. clavata; Sweden, Finland, France, North America.

- 3 Sternite VIII with trilobed posterior margin (fig. 54) **lamellaris** Eaton
 – Sternite VIII with convex anterior margin, anterior margin with wide brim (fig. 55, based on unassociated female from Hampshire, see above) **clavata** Morton

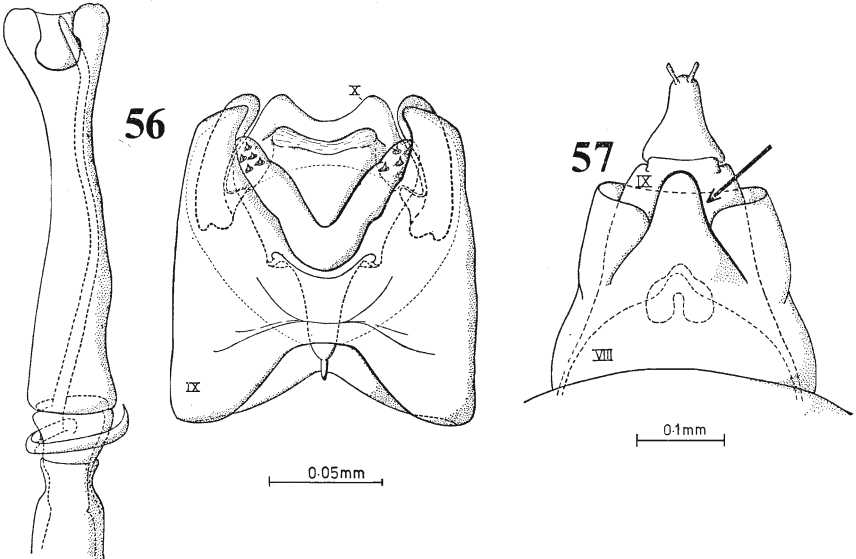
Genus *Tricholeiochiton* Kloet & Hincks

A small Palearctic genus with only two species; *fagesii* (Guinard), from Europe and the U.S.S.R., and *lacustris* Kimmins from Burma. The adults have very characteristic genitalia and the larvae are easily recognized by their extremely long legs.

- Sole British species (figs 56, 57) **fagesii** (Guinard)
Stagnant water with a slow current in vegetation thickets; Hampshire (17.vii.1932), Cheshire (1975/6, Wallace, pers. comm.) and possibly also Ireland; Sweden, Netherlands, Italy, Spain, European U.S.S.R.

Genus *Oxyethira* Eaton

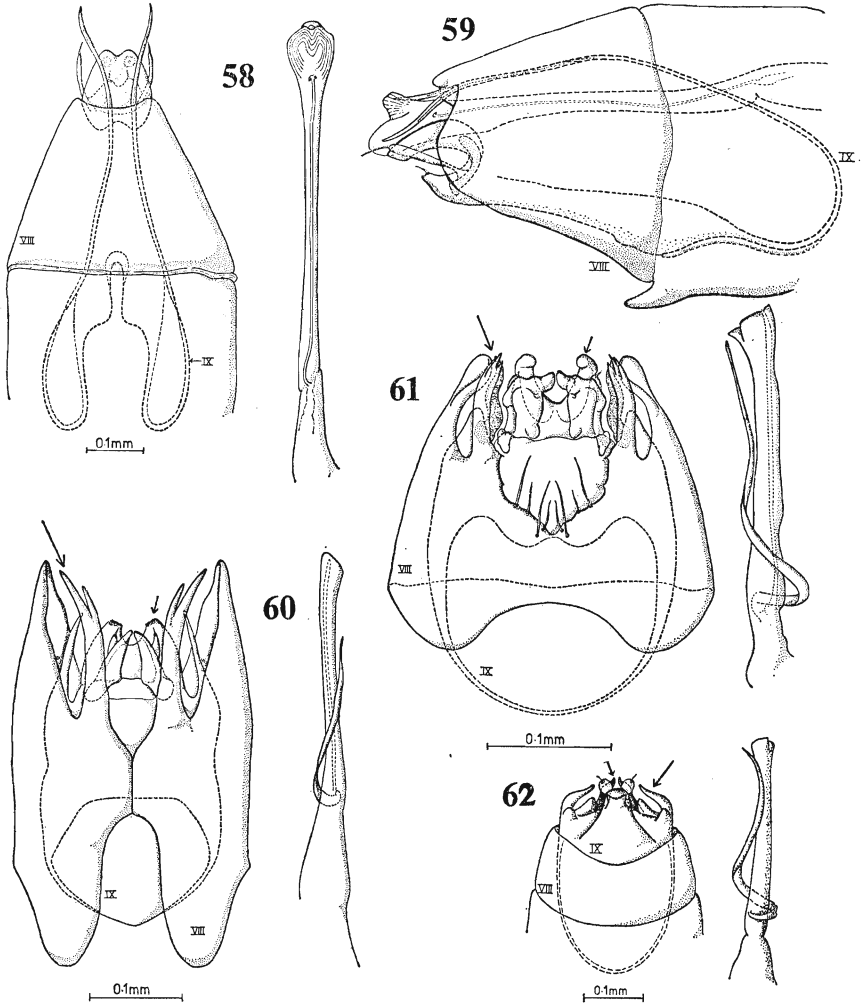
Oxyethira is a very successful, almost cosmopolitan, genus with approximately 75 species of which eight have been recorded in the British Isles.



Figs 56-57. *Tricholeiochiton fagesii* genitalia, ventral. 56, ♂. 57, ♀.

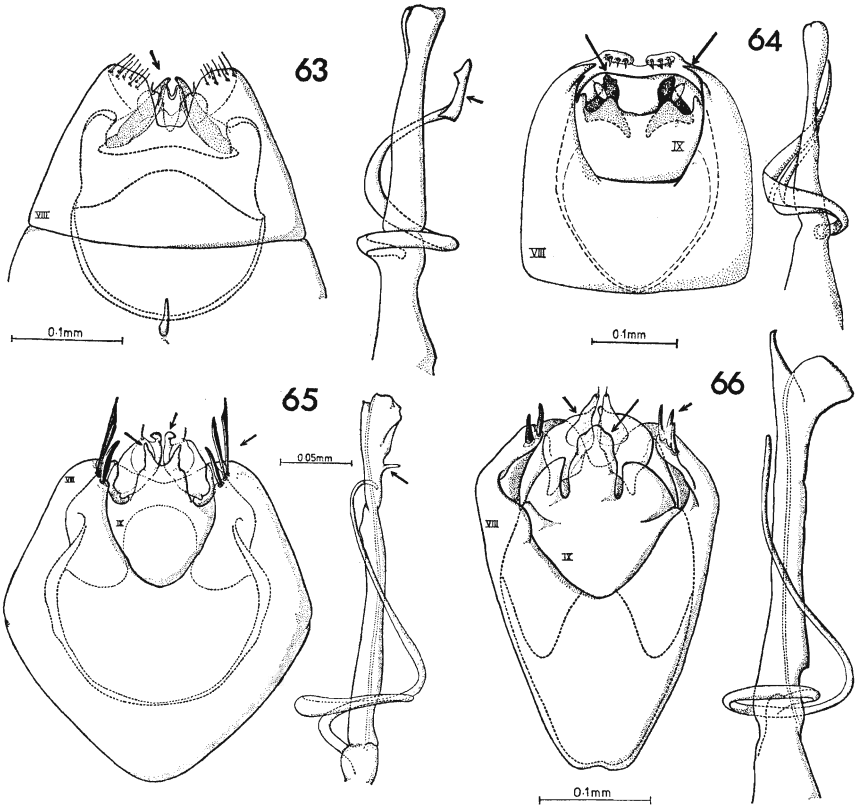
Key to species

- 1 Males 2
- Females 9
- 2 Segment IX reduced essentially to its marginal framework of which the two dorsal arms project as a pair of slender spines alongside apex of aedeagus; subgenital plate broad, slightly bilobed with pair of subapical ventral patches of concentric sclerotized rings; inferior appendages short, fused basally, rounded apically, each with short apical seta and slender, seta-bearing baso-dorsal process; apex of aedeagus dilated with concentric inner lines (figs 58, 59) **mirabilis** Morton
Lakes; *L. Eigheach, Rannoch, Perthshire, vii.1903; Scandinavia and north-west U.S.S.R.*
- Segment IX well sclerotized, annular 3
- 3 Posterior margin of segment VIII with pair of dorso-lateral slender digitate processes, apices bi- or trifurcate 4
- Dorso-lateral processes of VIII absent 5
- 4 Segment VIII elongate, longer than IX; lateral processes of IX produced as long slender spines; subgenital appendages slender, tapering apically; inferior appendages truncate with finely serrate (or setose) edges (fig. 60) **distinctella** McLachlan
Lakes, stagnant and slowly flowing water in plant thickets; vii; single ♂ taken at private lake near Romsey, Hampshire (1919); Scandinavia, north-west U.S.S.R.
- Segment VIII shorter than IX; lateral processes of IX thin and rounded apically, each giving rise internally to a strong sinuous spine; subgenital appendages broad basally with strongly incurved, short medio-apical processes; inferior appendages with short upturned processes (fig. 61) **sagittifera** Ris
Lakes, ponds, streams; vi-viii; local records from Scotland, Cumbria and Ireland - very rare; Scandinavia, central Europe, north-west U.S.S.R.
- 5 Lateral processes of segment IX sharply curved inwards (fig. 62) **tristella** Klapálek
Running water in the rapid current of small streams, rivers and lakes; v-ix; widely distributed throughout British Isles although local and rare, not recorded in Britain since 1940 (Oxford); Scandinavia, north and central Europe.
- Lateral processes of segment IX completely absent 6



Figs 58–62. ♂ genitalia. 58–59, *Oxyethira mirabilis*: 58, ventral; 59, lateral. 60, *O. distinctella*, dorsal. 61, *O. sagittifera*, dorsal. 62, *O. tristella*, ventral.

- 6 Lateral apical margins of segment VIII rounded and neither hooked inwards nor armed with stout black spines (fig. 63) **simplex** Ris
Lakes, rivers, streams in vegetation thickets; v–viii; local but widely distributed throughout the British Isles, recently taken in Inverness-shire (1968) and Berkshire (1973); Scandinavia, Netherlands, Switzerland, U.S.S.R.
- Lateral apical margins of VIII hooked inwards or with stout spines.....7
- 7 Lateral margins of VIII strongly hooked inwards, dorsal margin with pair of short, blunt, setae-bearing processes (fig. 64) **flavicornis** (Pictet)
Rivers, lakes, ponds in vegetation thickets; v–ix (bivoltine ?); widely distributed and very abundant throughout the British Isles including the Shetlands and Ireland; north and central Europe, Italy, Yugoslavia, U.S.S.R., Egypt.



Figs 63–66. ♂ genitalia, ventral. 63, *Oxyethira simplex*. 64, *O. flavicornis*. 65, *O. frici*. 66, *O. falcata*.

- Lateral margins of VIII armed with stout black spines. 8
- 8 Lateral spines of VIII (3) relatively long; small ventral plate with bilobed apex; subgenital appendages with short out- and down-turned hooks (fig. 65)

frici Klapálek

Prefers running water in rivers and streams; v–ix; Scotland, north-west and south-west England, Wales and Ireland; Scandinavia, north and central Europe.

- Lateral spines of VIII (2 or 3) short; ventral plate trilobed; median ventral process with acute, upturned apex; apices of subgenital appendages blunt (fig. 66)

falcata Morton

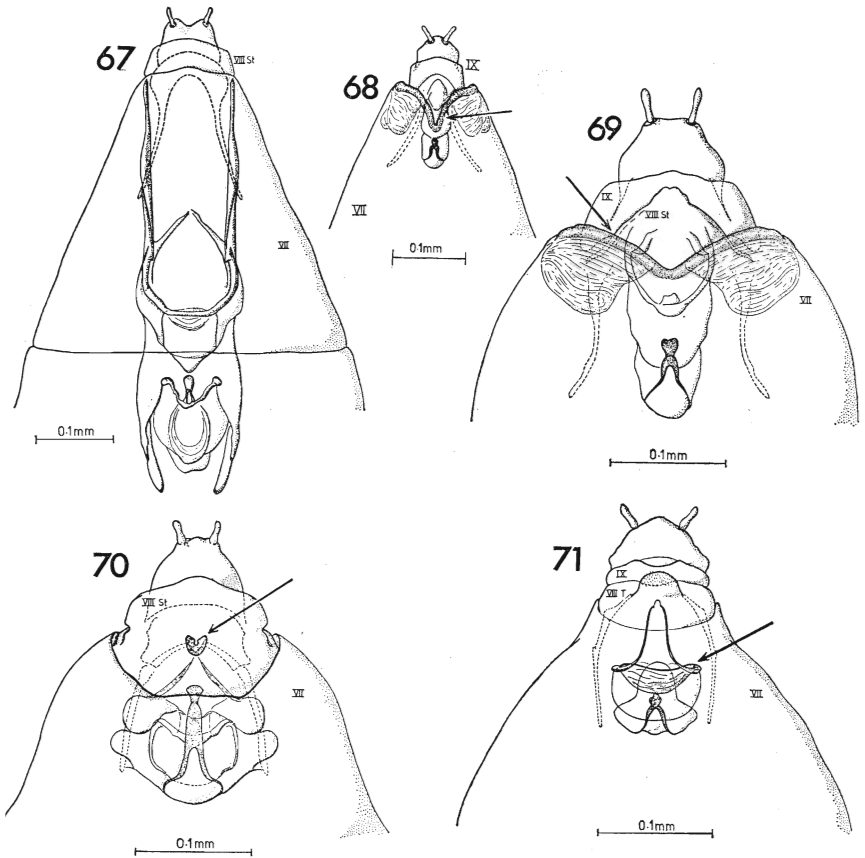
Rivers, lakes, streams; vi–ix; widely distributed and abundant in the British Isles; throughout Europe (excluding Scandinavia, Spain and Italy), Iran, Pakistan, Israel, Algeria, Morocco.

- 9 Internal apparatus extremely elongate, narrow, projecting anteriorly well into segment VI (fig. 67)

mirabilis Morton

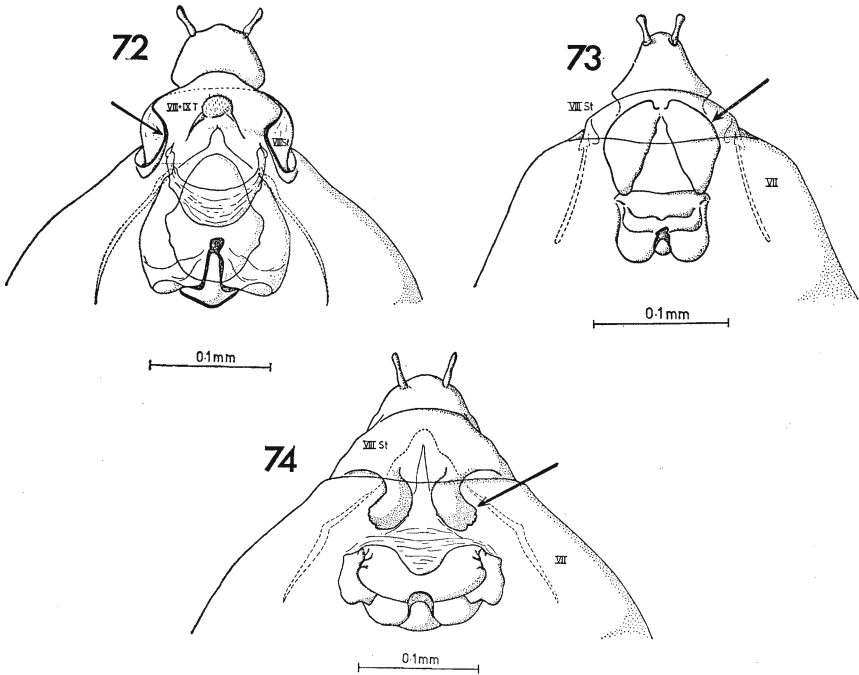
- Internal apparatus comparatively short. 10
- 10 Tergites VIII and IX distinct, internal apparatus elongate. 11
- Tergites VIII and IX fused, internal apparatus broad, quadrate. 12
- 11 Postero-ventral margin of VIII with broad V-shaped median excision, internal apodemes of IX (?) short, strongly curved outwards (fig. 69)

sagittifera Ris



Figs 67–71. ♀ genitalia. 67, *Oxyethira mirabilis*, ventral. 68, *O. distinctella*, ventral. 69, *O. sagittifera*, ventral. 70, *O. tristella*, ventral. 71, *O. simplex*, dorsal.

- Postero-ventral V-shaped excision of VIII relatively narrow and deep; internal apodemes of IX (?) comparatively longer and less strongly curved (fig. 68)
- 12 Sternum VIII with a small, dark, median sclerotized patch (fig. 70) **distinctella** McLachlan
- Sternum VIII without such a patch.....13 **tristella** Klapálek
- 13 Lateral margins of tergites VIII and IX (fused) strongly concave (fig. 72) **flavicornis** (Pictet)
- Lateral margins of tergites VIII and IX not concave.....14
- 14 Posterior sclerites of internal apparatus slender and convergent apically (fig. 71) **simplex** Ris
- Posterior sclerites of internal apparatus broad and plate-like.....15
- 15 Posterior lobes relatively faint, subtriangular, almost convergent apically; internal apparatus narrow (fig. 73) **frici** Klapálek
- Posterior lobes dark, distinct, comma-shaped, divergent basally and apically (fig. 74) **falcata** Morton

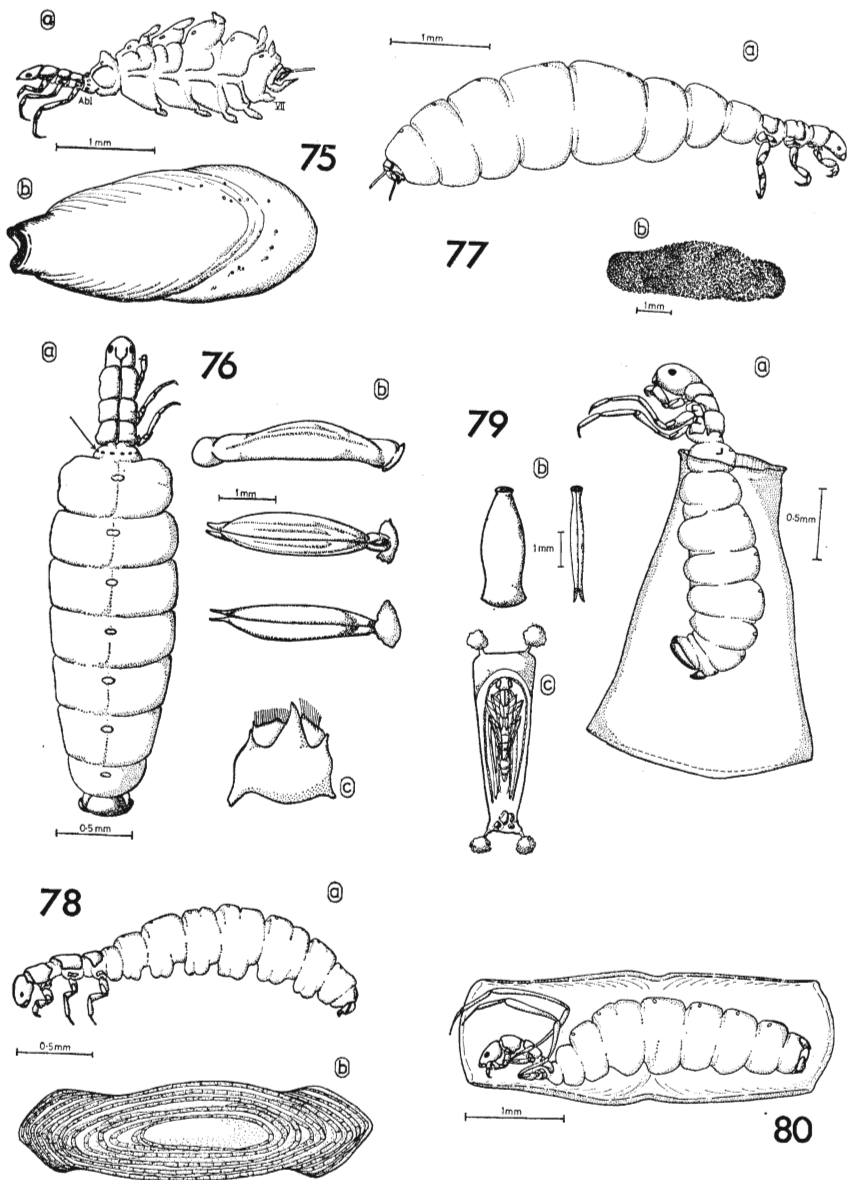


Figs 72-74. ♀ genitalia. 72, *Oxyethira flavicornis*, dorsal. 73, *O. frici*, ventral. 74, *O. falcata*, ventral.

Key to genera of British Hydroptilidae (larvae, fifth instar)

- 1 Abdominal segments II-VIII with dorsal and ventral median sucker-shaped processes ('papillae'); case constructed of secretion, sac-shaped, oval ('pumpkin-seed') (fig. 75) **Ithytrichia**
- Abdominal segments without median processes; case of different shape 2
- 2 Labrum asymmetrical (fig. 76c); abdominal segment II with lateral processes; case with deep grooves and ridges on the convex dorsal surface, ventral surface flat (fig. 76) **Orthotrichia**
- Labrum symmetrical or slightly asymmetrical in membranous part only; no lateral processes on abdominal segment II; case laterally compressed 3
- 3 Abdomen straight or almost straight, with transverse folds on the middle segments; case constructed of secretion and algal filaments or minute sand grains 4
- Abdomen curved; segments without transverse folds; case of secretion only 6
- 4 Smaller, 3.4-4.0 mm; case bean-shaped with slightly concave ventral sides, constructed of secretion and sand-grains, diatoms or silt particles (fig. 77) **Hydroptila**
- Larger 4.5-5.5 mm; case oval, broader in the middle and at the ends (fig. 78) 5
- 5 Sclerites of head and thorax very pale (light ochreous), barely discernible and devoid of markings **Allotrichia**
- Sclerites pale yellow with brown markings **Agraylea***
- 6 Mid and hind legs moderately long, 2-3 times length of forelegs; case jug-shaped (fig. 79) **Oxyethira**
- Mid and hind legs very long, 4-5 times length of forelegs; case sac-shaped (fig. 80) **Tricholeiochiton**

* The two British species of *Agraylea* may be readily distinguished by the line of four dark brown spots on the dorsal surface of the head capsule in *sexmaculata* Curtis which is absent in *multipunctata* Curtis (Barnard, 1971; Solem, 1972).



Figs 75-80. Fifth instar larvae & cases. 75, *Ithytrichia lamellaris*, lateral: a, larva; b, case, 76, *Orthotrichia costalis*: a, larva, dorsal; b, pupal case, lateral, dorsal & ventral views; c, labrum, dorsal. 77, *Hydroptila* sp., lateral: a, larva; b, case. 78, *Agraylea* sp., lateral: a, larva; b, case. 79, *Oxyethira* sp.: a, early fifth instar larva in case, lateral; b, late fifth instar larval case, lateral & dorsal; c, pupal case, ventral. 80, *Tricholeiochiton fagesii*, larva in case, lateral.

List of described larvae of British Hydroptilidae

The following list gives the main references to descriptions of the larvae of the British species of Hydroptilidae. Of the 31 known species, the larvae of 20 have been described in varying degrees of detail but not all of these descriptions contain comparable information neither are they all based on British material. For these reasons a key to the known species has not been constructed.

- Hydroptila forcipata*: Fahy (1971)
lotensis: Kachalova (1972) (crude figure only)
pulchricornis: Lepneva (1964)
sparsa: Hanna (1961); Lepneva (1964); Hickin (1967)
tineoides: Nielsen (1948); Lepneva (1964); Hickin (1967)
vectis: Jacquemart & Coineau (1962); Lepneva (1964)
- Orthotrichia angustella*: Jacquemart (1962)
costalis: Nielsen (1948); Lepneva (1964); Hickin (1967)
- Agraylea multipunctata*: Nielsen (1948); Lepneva (1964); Hickin (1967); Solem (1972)
sexmaculata: Lepneva (1964); Barnard (1971); Solem (1972)
- Allotrichia pallicornis*: Giudicelli & Vaillant (1967)
- Ithytrichia clavata*: Ross (1944)?
lamellaris: Nielsen (1948); Lepneva (1964); Hickin (1967)
- Tricholeiochiton fagesii*: Lepneva (1964)
- Oxyethira distinctella*: Lepneva (1964)
flavicornis: Nielsen (1948); Lepneva (1964); Hickin (1967)
frixi: Lepneva (1964)
sagittifera: Lepneva (1964)
simplex: Macdonald (1950); Hickin (1967)
tristella: Lepneva (1964)

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