

SOME NEW CADDIS FLIES (TRICHOPTERA) FROM THE WESTERN
CAPE PROVINCE

IV: SOME HYDROPTILIDAE

By

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(With 3 plates)

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INTRODUCTION

This is the fourth paper in the present series; in it a new species of *Orthotrichia* from the Great Berg River is described, together with its larva and larval and pupal cases. The other Hydroptilidae collected along the same river are commented upon, and the larva of *Oxyethira velocipes* (Barnard) described.

Methods of work have been the same as described in earlier papers (Scott, 1955, 1958, 1961). Many of the Hydroptilidae referred to were collected during the survey of the Great Berg River (Harrison and Elsworth, 1958; Harrison, 1958); further specimens have since been taken in the same area. The new species, *Orthotrichia barnardi* sp. n., was first correlated by Dr. A. D. Harrison, from larvae inhabiting the small cases resembling caraway seeds illustrated by Dr. Barnard in his work on South African caddis flies (Barnard, 1934, p. 391). Since then further specimens have been bred out, from similar cases taken from various parts of the Berg River; the resulting imagos all appear to belong to the same species. The caraway seed case is typical of genus rather than species, as is usually the case in the Hydroptilidae; a different species has been bred out from very similar cases elsewhere in South Africa, this will be described in a later paper. The immature stages of the two species, though superficially alike, do show recognizable differences. The new species is named in honour of Dr. K. H. Barnard, who first discovered the pupal cases.

Sincere thanks are again due to Dr. A. D. Harrison (now at the University College of Rhodesia and Nyasaland) for much of the material, to Mr. D. E.

Kimmins of the British Museum (Natural History) for his very kind advice, and to Professor J. H. Day of the Zoology Department of the University of Cape Town in whose department this work was carried out.

DESCRIPTIONS OF SPECIES

Genus ORTHOTRICHIA Eaton

Eaton, 1873, 141.

McLachlan, 1880, 518.

Orthotrichia barnardi sp. n.

(Plate XXI, A-G; plate XXII, A-M)

A minute, dark, hairy insect with a median longitudinal pale streak down head, thorax and wings when at rest. Spurs 0, 3, 4. No ocelli. The larvae and pupae inhabit small, dark, seed-like cases.

Imago (♂, described when alive, ♀ similar) (pl. XXI, A-G; XXII, A-C): *Head* (pl. XXI, G): Eyes large, black; dense tuft of peach-coloured setae on face between eyes, extending back between bases of antennae; main part of vertex bare, but apical part with some setae, and the whole entirely obscured by these and the facial setae and by two dense, bushy tufts of setae which arise from a pair of large, raised warts on the back of the head. These tufts are mainly pinkish, with a few black lateral setae. Antennae with 28-30 segments (24-25 in ♀), about half wing length, pinkish fawn with grey annulations (setae thickened and shaded); two white bands near apex, each of two segments. Maxillary palps five-jointed, pinkish with some grey setae anteriorly, first and second joints small, the second with long stiff bristles; labial palps three-jointed, pinkish. *Thorax* (pl. XXI, G): prothorax reduced, with a small pair of median warts and a larger pair of lateral warts; mesonotum with scutum covered with recumbent setae, postnotum and scutellum with a dense fur of erect setae; metanotum with a median band of recumbent setae flanked by lateral tracts of erect hairs; all thoracic setae pinkish except for tufts of black hairs on tegulae and on antero-lateral corners of pronotum. *Legs*: very hairy, pinkish, with some grey setae anteriorly (pinkish when seen from below, grey from above). Mid- and hind legs with tibiae expanded and bearded. Spurs 0, 3, 4, hairy, normal, the inner preapical spurs on the hind legs very long. *Wings*: forewings very densely hairy, almost entirely covered with erect, somewhat thickened, blunt-tipped setae; mainly black, with a broad streak of pale peach-coloured setae along the hind margin, producing a conspicuous pinkish longitudinal stripe down the middle of the back when the insect is at rest. This stripe starts from the tufts on the head and narrows gradually, merging posteriorly with the thick peach-coloured fringe at the tips of the forewings; it is partially interrupted by two blackish patches near the middle. There are also several peach-coloured streaks on the wings, particularly towards and along the anterior margin. Fringe pink and black, brindled in appearance in some parts, very long and dense (wider than wing in widest part). Hind wings greyish with

extremely long, silky, pinkish-grey fringe (three to four times width of wing). *Abdomen* pale green, genitalia brown. In specimens which have dried out for some time, the colouring fades to a brownish black marked with buff, with a pinkish tinge in places; abdomen grey-green; setae on legs and thorax pale gold. In spirit specimens the general appearance is brown and yellowish-gold.

Wings (pl. XXII, A): ♂ forewing 3.0 mm., ♀ same. ♂ forewing without lobe, with forks 1, 2, 3: R_1 with long cross-vein to R_s which makes it appear basally double; R_3 does not arise from stem of R_{4+5} as in *O. sanya* Mosely, *O. spinicauda* Kimmins and *O. straeleni* Jacquemart, but in the normal way. There is a line of long, stiff hairs on the ventral side of the wing, along the basal half of Cu_2 ; no black scales along subcosta. ♂ hind wing with fork 2 only. ♀ forewing with venation very similar to that of ♂, but somewhat obscured by thickened, pitted bands to which upright setae were evidently attached; similar, narrower bands also occur between several of the apical veins. Sc shorter than in ♂; R_3 incomplete basally. ♀ hind wing also very similar to that of ♂, but R_1 incomplete basally, and cross-vein joins R_s and M_{1+2} instead of R_s and M ; pitted bands also present between some of the veins, particularly in the apical forks.

♂ *genitalia* (pl. XXI, A-F): ♂ genitalia of the usual complex asymmetrical type. Sixth sternite with a tuft of hair covering a spatula-shaped process in the mid-ventral line; seventh sternite with a pointed process. Ninth segment largely withdrawn within the eighth. Ninth tergite strongly sclerotized, wider posteriorly than anteriorly, from the side cut away anteriorly, side-pieces being present in the posterior half only; these sweep round to join the claspers, the two sides being united ventrally by a membranous area which is bounded laterally by longitudinal ventral sutures, as Nielsen describes for *O. tetensii* (Nielsen, 1957) (see pl. XXI, F). From these side-pieces a pair of asymmetrical lateral processes arise, each tipped with a long seta, the process on the right being the longer. The claspers are short, narrow, leaf-like, with an irregular margin, the left one being larger than the right; each has a curved, finger-like projection forming the inner tip, and a stout seta on the outer edge. In dorsal view the ninth tergite is fused onto the tenth, which forms a narrower, lightly sclerotized hood, widening basally to form a sheath for the aedeagus; the hood bears a sharp, laterally directed spine near the right side of the apex. This spine is connected to a long, curved, blunt-ended process beneath the hood. Another strong, sinuously curved, backwardly-directed spine arises near the junction of IX and X in the mid-dorsal line; this is conspicuous in lateral views. The apical spine appears to correspond to the right-hand, laterally bent spine in *O. tetensii*, but there is no corresponding one on the left, unless indeed the curved dorsal spine should represent it, or even possibly the blunt-ended process beneath the hood. The aedeagus is long and slender, widening anteriorly, with a spiral titillator coiled loosely round it (pl. XXI, E); when fully extended the aedeagus may be as long as the entire abdomen, about 1.5 mm.; according to Nielsen (1957) it is incapable of retraction when once extended. Within the dorsal hood, above the aedeagus, there are two spine-like parameres; the one on

the left side is long and slender, running the full length of IX and X and projecting slightly beyond the apex of the hood; the one on the right is less than half as long, arising near the junction of IX and X and projecting from the right side close to the curved process of the basal plate. Both appear to be connected with an internal sclerite or sclerites, shown by dotted lines in plate XXI, D. Below the aedeagus there is an elongated structure apparently connected to a narrow basal apodeme; it widens and divides posteriorly into two branches, each tipped with a stout seta. This forked structure can be clearly seen in a cleared specimen in ventral view (pl. XXI, F), and the two apices are visible projecting beyond the ends of the claspers. According to Nielsen (1957) the forked structure may possibly represent the dorsal branches of the coxopodites of the claspers.

♀ *genitalia* (pl. XXII, B, C): The ♀ genitalia show clear relationship to those of *O. spinicauda* Kimmins (1958). The sixth sternite has a small, sharply pointed, median process; seventh sternite normal. Eighth segment, as in *spinicauda*, forms a complete ring, the dorsal and lateral parts with an irregular margin fringed with stout setae, the sternite forming an asymmetrical subgenital plate, partly membranous, which appears to enclose a duct; apex of plate strongly sclerotized and apparently connected to the membranous part of IX dorsal to it. Tergite of IX forming a lightly sclerotized hood, partly withdrawn into the eighth segment; sternite membranous, bearing a pair of subtriangular sclerotized plates which are usually pressed against the dorsal hood; they may, however, stand away from it, being attached along the proximal margin; proximal and lateral parts of these plates are more heavily sclerotized than the rest, apical margin irregular, pale, with a few small setae. The dorsal hood narrows just beyond the plates, and the terminal portion, rounded and with a small pair of rod-like cerci and a few setae, appears to represent the tenth segment.

This species resembles most other African species so far described in possessing a bifid structure beneath the aedeagus, a spiral titillator accompanying the aedeagus, and partly fused claspers; like *O. aequatoriana* Kimmins and *O. alboguttata* Jacquemart it lacks the row of black scales between costa and subcosta in the ♂ forewing. It shows most resemblance to *O. spinicauda* Kimmins, but can easily be distinguished from that species by its much larger size, wing differences, and, in the ♂ genitalia, by the strongly curved dorsal spine and the slender, upcurved, lateral processes. The ♀ also resembles *spinicauda*, but is easily recognizable in ventral view by the brown scale-like sclerotized plates.

Distribution

Case-bearing larvae of this species have been found in the upper part of the Great Berg River from late winter to early autumn, mainly on stones in current and on the trailing *Scirpus digitatus* on such stones, also in slower-flowing reaches in pools with stony bottoms, and sometimes on marginal vegetation. Pupae and imago appeared in the Mountain Torrent Zone (Station 1) in early autumn (March), and in the foot-hills (Stations 3 and 5) in spring and summer

(September to December). Larvae were also found much lower down the river in the stony run at Piketberg (Station 18) in the late summer. No larvae were found during the winter floods. Early instars are not at present identifiable, and many even of the smaller case-bearing larvae passed right through the nets used. Further details of the habitat will be found in Harrison and Elsworth (1958) and Harrison (1958).

Specimens (imagos)

All except GBG 770 H were collected from the Great Berg River as larvae or pupae, either from stones in current or *Scirpus* in current, and bred out in the laboratory. GBG 770 H was caught in the field, on the fish-ladder in Tulbagh Kloof, Klein Berg River (a tributary of the Berg).

GBG 542 A-F, 4 ♂♂, 2 ♀♀ (Stn. 1, March 1952, A.D.H.).

GBG 770 H, 1 ♂ (Tulbagh Kloof, 23/10/53, A.D.H.).

MISC 70, 2 ♂♂ (Stn. 3, December 1954, K.M.F.S.).

MISC 71, 2 ♀♀ (Stn. 3, December 1954, K.M.F.S.; one pinned).

MISC 85, 1 ♂ (Stn. 3, December 1954, K.M.F.S.).

MISC 122, 1 ♂, 2 ♀♀ (Stn. 3, October 1956, K.M.F.S.).

MISC 123, 1 ♂, 1 ♀ (Stn. 3, October 1956, K.M.F.S.).

MISC 134, 1 ♂ (Stn. 3, October 1959, K.M.F.S.).

(Catalogue numbers all refer to the collections of the National Institute for Water Research.)

The *holotype* ♂ (GBG 542 A) and paratypes (GBG 542 B, ♂, and MISC 71, ♀) will be placed in the South African Museum, and paratypes (MISC 70, 2 ♂♂, and MISC 123 A, 1 ♀) in the British Museum (Natural History). The rest of the material, together with larval and pupal specimens, is in the collections of the National Institute for Water Research.

Immature stages

Larval cases found vary in length from 1.5 to 2.5 mm.; none was found smaller than this. Case-bearing larvae are in their 5th instar according to Nielsen (1948), and increase considerably in size in this instar, adding to their cases as they grow. Similar-looking free-living Hydroptilid larvae have been seen, probably earlier instars of this species.

Larval case (pl. XXII, E)

The mature larvae live in small, brown, bivalve cases made of silky secretion. These resemble caraway seeds, and each has one pair of dorso-lateral ridges. The cases show striae, evidently resulting from the mode of formation from threads of secretion; the line of junction of the two halves of the case is mid-ventral, where the two 'valves' overlap slightly.

Mature larva (pl. XXII, D-L)

Length of larva slightly less than that of case, up to about 2.3 mm. Head brown, with paler areas round the fairly large eyes; lens-like areas present in

cuticle above eyes (pl. XXII, F). Clypeus wide, posteriorly triangular, one pair of slight lateral indentations. Labrum with an asymmetrical median point; mandibles large, blunt, with a single apical tooth below which is an indentation bounded proximally by a tooth or point, the broader left mandible with an inner brush of slender spines. Gular sclerite Y-shaped, a small triangular anal gular sclerite also present (pl. XXII, L). Pro-, meso- and metanota (pl. XXII, F) each with a pair of brown sclerotized plates, posterior margins darkened; narrow dark brown sternites also present (posterior or anal sclerites only). Pronotum longest, mesonotum shorter, metanotum shortest, each with a fringe of short, stiff setae interspersed with longer setae along the anterior border. Legs small, brown, much like those described by Nielsen for *O. tetensii*; forelegs shorter and stouter than mid- and hind legs, which are sub-equal, the hind legs being the longer (pl. XXII, G, H, J). Abdomen large, thick, white, more dorso-ventrally than laterally compressed, with clear segmentation; segment 1 small, with a few dorsal setae, largely covered by segment 2, segment 5 largest. Abdomen fits so closely into the case that the latter must be split open to extract the larva. No gills, no lateral line. Ninth segment with strongly sclerotized semicircular brown anal sclerite, bearing eight long marginal setae and two shorter, stout, curved bristles. Anal appendages small, each with a large basal sclerite and a minute hooked anal claw (pl. XXII, D, K).

The larva shows clear resemblances to that of *O. tetensii* Kolbe as figured by Nielsen (1948) and Ulmer (1957); there are, however, various minor differences, and the cases of *O. tetensii* have paired lateral ridges, in the fully grown specimens at any rate. There are also resemblances to the larva of *Orthotrichiella ranauana* Ulmer (1957). Ulmer distinguishes the larvae of *Orthotrichia* and *Orthotrichiella* on a basis of claw length as related to length of tarsus, and of antenna length as related to length of left mandible (1957, p. 182). The larva of *Orthotrichia barnardi*, however, has not quite the proportions of either, though nearer to the latter; the foreclaw is slightly shorter than the tarsus, and the claws of mid- and hind legs only half, or less than half, the length of the tarsi; length of antenna about a third of the length of the left mandible. The adults, however, definitely appear to fall into the genus *Orthotrichia*.

The larva is easily distinguishable from the species figured by Corbet (1958, fig. 4, e-f), as it lacks the dark, patterned metanotum and the dark mark on the clypeus, and the case has one, not two, pairs of dorso-lateral ridges. In comparison with the figures of the larva of *O. straeleni* (Jacquemart, 1957, figs. 135-154), the thoracic nota of *O. barnardi* lack the broad, darkened bands, and the sclerite on IX is much more strongly sclerotized; the larva of *O. straeleni* appears to make a plain case without lateral ridges.

Pupal case (pl. XXII, M)

The pupal cases have terminal holdfasts which anchor them firmly to *Scirpus* plants or to stones. The larval cases are utilized in their formation, with additional material closing them at both ends; they are opened by a V-shaped

dorsal slit when the mature pupa emerges. The larval sclerites are retained in the end of the pupal case opposite to this opening.

Ross (1944, p. 117) states that the pupae of the Hydroptilidae are very uniform in structure and no characters have been found to key them to genus; no description of the pupa is therefore given; it is of the usual Hydroptilid type.

Hydroptila capensis Barnard

Hydroptila capensis Barnard 1934, 391, fig. 51, a-i. Harrison and Elsworth, 1958, Tables 19, 21, 24. Harrison 1958, p. 263.

In the Great Berg River, the larvae and pupae of this species occurred mainly in the foot-hills, often in quiet tributary streams (Stations 1, 9, 10, 13 and 19 on main river, also Station 4 on the Franschoek stream at La Motte, in the Dwars River at Groot Drakenstein, in the Klein Berg at the Tulbagh Barrage, and in the Kuils River near Piketberg), and principally at times of the year when the rivers were low and running slowly and patches of *Spirogyra* had been able to develop. Thus most were found during the summer and autumn months, when the winter floods were over and the flow had slowed down. Numbers encountered were not generally large, excepting in early autumn one year (March 1953) at Wellington (Station 12), where slight organic pollution had resulted in a blanketing growth of *Spirogyra* among the stones in the stickles. The river was low and flow sluggish at the time. It seems that the limiting factor is current and its effect on algal growth rather than temperature, because numbers of larvae and pupae were also found in June (early winter), in this case, however, in a very small tributary brook that runs down behind the Forest Station at La Motte, where they were living on alga-covered stones in a small pool sheltered from flooding by banks of sedges.

This species is one of the few that may appear in temporary water in this country; the Kuils River does not run during the dry season (larvae and pupae were found there in spring—October), and the author has also found this species in temporary mountain streams and a recently filled farm dam in the same area.

H. capensis is typically found in association with *Spirogyra*, with filaments of which the larval and pupal cases are covered, but such larvae cannot be identified as *H. capensis* on case alone without correlation, at least with mature ♂ pupae, since specimens bred out in the Transvaal have shown that *H. cruciata* Ulmer also covers its cases with *Spirogyra* (material supplied by Mr. F. M. Chutter; this will be described in a later paper).

Hydroptila sp.

Hydroptila sp. Barnard 1934, 393, fig. 51, j.
'*Hydroptila* sp. A' Harrison 1958, p. 263.

Small numbers of larvae were also found with cases similar to those described by Barnard (1934); the bivalve cases are made of secretion covered

with minute sand grains. Similar larvae collected in the Transvaal have been bred out by Mr. F. M. Chutter, the imagos proving to be a new species of *Hydroptila*, but it cannot be assumed that the Berg River specimens belong to the same species without correlation, a difficult matter as the larvae are very small and far from common. A few were found in backwaters at Station 3, Berg River, in spring and summer, and among stones in the stickles in autumn.

Oxyethira velocipes (Barnard)

(Plate XXIII, A-K)

Argyrobothrus velocipes Barnard, 1934, 393, figs. 52, a-j.

Argyrobothrus velocipes Barnard, Harrison and Elsworth 1958. Harrison 1958.

Oxyethira velocipes (Barnard), Kimmins 1962.

Distribution

Larvae belonging to this species construct flat, transparent, flask-like cases, and were found from Station 1 in the Mountain Torrent Zone of the Berg River right down to the last station before the estuary. They appeared among the marginal vegetation in spring, summer and autumn, when the river was slowing down, and sometimes became locally common, showing a sporadic distribution which evidently depended on amount of shelter and extent of algal growth among other factors. This might be expected from the feeding habits, beautifully described by Nielsen (1948). The larvae were identified by correlation in the laboratory, imagos all proving to be *O. velocipes* (Barnard). As Barnard did not describe the larva of his species, but only figured the pupal case, a description of the larva and case is given below.

Larval cases (pl. XXIII, A, B)

The cases of the younger fifth instar larvae have plain, smooth edges; as the larva adds to the case, however, it does so in such a manner that each new section added is evidently commenced some little distance within the old posterior opening. As a result of this, the cases of older larvae show a series of strong lateral serrations along each side of the case. In this they differ from the cases of *O. costalis* described by Nielsen (1948), except for one aberrant specimen (Nielsen, 1948, fig. 54, κ). In *O. costalis* the smooth, plain shape is retained, and the same case used for pupation. Larval cases of *O. velocipes* show the remnants of material used for the ring-shaped fixing belt, just as in *O. costalis*. The larvae are orientated in the cases with head to the narrow end with the small, circular opening; the wide, flat end usually remains closed owing to the shape of the case, it can however be pushed open.

Larval cases vary in length from 1.3 to 4.5 mm.; the fifth instar larvae inhabiting them range from 1.3 to 2.2 mm. in length; as they increase in size the abdomen becomes proportionately larger in comparison with the rest of the body, always, however, retaining its laterally compressed shape, with the posterior end curled round ventrally.

Fifth instar larvae (pl. XXIII, A-K)

Plate XXIII, A, illustrates a mature larva in its case; as, however, in such specimens the thorax and 1st abdominal segment are largely obscured by the 2nd abdominal segment, a slightly younger 5th instar larva has been chosen to illustrate details of structure (pl. XXIII, C-K).

Head pale yellowish; eyes fairly large, under lens-like areas of cuticle (pl. XXIII, D); clypeus with one pair of lateral indentations, pointed antero-lateral corners, and triangular posterior area, three pairs of the bristles on the clypeus are thick, dark brown, and expanded towards the base. Labrum with a pair of pointed antero-lateral spines, an apparently soft central projection, and two larger and eight smaller setae, all of which are decumbent. There are tufts of setae on the ventral side. Both clypeus and labrum show strong resemblances to those of *O. costalis*. Antennae fairly long, with rounded base, slender sensilla, and long lateral seta. There is one pair of extremely long, slender setae, situated just above the eyes; the other setae on the head are much shorter and also slender (except for the thickened ones on the clypeus). The mouthparts usually seem to be carried tucked inwards. Mandibles (pl. XXIII, H): the right mandible is simple, with 3 small apical teeth; the left mandible has one apical tooth, below which are two broad, projecting, cutting edges, each with about 4 low, blunt teeth. There appears to be a deep cavity between these, from which arises a row of stout spines; the dorsal cutting edge is shorter than the ventral, its base being scooped out to show a penicillus of slender hair-like spines. These two lots of spines presumably correspond to the two brushes of setae in the left mandible of *O. costalis*, described by Nielsen. Gular sclerite (pl. XXIII, J), a scooped-out triangle with transverse thickenings; a small triangular anal gular sclerite also present. *Thorax*: Pro-, meso- and metanota lightly sclerotized, pale yellowish, the two latter narrower than the former, with pointed, darkened, lateral corners and few setae; pronotum wider, with rounded anterior corners and more setae. *Legs*: forelegs short, mid- and hind legs long and slender, subequal, not, however, increasing in size as the abdomen grows during the fifth instar; arrangement of setae as illustrated (pl. XXIII, E, F, G); legs pale yellowish to brownish in colour, the mid- and hind legs with a brownish band across the femora. *Abdomen* whitish, strongly laterally compressed, segmentation obvious; in the mature larva segment 2 hides most of segment 1 and the meso- and metanota. Ninth segment with a pale yellowish sclerite and a few strong setae. Anal prolegs fused to form 10th segment; small anal claws present; each claw appears to consist of one large hook and four smaller ones, but the smallest are difficult to distinguish clearly. No gills, no lateral line.

Pupal case (pl. XXIII, L)

The pupae are also found in flat, transparent cases; these have, however, smooth, plain edges like those of the youngest fifth instar larvae, and appear to be freshly made, not altered larval cases. The cases are anchored to a leaf by four discs made of secretion, two at each end, and the rounded opening

is closed by a fluffy plug of secretion as in *O. costalis*, not by a domed cap as in *O. incana* (Ulmer, 1957, fig. 277). The other (wide) end is also closed off, by a narrow strip of the same material, making an oval space in which the pupa lies. The pupae are orientated the opposite way round to the larvae, with the head at the wide end of the case. The larval sclerites are found within the case, at the narrow end.

SUMMARY

A new species of *Orthotrichia*, *O. barnardi* sp. n. (Trichoptera: Hydroptilidae), is described from South Africa, together with its larval stages. The larva of *Oxyethira velocipes* (Barnard) is also described, and an account given of Hydroptilid material collected from the Great Berg River, Western Cape Province.

REFERENCES

- BARNARD, K. H. 1934. South African caddis-flies (Trichoptera). *Trans. roy. Soc. S. Afr.* **21**, 291-394.
- CORBET, P. S. 1958. Larvae of certain East African Trichoptera. *Rev. Zool. Bot. afr.* **58**, 3-4, 203-213.
- EATON, E. A. 1873. On the Hydroptilidae, a family of the Trichoptera. *Trans. ent. Soc. Lond.* **1873**, 141.
- HARRISON, A. D. 1958. Hydrobiological studies of the Great Berg River, Western Cape Province. Part 2. *Trans. roy. Soc. S. Afr.* **35**, 227-276.
- HARRISON, A. D., & ELSWORTH, J. F. 1958. Ibid., Part 1. *Trans. roy. Soc. S. Afr.* **35**, 125-226.
- JACQUEMART, S. 1956. Trois *Orthotrichia* nouveaux du Lac Kivu (Trichoptera, Hydroptilidae). *Bull. Inst. Sci. nat. Belg.* **32**, 9, 1-6.
- JACQUEMART, S. 1957. Trichoptera des Lacs Kivu et Édouard. *Exploration Hydrobiologique des Lacs Kivu, Édouard et Albert* (1952-1954), **3**, 65-129.
- KIMMINS, D. E. 1957. New and little-known species of African Trichoptera. *Bull. Brit. Mus. (Nat. Hist.) Ent.* **6**, 1-37.
- KIMMINS, D. E. 1958. New species and subspecies of Odonata and on some Trichoptera from S. Rhodesia and Portuguese East Africa. *Bull. Brit. Mus. (Nat. Hist.) Ent.* **7**, 349-368.
- KIMMINS, D. E. 1962. New African caddis-flies (Order Trichoptera). *Bull. Brit. Mus. (Nat. Hist.) Ent.* **12**, 83-121.
- MACDONALD, W. W. 1950. The larvae of *Mystacides azurea* L., *Cyrnus flavidus* McLachlan and *Oxyethira simplex* Ris (Trichoptera). *Proc. R. ent. Soc. Lond. (A)* **25**, 1-3, 19-28.
- MARLIER, G. 1943. Trichoptera. *Explor. Parc. nat. Albert Miss. Damas.* **11**, 3-34.
- McLACHLAN, R. 1880. *A monographic revision and synopsis of the Trichoptera of the European fauna.* 518. London & Berlin.
- MOSELY, M. E. 1948. Trichoptera collected by Miss R. H. Lowe at Lake Nyasa. *Ann. Mag. nat. Hist. (12)* **1**, 45-47.
- NIELSEN, A. 1948. Postembryonic development and biology of the Hydroptilidae. *Biol. Skr.* **5**, (1), 1-200.
- NIELSEN, A. 1957. A comparative study of the genital segments and their appendages in male Trichoptera. *Biol. Skr.* **8**, (5), 1-159.
- ROSS, H. H. 1944. The caddis-flies, or Trichoptera, of Illinois. *Bull. Ill. nat. Hist. Surv.* **23**, 1-326.
- SCOTT, K. M. F. 1955. Some new caddis flies (Trichoptera) from the Western Cape Province—I. (Some Sericostomatidae.) *Ann. S. Afr. Mus.* **41**, 367-380.
- SCOTT, K. M. F. 1958. Ibid.—II. (Some Leptocerinae.) *Ann. S. Afr. Mus.* **44**, 39-52.
- SCOTT, K. M. F. 1961. Ibid.—III. (More Leptocerinae.) *Ann. S. Afr. Mus.* **46**, 15-33.
- ULMER, G. 1951. Köcherfliegen (Trichopteren) von den Sunda-Inseln, Teil I. *Arch. Hydrobiol. Suppl.* **19**, 1-528.
- ULMER, G. 1957. Ibid. Teil III. *Arch. Hydrobiol. Suppl.* **23**, 109-470.



Scott, K M F. 1963. "Some new caddis flies (Trichoptera) from the western Cape Province. IV: Some Hydroptilidae." *Annals of the South African Museum. Annale van die Suid-Afrikaanse Museum* 46, 469–478.

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