

Zoology Publications from
Victoria University of Wellington

Nos. 71, 72 and 73

Issued November, 1979.

Distributed on an exchange basis or may be purchased from
the Department of Zoology, Victoria University of Wellington,
New Zealand.

PRINTED BY R. W. STILES & CO. LTD., NELSON.


F001009401

Crown Record
Management

DL1 V645 Z 71-73

1
45



CONTENTS



- No. 71. Salmon, J. T. and Adams, E. C. G. A New Species of *Ceratrimeria* (Collembola: Neanuridae) from Zaire.
- No. 72. Adams, E. C. G. On the feeding methods and fine structure of the mouth-parts of *Ceratrimeria leleupi* Salmon and Adams (Collembola: Neanuridae).
- No. 73. Wells, J. B. J. Keys to aid in the identification of marine harpacticoid copepods. Amendment Bulletin No. 2.

A NEW SPECIES OF *CERATRIMERIA* (COLLEMBOLA:
NEANURIDAE) FROM ZAIRE

by

J. T. Salmon and E. C. G. Adams,
Victoria University of Wellington.

ABSTRACT

The new species described and illustrated here is similar to *C. pulchella* Handschin but differs in the structure of the post antennal organ and the claw.

INTRODUCTION

This species is described from part of a large collection of Collembola made by Dr N. Leleup and others some years ago in Central Africa. The collection was sent to the senior author for study by Dr J. Decelle, Musee Royal de l'Afrique Centrale, Tervuren, Belgium.

DESCRIPTION

Ceretrimeria leleupi sp. nov.

Figs. 1-9

Colour: Dorsally mottled purple to black; ventrally pale yellow; legs and furcula pale yellow mottled with dark purple; antennae dark purple.

Clothing: Rather sparse of short simple setae.

Body: Length up to 5 mm, almost half as wide as long, flattened, with large paratergal areas on each thoracic segment (Figs. 9A & 9B), smaller ones on Abds I-IV. Abd. VI clearly seen from the dorsal surface (Figs. 4 & 9A). The antennae subequal to the head length with segments III and IV partially fused; Ant IV longer than Ant III, the segments related as 20:27:20:32. Sensory organ on Ant III close to the posterior border and consisting of two short curved sense rods each in its own individual cuticular pouch (Fig. 8). Ant IV apically with three eversible sensory knobs and several long and short blunt exposed sense rods (Fig. 7); long curved setae on the basal two-thirds of Ant IV. Mandible (Fig. 6) claw-like with six teeth on the head and the shaft twisted so that the teeth form a shallow basin or scoop. The maxilla is needle-like consisting, on close examination, of two slender shafts one of which is slightly shorter than the other and faintly recurved or crochet-like at its apex (Fig. 5). Ocelli eight to each side, subequal and on black fields. Post antennal organ (PAO) broadly elliptical with 27-30 elongated tubercles arranged irregularly as two distinct groups; an outer on the periphery of the ellipse and an inner rather incomplete group sometimes reduced to only three or four (Fig. 3). Cuticle of the body finely tuberculate. Corpus of tenaculum naked and each ramus with three barbs.

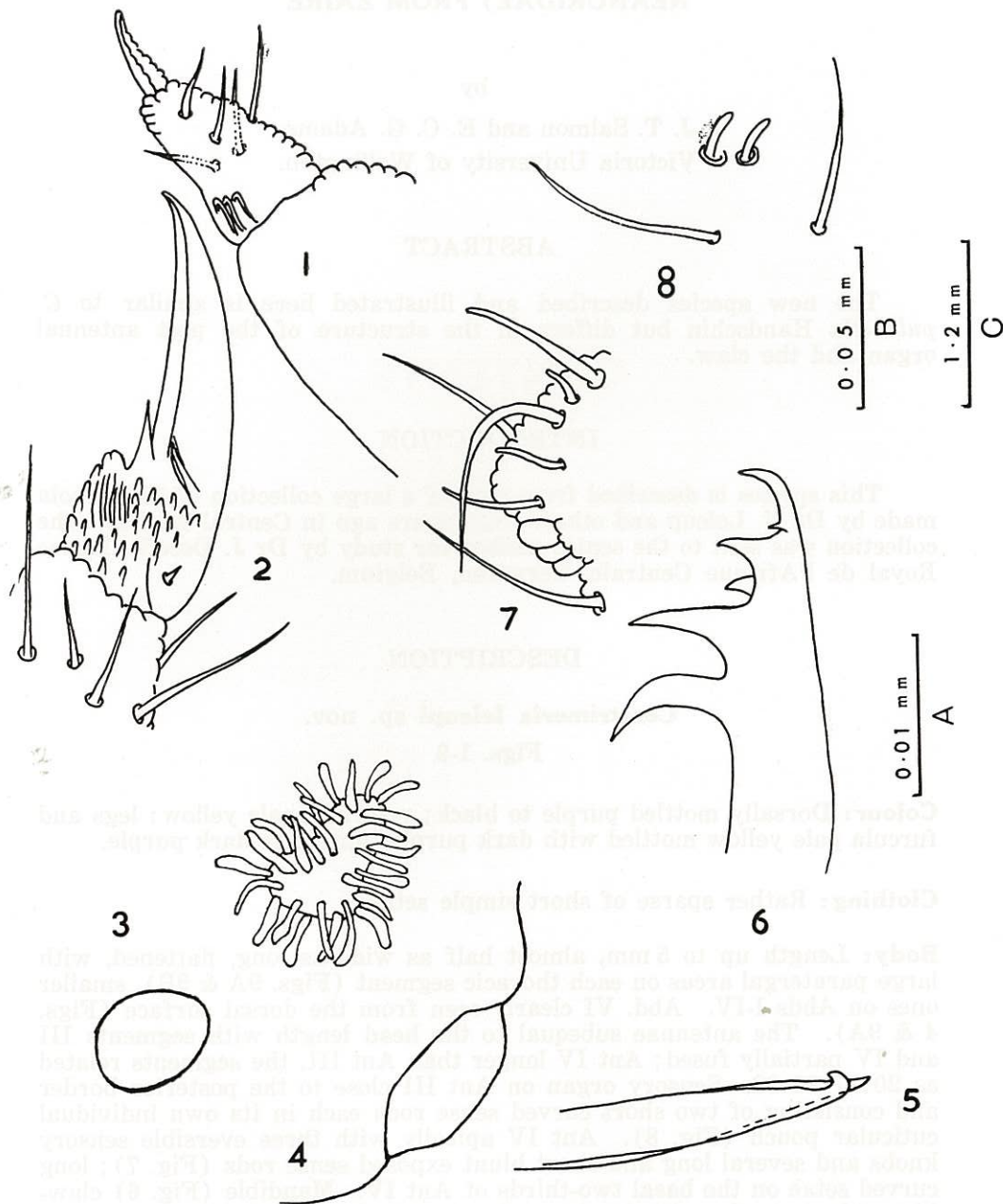
Figs. 1-8. *Ceratrimeria leleupi* n.sp.

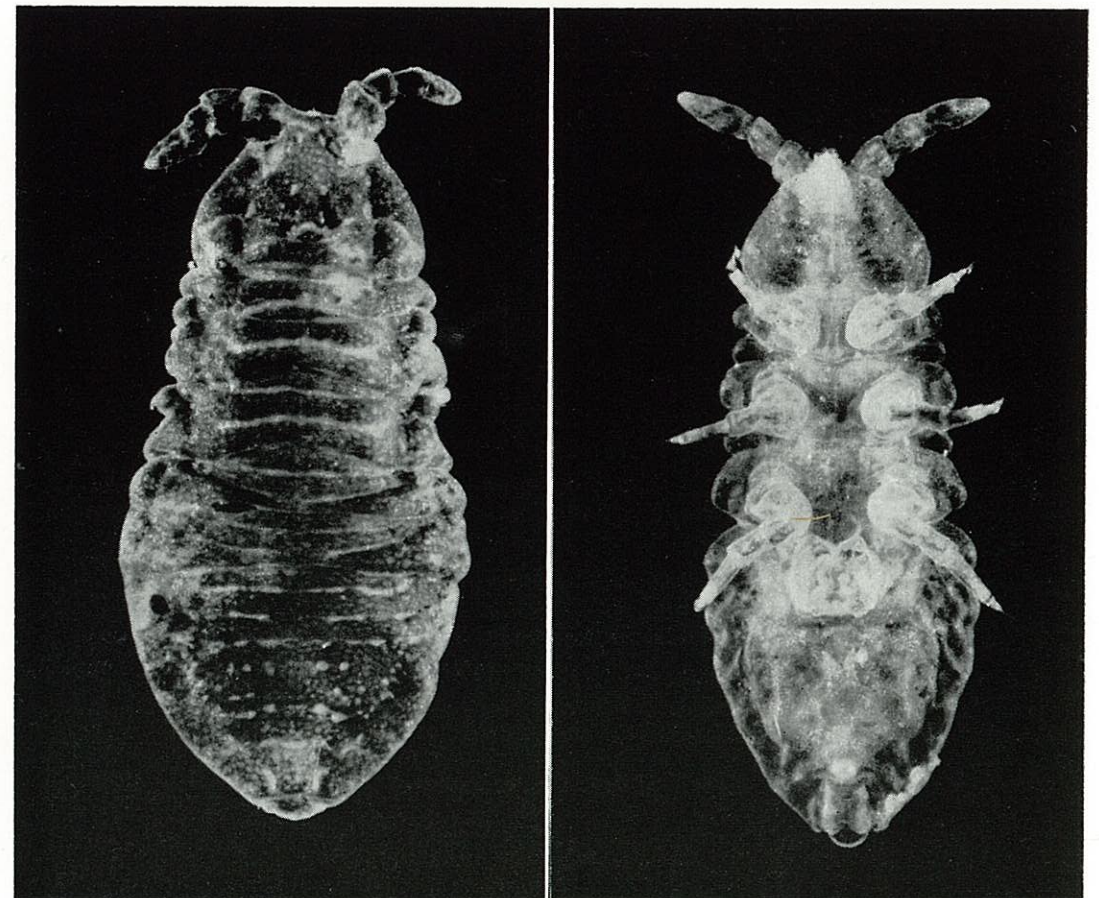
Fig. 1, Base of manubrium with mucrodens; Fig. 2, Claw; Fig. 3, PAO and adjacent ocellus; Fig. 4, Outline of Abd. VI as seen from the dorsal surface; Fig. 5, Apex of maxilla; Fig. 6, Outline of apex of mandible; Fig. 7, Apex of Ant. IV; Fig. 8, Sensory organ of Ant. III with two short sense rods. Magnification: Figs. 3, 5, 6, 7 and 8, Scale A; Figs. 1 and 2, Scale B; Fig. 4, Scale C.

Foot: Claw (Fig. 2) stout and tuberculate basally with a very short outer basal, stout, spine-like seta and a very large single inner basal tooth. No outer teeth. Hind claws more tuberculate than other claws.

Furcula: Reduced (Fig. 1), about one quarter length of antennae. Manubrium, dens and mucro related as 45:40:15. Manubrial hooks quite large. Five simple setae arranged as two groups of three transverse basal and two distal on each dens. Mucro slightly recurved, granulate basally and with the two ventral edges finely corrugated. Cuticular granules of dens larger than those of body.

Localities: Africa, Zaire, Kivu: Terr. Lubero, at 2,200 m altitude, in humus; also in humus at Terr. Uvira, Lac Langue, 2,700 m; Terr. Kalepe, 1,600 m; and Terr. Kalehe, 2,200 m.

We have much pleasure in naming this species for its collector, Dr N. Leleup.

Fig. 9. *Ceratrimeria leleupi* n.sp.

A, dorsal view; B, ventral view (two different specimens). Magnification x19.

TYPE MATERIAL

Holotype from Kivu mounted on glass slide, 10 paratypes mounted on glass slides, and 11 tubes of paratype specimens preserved in alcohol are deposited in the Musee Royal de l'Afrique Centrale, Tervuren, Belgium.

Four paratypes on glass slides deposited in the National Meuseum, Wellington, New Zealand.

DISCUSSION

This new species is closely related to the species *Ceratrimeria pulchella* Handschin, but differs from it in the structure of the PAO and also in the form of the claw, particularly in the possession of a short outer basal seta, and the absence of outer teeth.

Professor J. T. Salmon,
65 Seddon Street,
Waikanae,
New Zealand.

Dr E. C. G. Adams,
Victoria University of Wellington,
Private Bag,
Wellington,
New Zealand.

ON THE FEEDING METHODS AND FINE STRUCTURE OF THE MOUTH-PARTS OF *CERATRIMERIA LELEUPI*

Salmon and Adams (Collembola: Neanuridae)

by

E. C. G. Adams,
Victoria University of Wellington.

ABSTRACT

The fine structure of the mouth-parts of *Ceratrimeria leleupi* (Collembola: Neanuridae) are described from a study with the scanning electron microscope. The mouth-parts are clearly not adapted for piercing and sucking as formerly stated in the literature. The mandibular head is claw-like, and the presence of bacteria on both the mandible and maxilla suggests this species may feed selectively on small organisms such as bacteria.

INTRODUCTION

Collembolan mouth-parts are described as entognathous, and it is generally recognised that there are two distinct types. In what is considered to be the more primitive or generalized type (Salmon 1964; Massoud 1967) the mouth is a wide opening at the distal border of the head. The mandible is robust and carries an apical toothed area or "pars incisiva" and a broader molar plate provided with a number of rows of teeth, the "pars molaris" of Massoud (1967). It is assumed that forms with this type of mandible chew their food, although some doubt has been cast upon this interpretation by Goto (1972). In the second group the mouth region is tapered to form a cone shaped structure known as the buccal cone. The mandible lacks a molar or grinding plate and is described by Massoud (1967) in the Neanuridae, as reduced to a long, slender, flattened plate carrying an apical toothed area the "pars incisiva". This plate is said to have a cutting action although this does not seem to be in agreement with the theory accepted throughout entomological literature, that forms provided with a buccal cone suck their food. It seems possible however, that a suction method of feeding has been attributed to these forms because of the apparently sharply pointed nature of the cone, rather than on a knowledge of the fine structure of the mouth-parts.

Recent writers including Goto (1972) and Massoud and Ellis (1974) describe the fine structure of several chewing type Collembola, but the structure and function of the mouth-parts of forms lacking a molar plate is little understood.

Wolter (1963) while accepting the view that forms with a buccal cone suck their food, drew attention to differences in the structure of the maxillary heads. He considered that those with a well developed toothed maxillary head probably rasped their food while those with a stylet-like head probably pierced it, before sucking the fluid material through the cone.

The diet of forms lacking a molar plate is unknown. It was noted however, in feeding studies by Macnamara (1924) and Poole (1959), that in subsequent preparations of the gut of these particular species, there were rarely any visible gut contents. This seemed to suggest that

they are fluid feeders. Singh (1969) also observed mainly fluid gut contents in *Friesea mirabilis* (Tullberg) agreeing with the results of Poole (1959) on the same species. Particles identified in the gut included fungal spores and hyphae, yeast, bacteria and collembolan eggs.

Adams and Salmon (1972) in a study of *Brachystomella parvula* (Schaeffer), a collembolan lacking a molar plate, observed that a sucking tube is not formed during feeding and the mouth-parts could not be described as adapted for sucking. It was noted that the gut contents were mainly of a fluid nature containing structures resembling bacteria, encysted protozoa and fine unidentifiable particles.

Recently attention has been drawn to the enigma in detritivore communities of a high degree of species diversity, accompanied by an apparently low degree of feeding specificity (Anderson, 1975; Joosse, 1975) and Collembola would seem to be no exception to this (Anderson and Healey, 1972; McMillan, 1975). It is suggested therefore that a greater knowledge of the fine structure and function of collembolan mouth-parts could provide more specific information on their feeding habits.

In this study the fine structure of the mouth-parts of *Ceratrimeria leleupi*, a species lacking a mandibular molar plate and formerly regarded as a piercing and sucking type, is examined using the scanning electron microscope.

Specimens are also examined under the light microscope for evidence of food in the gut.

MATERIALS

A collection of Collembola from Zaire contained several hundred specimens of *Ceratrimeria leleupi* Salmon and Adams, 1979. In the majority of specimens examined, the buccal cone was closed and dissection of the cone and mouth-parts was necessary for identification purposes. In a few specimens however, the buccal cone was open and the mandibles and maxillae were exerted from the mouth. These specimens were selected for detailed examination of the mouth and mouth-parts in situ.

In order to view the mouth-parts in their natural extended position no attempt was made to dissect them out of the cone. Whole specimens were mounted with the buccal cone uppermost. The following description of the mouth-parts of *C. leleupi* is from observations with the scanning electron microscope.

Specimens were prepared using the critical point drying method. They were fixed to a standard Cambridge S.E.M. stub with silver dag, sputter coated with gold and viewed on a Cambridge Mk. 11.A scanning electron microscope.

MORPHOLOGY OF THE MOUTH-PARTS

The buccal cone projects antero-ventrally from the head and is formed from the distal borders of the labrum and labium united basally on the cone by the oral folds (Folsom, 1900). (Figs. 1, 2). The lateral free margins of the labrum are folded and thickened with smooth cuticle and converge towards the distal border where they end abruptly in an upturned collar-like structure (Fig. 1). The general tuberculate cuticle of the body is continued on to the base of the labrum. A series of longitudinally arranged folds of finely granular cuticle run forward on the labrum merging to a single fold at the distal border (Fig. 1). The

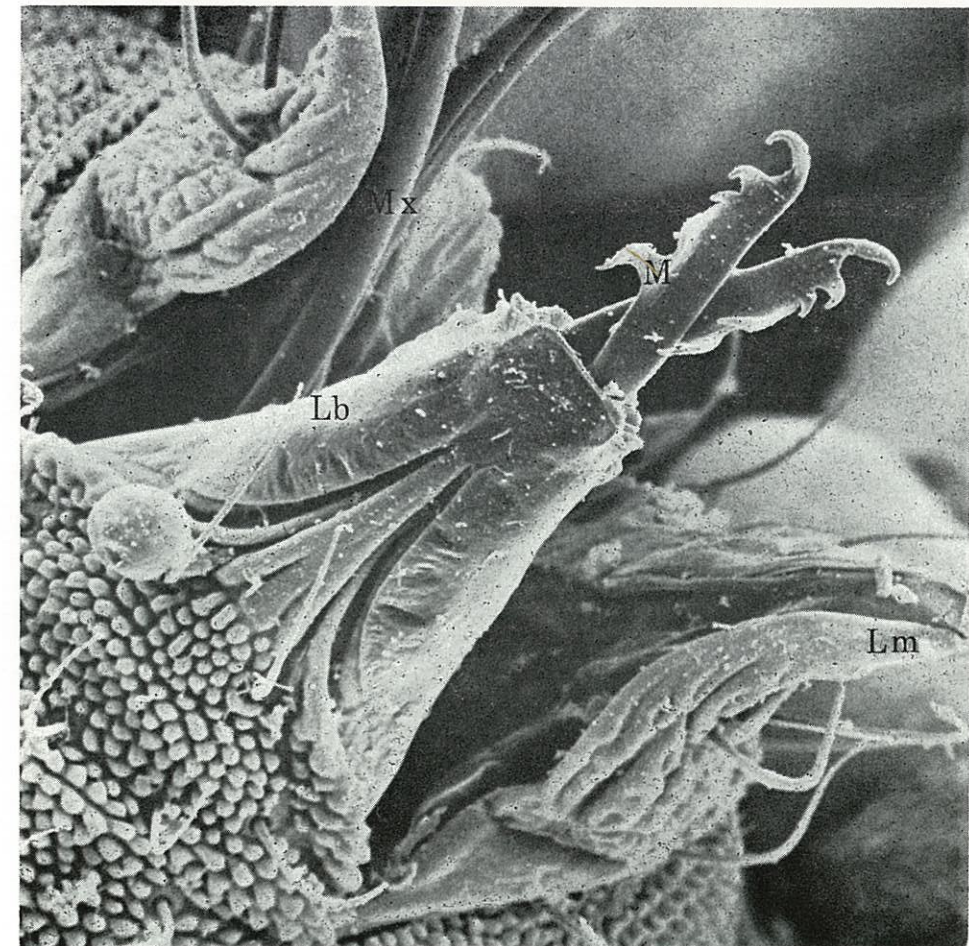


Fig. 1 *Ceratrimeria leleupi*

Dorsal view of open buccal cone, showing mandibles protruding beyond edge of labrum and divided labium to right and left. The rod-like maxillae show partially at upper left, and the superlinguae appear at the distal border of the labrum. Note the folded, thickened, non-tuberculate edge of the labrum. Lb, labrum; Lm, labium; M, mandible; Mx, maxilla. (x 1,200).

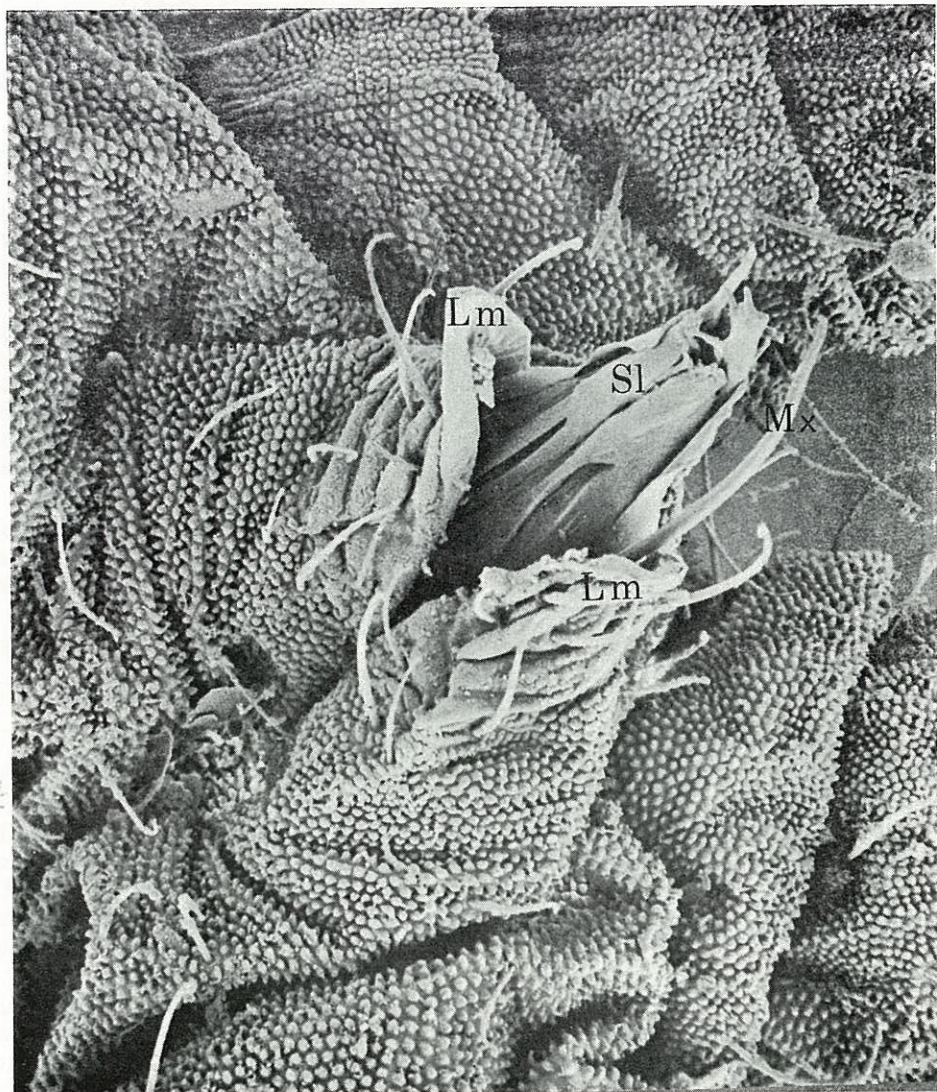


Fig. 2 *Ceratrimeria leleupi*

Ventral view of open buccal cone. Superlinguae show beneath labrum in upper centre of cone and a rod-like maxilla emerges from right of cone. Mandibles are partially obscured distal to superlinguae. Note deeply cleft labium with thickened folded borders, antenna above and at lower right. Sl, superlinguae; Lm, labium; Mx, maxilla; (x 600).

labium tapers distally on the cone in a similar manner to the labrum and is divided medially into right and left halves (Fig. 2). The lateral and terminal borders, and distal portion of the medial borders are folded and thickened with smooth cuticle. From the medial division on the cone, the ventral line continues back the entire length of the labium to the thorax. The cuticle of the labium is tuberculate but in the distal half of the cone it is finely granulate and thrown into a number of irregular folds. Each half of the labial section of the cone carries a small basal seta and nine larger setae distal to this, one of which, situated near the basal seta is distinctly longer than the rest. The mouth opening at the apex of the cone extends down each side of the cone bordered by the thickened and folded margins of the labrum and labium. The mandible is a slender, elongated, rod-like structure with an expanded apical region which resembles a claw or scoop (Figs. 3, 4). Six strongly curved teeth of varying size are arranged at the apex and along the medial border. They consist of four major teeth with a small tooth between the first and second and another between the second and third major teeth. The basal or sixth tooth, is the longest and stoutest of all. The lateral border of the mandibular head is thickened and together with the apical tooth, is rolled slightly inward. The toothed border of the mandible is also rolled over in such a manner that an elongated cupped depression is formed between them, and the whole mandible head resembles a claw. The mandibular head is approximately 80 μm in length and 20 μm in its widest part. Each maxilla consists of a pair of slender rods or lamellae. In all specimens examined the rods were closely opposed (Fig. 3), one of the pair being slightly longer than the other and faintly hooked apically. The maxilla is approximately 10 μm in diameter distally. The maxillae when exerted usually extend slightly beyond the mandibles. No opening could be found at the distal extremity of the maxilla to suggest a chemoreceptor function. The superlinguae are a pair of large, lamellate, folded structures lying between the labrum and labium. They appear to be situated ventrally to the mandibles and maxillae and may be partly exerted from the mouth opening (Fig. 1).

DISCUSSION

It is of interest to consider the function of these mouth-parts and what type of feeding is possible in this collembolan. The labium is divided into separate halves for almost the entire length of the cone and this division, together with the lateral extensions of the mouth allows the distal portion of the cone to open when the mandibles and maxillae may be extended beyond the mouth opening (Figs. 1, 2). As the maxilla is hooked apically it would not appear to act as a piercing stylet. The mandibular shaft is rod-like, roughly circular in cross section rather than a flat shaft and the head is not a flat cutting plate as previously described (Massoud 1967), but is modified to form a cupped, claw shaped structure. The mandibular head therefore cannot be termed a "pars incisiva" as the teeth do not form a cutting edge, and the action of the mandibles is no longer a transverse cutting action, but a protraction and retraction (Wolter 1963).

As previously discussed, Collembola of this type have long been regarded as sucking, or piercing and sucking their food. It was considered that owing to the small size of the apical mouth opening they are not capable of conveying any solid food particles into the mouth cavity. The consistent absence of visible gut contents observed by a number of writers, including Macnamara (1924) and Poole (1959), was

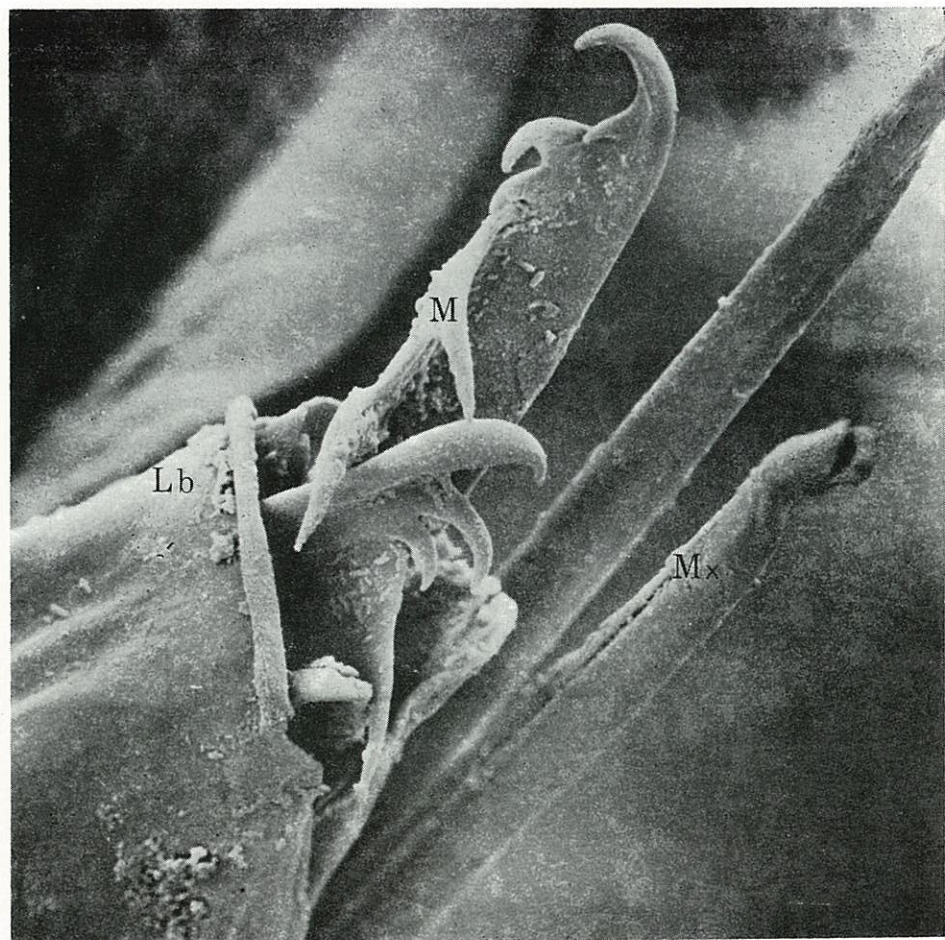


Fig. 3 *Ceratrimera leleupi*

Distal portion of cone with mandible and maxillae partly extruded. Lower maxilla shows double structure and mandibles carry bacteria. M, mandible; Mx, maxilla; Lb, labrum (x 2,500).

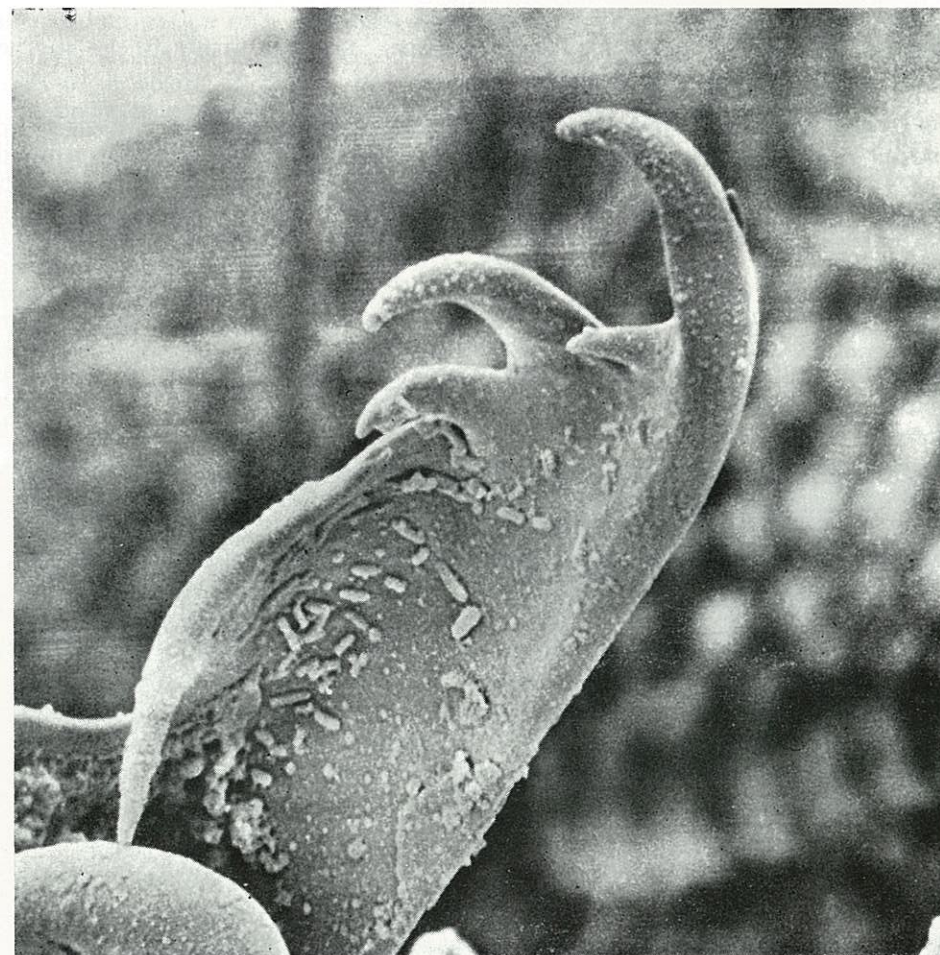


Fig. 4 *Ceratrimera leleupi*

Mandibular head showing claw-like form and containing bacteria (x 5,000).

considered to indicate that they are fluid feeders. The entire mouth cone was said to function as a suction tube attaching itself firmly to the surface of the substrate during feeding.

The mandibles and maxillae of the present species are clearly not sucking structures and with the loss of the molar plate comminution of food particles by the mandibles is not possible. The structure of the mouth opening with thickened folded borders and divided labium bears a strong resemblance to that observed in *Brachystomella parvula* (Schaeffer) by Adams and Salmon (1972). In *B. parvula* the terminal portion of the cone remains open during feeding and the maxilla heads and superlinguae make rapid movements in and out of the mouth openings. Specimens of the present species were found with the cone open and the mouth-parts extended to varying degrees. As noted above, in forms possessing a buccal cone, the action of the mandibular and maxillary muscles is protraction and retraction. It seems reasonable to

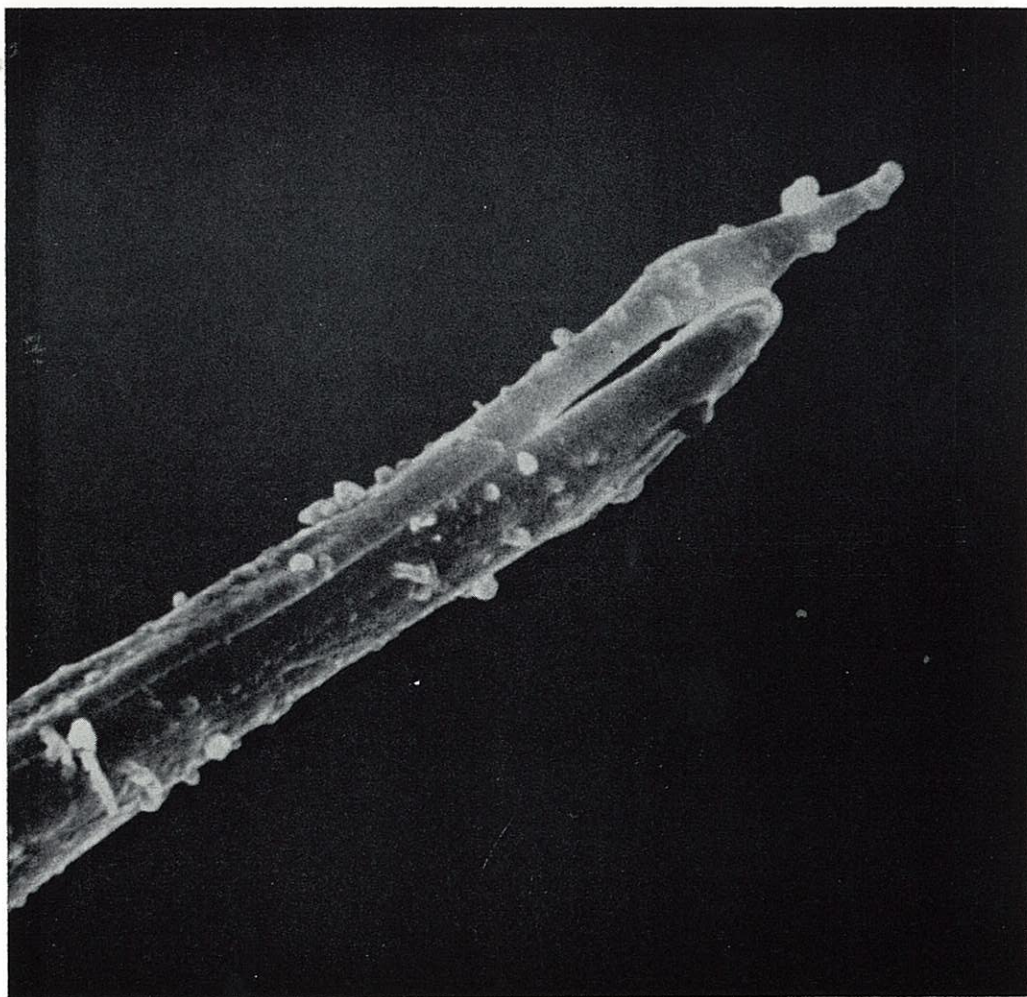


Fig. 5 *Ceratrimeria leleupi*
Distal end of maxilla, carrying bacteria of branching and coccoid form
(x 7,000).

assume therefore, that the action during feeding in this species consists, as in *B. parvula*, of an opening of the distal portion of the cone which allows the heads of the mandibles and maxillae to emerge and operate in a protraction-retraction movement conveying food particles in to the mouth. As the mandibles and maxillae are of minute size and lack grinding or chewing plate, the size of food particles or organism ingested is accordingly limited. It has been suggested by Christiansen (1964) that bacteria may form an important part of the collembolan diet and several species were cultured on bacteria as the sole source of food. These however were not visible within the gut after ingestion. In the present study, bacteria of bacillus and coccoid form were observed on the mandibular heads of a number of specimens (Figs. 3, 4). Both mandibles were found to contain bacteria with very little other material present. In other specimens, although the mouth-parts were often fully extruded, the cupped mandibular heads appeared empty. Bacteria were the only identifiable material found on the mandibles. Similarly, bacteria of coccoid and branched form were found adhering to the maxillae, concentrated particularly at the distal end (Fig. 5). Bacteria were not observed on any other parts of the body. The consistent lack of visible gut contents in this species and the presence of bacteria on the mandibles and maxillae suggests that small organisms such as bacteria are at least a source of food.

The question then arises as to the function of the buccal cone. If it does not act as a suction tube, does it serve some other function in food selection? It has been noted that in Collembola possessing a buccal cone, the structure and function of the mouth-parts has changed. The molar plate with its grinding action is lacking and the mandibles, if present, are modified to slender, elongated, extremely delicate structures. With this modification there is a consequent reduction in the size of food particles ingested. The narrowing of the wide frontal mouth region to a tapered buccal cone appears to have evolved with this structural change in the mouth-parts and it seems probable that the cone serves to support and protect the delicate protrusible mouth-parts.

SUMMARY

The mandible is seen to be a cupped claw-like structure. It is not a piercing stylet, as might be expected in an insect regarded as piercing and sucking its food, nor is the head in the form of a flat cutting plate. No locking structures are found on the cone which might serve to hold the labrum and divided labium together to form a suction tube during feeding. The maxillae, formerly described as stylet-like are seen to be hooked apically and would not appear to be adapted for piercing. They are finely delicate structures, but it is possible they may serve to supplement the function of the dentate claw-like mandibles in gathering food. The size of the apical portion of the maxillae, 1-2 μm in diameter, is comparable to the size of a generalized soil bacterium 1 μm^3 (Clark 1967). As the maxillae extend beyond the mandibles in what appears to be the feeding position, they would seem suited to rake or sweep small food particles such as bacteria in to the cupped mandibular head. These food particles could then be conveyed to the digestive tract by the protractor retractor action of the mandibles.

The present study indicates that this collembolan does not feed by sucking or chewing its food but it could be described as browsing on the microfauna or flora of detrital material. This supports the view of Adams and Salmon (1972) that the division of Collembola into chewing forms and sucking forms is no longer valid.

ACKNOWLEDGEMENTS

My thanks to Mr M. N. Loper, Victoria University of Wellington, for preparation of specimens and also to Mr Graeme Walker for his help in viewing and photographing specimens at the Physics and Engineering Laboratory, Wellington.

Dr E. C. G. Adams,
Zoology Department,
Victoria University of Wellington,
Private Bag,
Wellington.
New Zealand.

REFERENCES

- ADAMS, E. C. G. and SALMON, J. T., 1972: The mouth-parts and feeding methods of *Brachystomella parvula* (Schaeffer) (Collembola: Brachystomellidae). *Trans. ent. Soc. Lond.* 124(3): 269-286, 17 figs.
- ANDERSON, J. M. 1975: The enigma of soil animal species diversity. In (Ed.) J. Vanek, *Progress in Soil Zoology*: 51-58, Prague.
- and HEALEY, I. N. 1972: Seasonal and interspecific variation in major components of the gut contents of some woodland Collembola. *J. Anim. Ecol.* 41, 359-368.
- CHRISTIANSEN, K., 1964: Bionomics of Collembola. *Ann. Rev. Entomol.* 9, 147-178.
- CLARK, F. E., 1967: Bacteria in soil. In A. Burges and F. Row (Eds.), *Soil Biology*: 15-49. London and New York.
- FOLSOM, J. W., 1900: The development of the mouth-parts of *Anurida maritima*. *Bull. Mus. comp. Zool. Harv.* 36 (5): 87-150.
- GOTO, H. E., 1972: On the structure and function of the mouth-parts of the soil-inhabiting collembolan *Folsomia candida*. *Biol. J. Linn. Soc.*, 4: 147-168.
- JOOSSE, E. N. G., 1975: Feeding activity and availability of food in Collembola. In J. Vanek (Ed.), *Progress in Soil Zoology*: 315-324. Ed. W. Junk. The Hague.
- MACNAMARA, C., 1924: Food of Collembola. *Can. Ent.* 56: 99-105.
- McMILLAN, J. H., 1975: Interspecific and seasonal analyses of the gut contents of three Collembola (Family Onychiuridae). *Rev. Ecol. Biol. Soc.* 12 (2): 449-457.
- MASSOUD, Z., thèses (Université de Paris, Faculté des Sciences 1967).
- and ELLIS, W. N., 1974: Considerations sur les genres *Tomocerus* et *Pogonognathellus* (Collembola, Insecta). *Pedobiologia* II 321-337.
- POOLE, T. B., 1959: Studies on the food of Collembola in a Douglas fir plantation. *Proc. Zool. Soc. Lond.* 132: 71-82.
- SALMON, J. T., 1964: An Index to the Collembola. *Bull. R. Soc. N.Z.* 7, 1-644.
- and ADAMS, E. C. G., 1979: A New Species of *Ceratrimeria* (Collembola: Neauridae) from Zaire. *Zool. Publ. Victoria Univ. Wellington.* 71:
- SINGH, S. B., 1969: Studies on the gut contents of a suctorial collembolan *Friesca mirabilis* (Tullberg) (Insecta). *Entomologist* 102: 180-184.
- WOLTER, H., 1963: Vergleichende Untersuchungen Zur Anatomie und Funktionsmorphologie der stechend-saugenden Mundwerkzeuge der Collombollen. *Zool. JI. (Anat.) Bd. 81*, S. 27-100.

KEYS TO AID IN THE IDENTIFICATION OF MARINE HARPACTICOID COPEPODS

Amendment Bulletin No. 2.

by

J. B. J. Wells,
Victoria University of Wellington.

INTRODUCTION

This second bulletin of amendments to my Keys (Wells, 1976, 1978) deals with additions and alterations made necessary by recent publications and takes another opportunity to correct errors. Once again I wish to thank my colleagues for information received and to encourage them to continue sending it for incorporation in future bulletins. Page numbers in parentheses are those of the original Keys (Wells, 1976).

Family Gelyellidae

Gelyella droguei Rouch & Lescher-Moutoué, 1977, a new genus and species, is the sole species in a new family of primitive freshwater harpacticoids which tends to link together Lang's (1948) primary divisions of Polyarthra and Oligoarthra. The Key to Families (p.5) requires modification of couplet 5 as follows—

- | | |
|-----------------------------------------------------------------|-----------------------------|
| 5. P.4-P.5 absent. | Gelyellidae |
| P.4-P.5 present. | 5a |
| 5a. Distal segment of Enp. P.2 much longer than the entire Exp. | Longipediidae ^{a)} |
| Distal segment of Enp. P.2 shorter than the Exp. | Canuellidae |

Family Cerviniidae

Dinet (1978) describes nine new species of *Pontostratiotes* — *P. uxoris*, *P. gladius*, *P. lubricus*, *P. vitelloi*, *P. viverae*, *P. denticulatus*, *P. ceciliae*, *P. vasconensis*, *P. barnetti*. All are referable to the genus codon in KGG 1 (p.21), as in *P. pori*, nom. nov. by Dinet (1978) for the *P. abyssicola* of Por (1969). Add to General Note 2 (p.26).

Family Ectinosomatidae

1. *Arenosetella fimbriaticauda* McLachlan & Moore, 1978, to genus codon in KGG 1 (p.28). Add to General Note 2 (p.36).
2. *Ectinosoma barbicauda* Bozic, 1978, to genus codon in KGG 100 (p.29). Add to General Note 2 (p.36).
3. McLachlan & Moore (1978) have re-examined *Hastigerella tenuissima*, *H. palpilabra* and *Arenosetella monensis*. They show that all possess a weak ornamentation of the anal segment and, further, that in all respects they are identical and must be considered synonymous. The senior synonym is *H. tenuissima* which must be transferred to *Arenosetella* and added to the genus codon in KGG 1 (p.28). Delete the codons for *H. tenuissima* and *H. palpilabra* in KGG 300 (p.33) (see also Wells, 1978 p.1, for *Arenosetella monensis*).

Family Darcythompsoniidae

Kunz (1978) describes a specimen that he believes to be the previously unknown male of *Leptocaris minimus* Jakobi. This male has P.1-P.4 Enp.2 with 3:3:3:2 setae and lacks a seta on P.3 Enp.1. Although Kunz was unable to examine the female he is convinced that the additional small setae illustrated by Jakobi (1954) are only accessory spinules. Therefore, the codon in KGG 1 (p.37) must be amended to read — a/a/4:4/0:0:0/3:3:3:2. A note that the male of this species has now been described should be made under General Notes (p.39).

Family Harpacticidae

- Harpacticus furcatus* is redescribed by Itô & Fukuchi (1978); add to General Note 1 (p.47).
- Tigriopus igai* Itô, 1977, to codon for *Tigriopus*^{b)} in KGG 1 (p.43); add to footnote b) (p.44).
- Harpacticella oceanica* Itô, 1977, requires a new codon in KGG 100 (p. 46) — nor/7/1/♀/5:5/0:4.
- There are errors in the codons for *Harpacticella* spp. in KGG 100 (p.46); correct as follows—
Harpacticella^{d)} — nor/7/1/♀/5:5/0:3.
H. paradoxa — nor/7/1/♀/5:5/0-1:3.

Family Thalestridae

- Delete *Paradactylopodia oculata* from KGG 200 (p.62). This species requires a new codon in KGG 1 (p. 58) — 3:3/7:8:7/2:2/3/p:d.
- There are several errors with regard to species of *Pseudotachidius*; correct as follows—
 - in KGG 1 (p.58)
 - delete the codon for *P. coronatus* and *P. similis*.
 - add a new codon for *P. similis*—
3:3/??:5/??:1/?/p:d.
 - add a new codon for *P. vikingus* ♀—
3:3/6:6/1:1/3/p:d.
 - In KGG 200 (p.62) add a new codon for *P. peruanus* Becker, 1974—
4-5/1/less than or equal to Enp.1.
 - in KGG 300 (p.63)
 - add a new codon for *P. coronatus*—
p:d/3/5-6/2/3.
 - codon for *P. vikingus* refers to the male only.
 - delete the codon for *P. peruanus*.
- Paradactylopodia hexarticulata* is incorrectly spelt by Wells, (1978, p.3).

Family Diosaccidae

- Pseudostenhelia wellsii* Coull & Fleegeer, 1977, to genus codon in KGG 1 (p.70) which now requires amendment as follows—
3/2/2/4/2-3:2-3:2-3; add to General Note 2 (p.99).
- Haloschizopera latisetifera* Marinov, 1973a, to codon for *Haloschizopera*^{a)} in KGG 100 (p.72); add to footnote a) (p.73).
- Delete *Metamphiascopsis nicobaricus* from footnote c) of KGG 260 (p.84) and add a new codon for this species in KGG 250 (p. 82—
wd/9/2:6.
- Amphiascus longarticulatus* Marcus (see Wells, 1978 p.3) is re-described by Bodin (1977). His specimens have a weak third inner seta on P.2 Exp.3. It is not known if this seta is present in Marcus's material. The species must now be added to footnote b) of KGG 260 (p.84). Bodin considers *Amphiascus* sp. Wells, 1968, to be this species.
- Stenhelia (D) krishnensis* Radhakrishna & Reddy, 1978, to codon for *S. madrasensis* in KGG 500 (p.88). These two species probably are synonymous.
- Protopsammotopa wilsoni* Wells, 1977, to genus codon in KGG 1100 (p.98); amend entry in General Note 2 (p.99).
- Add *Schizopera issykkulica* Mauyilova, 1966, to General Note 4 (p. 99).

Family Ameiridae

- Ameira scotti* has been omitted from the Keys; add a new codon in KGG 400 (p.114)—
0:0:0/1:1:1/1:1:1/4:5:5/4:5/2:4.
- Ameira longipes*: The first codon for this species in KGG 400 (p.115, line 1) must be deleted. The true codon is the last one on this page.
- Parevansula elegans* (Marinov, 1974) requires a new codon in KGG 1 (p.101)—
3:2/2:2:2/1:1:2/4/0. This species is assigned by Marinov to the genus *Philoleptomesochra*, but see General Note 2 (p.122).
- Nitocra sewelli husmanni* is incorrectly spelt by Wells (1978, p.4).

Family Paramesochridae

- Apodopsyllus unguiformis* Coull & Hogue, 1978, to codon for *A. africanus* and *A. schulzi* in KGG 300 (p.129).
- Apodopsyllus bermudensis* Coull & Hogue, 1978, is described for all the previous records of *A. africanus* from Bermuda; add a new codon in KGG 300 (p.129)—
2/4/0:4/1:2 and make an appropriate note in General Note 1 (p. 130).
- Apodopsyllus perplexus* appears incorrectly in KGG 300 (p.129) as *A. reductus*. This species was originally described as *Leptopsyllus reductus* Petkovski, 1955, but as this is a junior primary homonym of *L. reductus* Lang, 1948, the name must be permanently rejected (Article 59(a) of the International Code of Zoological Nomenclature,

1964). This was overlooked by Kunz (1962) in his revision of the family, in which he removed *L. reductus* Petkovski to *Apodopsyllus* but retained the homonymous trivial name. The homonymy was recognised by Wells (1963) who proposed replacement by *Leptopsyllus perplexus* nom. nov. This replacement name has priority over *L. petkovskii* nom. nov., proposed by Noodt (1964). Thus the correct name for *L. reductus* Petkovski is *Apodopsyllus perplexus* (Wells, 1963).

Family Tetragnipitidae

1. *Phyllopodopsyllus laspalmensis* Marinov, 1973b, to codon for *P. mossmani* in KGG 1 (p.133).
2. *Phyllopodopsyllus paramossmani*: Amend the codons in KGG 1 (p. 133) to read—
 $\text{♀} - a/a/2/3:3:3/4:4:6.$
 $\text{♂} - a/a/2/3:3:2/4:4:6.$
 The male must be added to the codon for *P. longipalpatus* ♂.

Family Canthocamptidae

1. *Mesochra flava* as redescribed by Soyer (1977) differs from the original description of Lang (1933). As his material is not from the type locality Soyer's specimens must be considered only as showing that there is some geographic variability in the species. Therefore a second codon is required for this species in KGG 100 (p. 137)—
 $7/3/6:7:7/4:5/6:5/4:6.$
2. *Mesochra pallaresi* Soyer, 1977, is described for Pallares' (1968, 1975) specimens of *M. flava*. *M. pallaresi* must be added to the original codon for *M. flava*—
 $7/3/6:7:7/5:5/6:5/3:6$ (KGG 100, p.137); add an appropriate note in General Note 3 (p.139).

Family Cylindropsyllidae

1. *Notopontia stephanieae* Bodiou, 1977, a new genus and species, requires a new codon in KGG 1 (p.141)—
 $s/2:na/f/2:2:1/p.$
2. *Stenocaris kerguelenensis* Bodiou, 1977; the female to the codon for *S. minor* and *S. kliei* and add a new codon for the male—
 $2:1:2/ns/2:2/na$ (both in KGG 200, p.143).
3. KGG 300 (p.144)—
 (a) Character 2 should read "P.1 Enp."
 (b) *Leptastacus naylori* McLachlan & Moore, 1978, requires a new codon—
 $p/2/0:0:1/3:4:5/1:1:0/1:2:1.$
4. KGG 500 (p.148)—
 (a) Character 1 should read "P.1 Exp."; there is only one segment in this ramus.
 (b) *Psammastacus erasmusi* McLachlan & Moore, 1978, to codon for *P. spinicaudatus*.
5. *Arenopontia* (*N.*) *sakagami* Itô, 1978, to codon for *Arenopontia*^(s) in KGG 600 (p.149); add to footnote c) (p.150).

Family Cletodidae

1. KGG 1—
 (a) Delete the codon for *Eurycletodes* (*O.*) *arcticus* (p.156). This species must be added to the codon for *E. (O.) latus* (p.157).
 (b) *Eurycletodes aberrans* Marinov, 1973b, cannot be placed in either subgenus as it displays features of both; add to codon for *Mesocletodes carpinei* Soyer (p.154; see also Wells, 1978, p.7).
 (c) *Nannopus palustris*: Coull & Fleeger (1977) comment on the variability of this species, in particular on the setation of P.2-P.4. The present codon (p.157) must be amended to take these comments into account—
 $3:2/3:3:3/2:1/6-7:7-8:6-8/3:2$ and an appropriate note must be inserted in General Note 1 (p.170).
 (d) Add *Cletocamptus affinis* to footnote e) (p.159).
2. *Cletodes reductus* Moore, 1977, requires a new codon in KGG 600 (p.167)—
 $a/2:1/0:1/d:2:5/d:0:3.$
3. *Argestes mollis*: Amend the codon in KGG 700 (p.169) to read—
 $5/1:1:1:1/7:8:7/5:5/2:4.$

Family Laophontidae

1. *Laophonte longicaudata* s.str.: Amend the present codons as follows—
 KGG 1300-♀♀ (p.183) — $6:7:7/1:1:1/0:0:0/4:6:3/0:0:1.$
 KGG 1000-♂♂ (p.196) — $6:7:7/1:1:1/4:4:3/0:1/p.$
2. *Laophonte euxiniphila* Soyer, 1977, requires new codons as follows—
 KGG 2100-♀♀ (p.187) — $5:5:5/1:1:1/0:0:0/3:5:4/0:0:0.$
 KGG 1-♂♂ (p.188) — $3:3:3/2:2/2:3/3/3.$
3. *Heterolaophonte stroemi*: P.4 Exp.3 can have five or six setae. Add a second codon in KGG 1900-♀♀ (p.185)—
 $6:6:5/1:1:1/0:0:0/4:6:4/0:0:0.$
4. *Heterolaophonte longisetigera*: Dr G. R. F. Hicks (pers. comm.) reports that in English material of this species the P.5♂ setation is variable, with a total of five or six setae, and that P.3 Enp. is always three-segmented. Therefore this species must be added to the codon for *Apoletion* in KGG 1-♂♂ (p.190).
5. *Echinolaophonte mirabilis* is incorrectly called *E. mirabilipes* in KGG 1-♀♀ (p.174).
6. *Echinolaophonte armiger*. Amend the present codon in KGG 300-♀♀ (p.177) to read—
 $5:6-7:6/1:1:1/0:0:0/3:4:3/0:0:0.$
7. *Klieonychocamptus kliei ponticus* Marcus, 1971, is a junior secondary homonym of *K. ponticus* (Serban & Plesa, 1957). I propose *K. k. marcusi* nom. nov. as a replacement name (see p.175, footnote e) and p.190).
8. *Pseudolaophonte glemareci* Bodin, 1977, requires new codons as follows:—
 KGG 1-♀♀ (p.172) — $2:2:2/0:1:1/5:5/2/5.$
 KGG 1-♂♂ (p.188) — $2:2:2/0:1/2:3/2/2.$

9. Transpose columns three and four of the codon for *Laophontopsis lamellifera* in KGG 1600-♀♀ (p.184).
10. *Cubanocleta noodti* Petkovski, 1977, a new genus and species, is placed by its author in this family even though the A.2 lacks an exopod. Thus, it keys out to the family Ancorabolidae in the Keys to Families (p.8, couplet 24). It requires new codons as follows—
KGG 1-♀♀ (p.172) — 3:3:3/1:1:1/4:3/3/4.
KGG 1-♂♂ (p.188) — 3:3:3/1:1:1/4:3/3/1.
11. *Laophonte spinifer* is incorrectly spelt by Wells (1978, p.7).

REFERENCES

- BODIN, P., 1977. Description de deux espèces de copépodes harpacticoides (Crustacea) de l'écosystème expérimentale de Roscoff. *Cahiers de Biologie Marine* 18: 311-324.
- BODIQU, J. Y., 1977. Harpacticoides (Crustacés, Copépodes) des Iles Kerguelen. III—Description de deux formes nouvelles de la famille des Cylindropsyllidae. *Comité National Français des Recherches Antartiques* 42: 277-286.
- BOZIC, B., 1978. *Ectinosoma barbicauda*, espèce nouvelle de La Réunion (Crustacea, Copepoda, Harpacticoida). *Bulletin du Muséum National d'Histoire Naturelle, Paris, Zoologie* 352, 157-163.
- COULL, B. C. & FLEEGER, J. W., 1977. A new species of *Pseudostenhelia*, and morphological variation in *Nannopus palustris* (Copepoda, Harpacticoida). *Transactions of the American Microscopical Society* 96: 332-340.
- COULL, B. C. & HOGUE, E. W., 1978. Revision of *Apodopsyllus* (Copepoda, Harpacticoida), including two new species and a redescription. *Transactions of the American Microscopical Society* 97: 149-159.
- DINET, A., 1978. Le genre *Pontostratiotes* Brady, 1883 dans l'étage abyssal du Golfe de Gascogne (Copepoda, Harpacticoida). *Bulletin du Muséum National d'Histoire Naturelle, Paris, Zoologie* 348: 1165-1199.
- ITO, T., 1977. New species of marine harpacticoid copepods of the genera *Harpacticella* and *Tigriopus* from the Bonin Islands, with reference to the morphology of copepodid stages. *Journal of the Faculty of Science, Hokkaido University, Ser. VI, Zoology* 21: 61-91.
- ITO, T., 1978. A new species of marine interstitial harpacticoid copepod of the genus *Arenopontia* from the Bonin Islands, southern Japan. *Annotationes Zoologicae Japonenses* 51: 47-55.
- ITO, T., & FUKUCHI, M., 1978. *Harpacticus furcatus* Lang from the Antarctic Peninsula, with reference to the copepodid stages (Copepoda: Harpacticoida). *The Antarctic Record, National Institute of Polar Research, Tokyo* 61: 40-64.
- JAKOBI, H., 1954. Harpacticoida (Cop. Crust.) da microfauna do substrato arenolodosa do "Mar de Dentro" (Ilha do Mel—Baia de Paranaguá—Brasil). *Dusenian* 5: 209-232.
- KUNZ, H., 1962. Revision der Paramesochridae (Crust. Copepoda). *Kieler Meeresforschungen* 18: 245-257.
- KUNZ, H., 1978. Zur Kenntnis der Gattung *Leptocaris* (Copepoda, Harpacticoida, Darcythompsoniidae). *Crustaceana* 35: 41-49.
- LANG, K., 1933. Marine Harpacticiden von der Campbell-Inseln und einigen anderen südlichen Inseln. *Acta Universitatis lundensis* 30(14): 1-56.
- LANG, K., 1948. *Monographie der Harpacticiden*. Hakan Ohlsson, Lund, pp. 1683.
- MARCUS, A., 1971. Copépodes du mésopsammon de la zone médiolittorale de la mer Noire (littoral Roumain). La description d'une nouvelle sous-espèce *Klieonychocamptus kliei ponticus* n.spp. *Travaux du Muséum d'Histoire Naturelle 'Grigore Antipa'* 11: 71-82.
- MARINOV, T. M., 1973a. Neue Harpacticiden aus dem Atlantischen Ozean (im Bereich nordwest-afrikas und der kanarischen Inseln). I. *Haloschizopera latisetifera* n.sp. *Comptes rendus de l'Académie bulgare des Sciences*. 26: 1235-1237.
- MARINOV, T. M., 1973b. *Phyllopodopsyllus laspalmensis* n.sp. und *Eurycletodes aberrans* n.sp. aus dem Atlantischen Ozean. *Comptes rendus de l'Académie bulgare des Sciences* 26: 1525-1528.
- MARINOV, T. M., 1974. *Philloleptomesochra elegans* n.sp.—eine neue Harpacticidenart (Copepoda, Harpacticoida) aus dem Atlantischen Ozean. *Comptes rendus de l'Académie bulgare des Sciences* 27: 85-87.
- MAUYILOVA, E. F., 1966. A study of the Harpacticoida of Lake Issyk-Kul. *Doklady Akademii Nauk SSR* 170: 1436-1438 (in Russian).

- McLACHLAN, A & MOORE, C. G., 1978. Three new species of Harpacticoida (Crustacea, Copepoda) from sandy beaches in Algoa Bay, South Africa, with keys to the genera *Arenosetella*, *Hastigerella*, *Leptastacus* and *Psammastacus*. *Annals of the South African Museum* 76: 191-211.
- MOORE, C. G., 1977. Une forme nouvelle de *Cletodes* Brady (Copepoda, Harpacticoida) de la côte catalane française. *Vie et Milieu* 27A: 255-262.
- NOODT, W., 1964. Copepoda Harpacticoida aus dem Litoral des Roten Meeres. *Kieler Meeresforschungen* 20: 128-154.
- PALLARES, R. E., 1968. Copepodos marinos de la Ria Deseado (Santa Cruz, Argentina). Contribucion sistematico-ecologica, I. *Contribucion Cientifica del Centro de Investigacion de Biologia Marina, Buenos Aires* 27: 1-125.
- PALLARES, R. E., 1975. Copepodos harpacticoides marinos de Tierra del Fuego (Argentina). I. Isla de los Estados. *Contribucion Cientifica del Centro de Investigacion de Biologia Marina, Buenos Aires* 122: 1-34.
- PETKOVSKI, T. K., 1955. IV Beitrag zur Kenntnis der Copepoden. *Acta Musei Macedonici scientiarum naturalium* 3: 72-104.
- PETKOVSKI, T. K., 1977. *Cubanocleta noodti* n.gen., n.sp., ein neuer harpacticoid (Crustacea, Copepoda) aus dem hyporheal Kubas. *Fragmenta Balcanica* 10: 57-68.
- POR, F. D., 1969. Deep-sea Cerviniidae (Copepoda: Harpacticoida) from the western Indian Ocean, collected with R/V Anton Bruun in 1964. *Smithsonian Contributions to Zoology* 29: 1-60.
- RADHAKRISHNA, Y. & REDDY, Y. R., 1978. A new species of *Stenhelina* Boeck (Copepoda, Harpacticoida) from south India. *Crustaceana* 35: 152-158.
- ROUCH, R. & LESCHER-MOUTOUE, F., 1977. *Gelyella droguei* n.g., n.sp., curieux harpacticide des eaux souterraines continentales de la nouvelle famille des Gelyellidae. *Annales de Limnologie* 13: 1-14.
- SERBAN, M. & PLESA, C., 1957. Notes sur les copépodes de la mer Noire. *Izdaniya. Zavod za Ribarstvo na N.R. Makedonija. Skopje* 1: 229-254.
- SOYER, J., 1977. Harpacticoides (Crustacés, Copépodes) de l'Archipel de Kerguelen. II.—Deux formes de vases euxiniques intertidales. *Comité National Français des Recherches Antartiques* 42: 267-276.
- WELLS, J. B. J., 1963. Copepoda from the littoral region of the estuary of the River Exe (Devon, England). *Crustaceana* 5: 10-26.
- WELLS, J. B. J., 1968. New and rare Copepoda Harpacticoida from the Isles of Scilly. *Journal of Natural History* 2: 397-424.
- WELLS, J. B. J., 1976. *Keys to Aid in the Identification of Marine Harpacticoid Copepods*. Department of Zoology, University of Aberdeen, pp.215.
- WELLS, J. B. J., 1977. *Protopsammotopa wilsoni* n.sp. (Copepoda, Harpacticoida) and the fate of the type material of *Goffinella styliifer* C. B. Wilson. *Crustaceana* 32: 200-202.
- WELLS, J. B. J., 1978. Keys to Aid in the Identification of Marine Harpacticoid Copepods. Amendment Bulletin No. 1. *Zoology Publications from Victoria University of Wellington* 70: 1-11.

Professor J. B. J. Wells,
Department of Zoology,
Victoria University of Wellington,
Private Bag,
Wellington,
New Zealand.

