Invertebr. Taxon., 1987, 1, 1023–247

Non-marine Harpacticoid Copepods of Australia. I. Canthocamptidae of the Genus *Canthocamptus* Westwood s.lat. and *Fibulacamptus*, gen. nov., and Including the Description of a Related New Species of *Canthocamptus* from New Caledonia

R. Hamond

Zoology Department, University of Melbourne, Parkville, Vic. 3052;
present address: Scaldbeck House, Morston, Holt, Norfolk, U.K.

Contents

Abstract

The external morphology of *Canthocamptus* s.lat. and *Fibulacamptus*, gen. nov. has been resurveyed and a number of new terms and abbreviations introduced. Separate keys are given to the females and males of these genera and of all their 28 Australian species, as well as a table of their setal formulae and maps of their respective distributions; 21 of the 28 species are new.

The genus *Canthocamptus*, when defined as in section 6 for reasons given in section 3, contains 24 species which can be placed in six fairly well-defined groups; however, the previous descriptions of Australian *Canthocamptus* species are so lacking in detail that two of them must be regarded as completely unidentifiable. *C. bidens* (which is probably parthenogenetic anyway), *C. longipes* and *C. sublaevis* are known so far only as females and *Canthocamptus* sp. 1 from only a single male, each

0818-0164/87/081023$20.00

of the others described here being from both sexes. *C. ablatifurcatus*, sp. nov. from New Caledonia is described in Appendix 4; but other existing descriptions of non-Australian species are not sufficiently detailed to refer any of them to one or other of the six groups, to equate any of these groups to a named genus or subgenus of the Canthocamptidae, or to offer any basis for the much-needed revision of this family.

Fibulacamptus differs from all other harpacticoids in the grapnel-like outer terminal seta on the male P4exopod3, but is otherwise close to *Canthocamptus* as defined here; it contains four species, all new.

1. Introduction

As with so many groups of animals and plants, widespread and thorough collecting in Australia (both mainland and Tasmania) in recent years has shown that non-marine harpacticoids are far richer, both in species and in individuals, than was previously supposed. To paraphrase a remark in the Introduction by Luxton (1982), insofar as any given area remains an ecological nightmare for any given group, it is still a paradise for anyone working on the systematics of that group; conversely, worthwhile ecological and other studies must be founded on a reliable taxonomy leading to quick and easy identifications. This is certainly true of harpacticoids, no matter where they live; of those living either terrestrially or in completely fresh water, only the genus with the largest number of species and a closely related smaller one are dealt with here, the others being reserved for later papers.

Both the classical scheme of copepod classification (as in, for instance, Hamond 1969) and the very fine revision by Kabata (1979) assign a rather isolated position to the harpacticoids among the other kinds of copepods. Of the principal descriptive monographs on this group, those by Sars (1911) and Lang (1948) include freshwater forms only as a minority, and that by Lang (1965) includes none at all; conversely, there are lesser monographs more or less confined to freshwater forms, of which the only ones relevant here are those by Borutzky (1964) and Gurney (1932). The catalogue by Bodin (1979) specifically excludes purely freshwater forms, but does include most of the brackish water ones.

General surveys of the freshwater crustaceans of Australia are given by Bayly *et al.* (1967) and by Williams (1980); those of Tasmania alone are surveyed by Williams (1974). All the free-living *adult* copepods dealt with by these authors belong to the orders Cyclopoida, Calanoida, and Harpacticoida, whose distinctive characters are concisely explained by Bayly *et al.* (1967, pp. 10–16); however, the taxonomic revision of genera and species within each of these orders is an enormous and still unfinished task, enough for many papers of which this is only one. Free-swimming *larval* copepods, apparently of the classical 'order Lernaeoida' whose adults are parasitic on non-marine fishes, are rare and virtually unstudied in this country. Previous workers have used various generic names for the animals described below (see Bayly *et al.* 1967, p. 12); section 3 of this paper gives my reasons for including them in *Canthocamptus* s.lat., except for four species placed in *Fibulacamptus*.

This paper is dedicated to the memory of my cousin Robert Gurney (1879–1950), and attempts to do for Australia a part of what he (Gurney 1932) did for the British Isles, namely to describe and figure all locally known species of *Canthocamptus* s.lat. and closely related forms in a self-contained monograph.

2. Comments on Previous Descriptions of Australian *Canthocamptus*-like Species

Previous descriptions of Australian *Canthocamptus*-like species vary greatly in information content and will therefore by discussed in order of decreasing quality:

(1) By far the best figures are those of *Canthocamptus australicus* by Sars (1908), as *Attheyella australica*, in a journal not found in any Australian library. Dr M. Christiansen informs me that the types no longer exist, at least in the G. O. Sars Collection in the Oslo Museum; but the type locality (St Arnaud, Vic. = locality 1 on Map 2) is more or less in the middle of the presently known north-

west limit of the mainland distribution of the most common lowland Victorian species, with which Sars' figures agree extremely well.

(2) Virtually coextensive with *C. australicus* is the second most common Victorian lowland species (*C. longiseta*, Map 3), which agrees quite well with the figures given by Henry (1922, as *Moraria*) save for an unexplained discrepancy in the form of the female P5 (see p. 1084).

(3) Of distinctly less quality are the figures given by Chappuis (1951) of *Antarctobiotus nichollsi* (which I shall redescribe under this name in another paper), '*Attheyella hirsuta*', and '*Attheyella tasmaniae*', from untraceable specimens (probably no longer extant) collected by Dr A. G. Nicholls from the wet moss which grows all down the vertical rock face of the Guide River Falls in north-western Tasmania (= locality 6 on Map 6), a picnic spot about 2 km south-west of the village of Ridgley, which is itself about 10 km south-south-west of Burnie; Chappuis correctly describes the Guide River as a tributary of the Cam River which enters the sea at Somerset (about 3 km west of Burnie). I have sampled the wet moss on several occasions, finding both sexes of each of these three species, and one or both sexes of certain other *Canthocamptus* spp. Given that my specimens come from exactly the same place as the type, it is fairly clear which species is which; however, had I seen only specimens from Tasmanian waterfalls other than the Guide River Falls, the standard of Chappuis' work is not high enough to make it certain that I was dealing with one or other of his Guide River Falls species, rather than with a closely allied but distinct species. Therefore, as with all previously known Australian harpacticoids (marine or otherwise), I have made a special effort to collect topotypes of each species dealt with here, against a background of general collecting in every sort of potential harpacticoid habitat.

(4) The descriptions and figures by Brehm (1950, 1953) of Tasmanian freshwater harpacticoids from localities other than the Guide River Falls (also sent by Dr Nicholls) are so utterly lacking in necessary detail that, in the absence of Tasmanian specimens, I would have been obliged to disqualify every one of them as being unrecognizable. Only after seeing a great many Tasmanian specimens have I been able to validate his '*Delachauxiella fimbriata*' (as *C. fimbriatus*). I have accepted his '*Chappuisiella australica*' for convenience rather than from conviction, because I can find no difference between Victorian *C. australicus* (as above) and specimens from several places in Tasmania (Map 5); I also ascribe the 'other animal' (Brehm 1953, p. 57) to *C. australicus*, whose later subadult stages are the only harpacticoids I have found there which have opercula closely resembling that in his accompanying figure. However, even after examining so many specimens, I cannot relate his '*Delachauxiella salvatoris*' or his '*D. incerta*' beyond doubt to any one species rather than another; their descriptions and figures are so hopelessly inadequate that, in my opinion, both these alleged species should be ignored, especially since Brehm did not leave any preserved material either in the Biologisches Station at Lunz-am-See, Austria A-3293 (Dr Peter Adamicka, personal communication), in which he worked for many years, or in the Vienna Museum.

(5) The grossly unsatisfactory nature of Brehm's Tasmanian work has already been hinted at by Williams (1974, pp. 76, 77), whose remarks require amplification, as follows: (*a*) the harpacticoids found by Schminke (1971, not seen by me) have not yet been published; (*b*) neither extensive collections in Tasmanian non-marine habitats, nor further samples in the estuary of Brown's River in the southern suburbs of Hobart (Lang 1948, p. 342), nor samples from fully marine shores close to the mouth of this river, have yielded any species of *Tigriopus*, whose alleged finds in fresh water must be regarded as doubtful until it is found there again, and described and figured competently; and (*c*) harpacticoids, not taxonomically eligible for the present paper, have now been found in non-marine habitats on Macquarie Island.

3. *Canthocamptus* s.lat. as a Taxonomic Repository

Most countries resemble Australia in having *Canthocamptus*-like species in suitable freshwater and semi-terrestrial habitats. The taxonomy of these species has always been regarded as notoriously hard to unravel, firstly because many of them are very much alike in all save small details, and secondly because even conspicuous features, while often very helpful at the specific level, are by no means necessarily so at the generic or subgeneric levels. Even with the greatly enhanced visibility conferred by modern methods (phase-contrast, and Nomarski's interference-contrast, generally known simply as Nomarski), and the further advantage of being able to compare specimens from many parts of Australia and Tasmania side by side, I have found it extremely difficult to sort the species described here into the six groups in section 7; Gurney (1932, for the British Isles), Lang (1948, for taxa from all over the world), and Borutzky (1964, for the Soviet Union), are the only previous authors to make similar comparisons of specimens from over a comparably large area in each case, which they did without phase-contrast or Nomarski and also without including many characters that they could have seen even with the methods available to them (bright field, dark field, and oblique lighting), so that their keys, descriptions, and figures, while presumably adequate for their species within their respective areas, are almost useless in other areas, and only doubtfully of use, even for species that they do describe, if from an area other than their own. For example, by far the most reliable and most comprehensively illustrated of the above works is that by Gurney (1932), which is admirable for the British Isles and would be largely sufficient for the adjacent European lowlands so far as (say) the Pyrenees, the Alps, and the Urals, but nevertheless would not be safe to use beyond these limits because Gurney's descriptions and figures are not fully adequate to distinguish a species described by him from one that is not. Similar considerations would apply to the use of Borutzky (1964) to specimens from western Europe, China, Japan, or other countries near the Soviet Union.

The situation is similar, but far worse, when one tries to use the monographs of Gurney, Lang, or Borutzky to identify Australian species. These authors produced taxonomically incommensurable accounts in which each of them omitted different details, selected mostly different criteria for their subgenera (as listed later), and used different characters in their respective keys, so that one gets a different result with each of them when trying to identify any of the species described here. A few examples will make this clear:

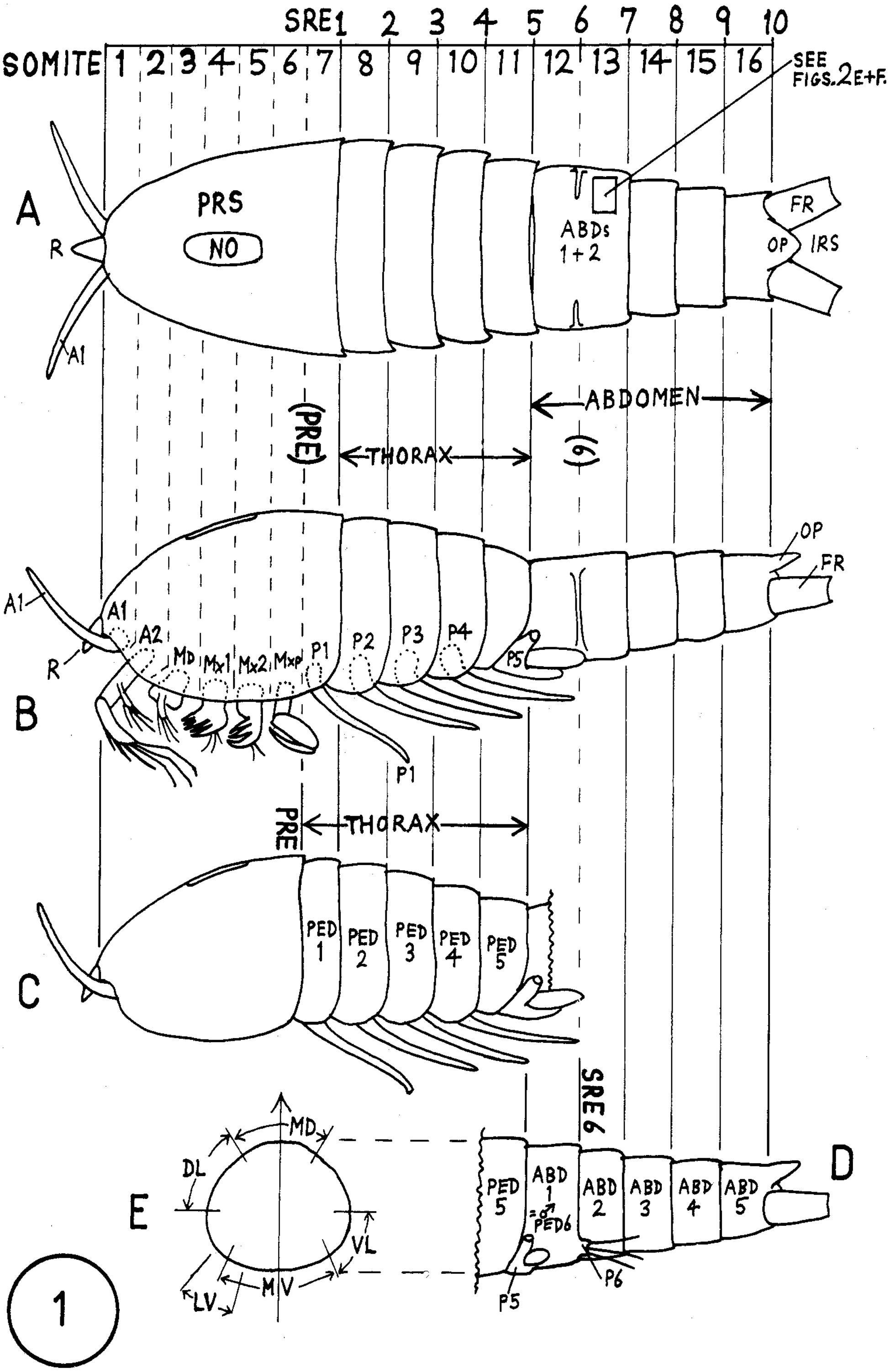
(1) *C. mortoni* and *C. henryae* give a different answer each time, as follows: (*a*) with Gurney's keys (1932, pp. 51, 52, 82 and 88) both species lead to *Attheyella wulmeri*, although *mortoni* could also lead to *A. crassa*; however, each of these two Australian species differs from each of the British ones in other ways; (*b*) Lang's generic key (1948, pp. 918–19) leads the females of both species to *Echinocamptus*; the males of both species would also lead to this genus, were it not for their respective P5 exopods each having only 3 setae, or to the very poorly described and figured *Spelaeocamptus* if one regards the P5 basiendopod in either species as sufficiently reduced. Harding (1958, p. 313) pointed out that Lang broke some of the most basic rules of nomenclature in defining *Echinocamptus* so as to exclude its own type-species *echinatus*; (*c*) Borutzky's keys (1964, pp. 122–3) lead *C. henryae* to *Attheyella*, in whose species-key (his p. 235) couplet 1 is ambiguous in that *C. henryae* has P1endopod1 only slightly shorter than the entire exopod, and thus too long to lead to *orientalis* but, at the same time, a little too short to lead to *stachanovi*, from both of which *henryae* is different in other ways. *C. mortoni* would also lead to the same conclusions unless one regards it as having P1endopod1 as long as the entire exopod (it is, in fact, only very slightly shorter), in which case it does not fit into either of Borutzky's two subgroups of *Brehmiella* because of having, on P5 basiendopod, 6 setae in the female and 2 in the male.

(2) My specimens of *C. australicus* and *C. hirsutus* lead as follows: (*a*) with Gurney's keys (1932, pp. 51, 52, and 82) they both lead without difficulty to *Attheyella*, in whose key to species (Gurney, p. 88) they would lead to *gracilis*; this is the only British *Attheyella* having (according to Gurney) perfectly smooth somitic rear edges,

but it differs from *australicus* and *hirsutus* in having only 2 outer spines on exopod 3 of P3–P4; (*b*) in Borutzky's keys (1964, pp. 122–4 and 235–6) they both lead without any difficulty to *Attheyella crassa*, whose somitic rear edges are shown as smooth by Sars (1911, plate CXXIX) and by Borutzky himself (1964, figs 79/15 and 79/16), whereas Borutzky's fig. 75, his text on p. 237, and Gurney's figs 745 and 746 all agree in showing them to be minutely denticulated; (*c*) both these species lead to couplet 14 of Lang's generic key (1948, p. 919), but in both of them the A2 exopod has 1 segment and the female P5 exopod has 5 setae, so that they are a mixture of *Bryocamptus* and *Echinocamptus*; above all, using this key, it is utterly impossible to get either of these species into *Attheyella*, in which Lang himself placed *australicus*! However, if one bypasses his generic key and starts straight off with his key to *Attheyella* spp. (Lang 1948, pp. 962–3 and 988–9), then both these species lead to *australicus* with no trouble at all.

To object that the Gondwanaland freshwater harpacticoids have evolved in isolation from those on other contemporary continents, and that therefore their present-day descendants ought not to be expected to fit into a taxonomy based largely on the present-day descendants of the forms on the other continents, is partly true but totally unhelpful. It is partly true because Lang (1948) incorporated all the then known Canthocamptidae, some of which (in New Zealand and southern South America as well as various subAntarctic islands) have as good a claim to a Gondwanan origin as any Australian species; and even then, as we have just seen, his key to genera could not give the right answer with regard to *C. australicus*, while he had no idea at all where to place *C. longiseta* (p. 1083) except to say that it was not a *Moraria*. It is totally unhelpful, because what is really wanted is a taxonomy that adequately covers all known forms, no matter where they come from, and one that is soundly enough based to accommodate subsequently discovered forms without too much alteration (i.e. it has a limited degree both of predictive value and of intrinsic flexibility).

The current situation is almost the exact opposite of this, and stems entirely from the custom whereby previous authors (chief among them Chappuis and Brehm) described and figured species from other countries no better than they did those from Australia (see section 2 above). By modern standards, work of this kind is of absolutely no use whatever, except to offer a few characters by which a given species *might* be recognized beyond reasonable doubt if found again exactly in (or, failing that, acceptably near to) the type locality. Above all, such work should never have been used (as it was) as a totally inadequate foundation upon which to erect piecemeal the most suspect taxonomic framework imaginable, embodying no less than 18 taxa [collated by Borutzky (1964), Gurney (1932) and above all, by Lang (1948)], namely *Arcticocamptus*, *Antrocamptus*, *Attheyella* s.str., *Baikalocamptus*, *Bryocamptus*, *Canthocamptus*, s.str., *Canthosella*, *Chappuisiella*, *Delachauxiella*, *Echinocamptus*, *Elaphoidella*, *Hypocamptus*, *Limocamptus*, *Mrazekiella* (nom. nov. for *Brehmiella*; see p. 51 of Wilson 1958), *Paracamptus*, *Pentacamptus*, *Rheocamptus*, and *Ryloviella*), all of which, together with the six groups in section 7, I would strongly recommend treating as subgenera of *Canthocamptus* s.lat. (the oldest available name) until all their respective type species, and as many others as possible from all over the world, can be studied again by modern standards with the methods used here, as part of a world revision. In this revision all taxonomic comparisons would be made as far as possible directly between specimens, not between a specimen and a drawing, let alone between two drawings unless there was really no alternative (and even then to draw even the simplest conclusions with extreme caution). Until this world revision has reached the point at which *Canthocamptus* s.lat. (as here) can once again be divided into subgenera, each of which can be objectively assessed against any of the others on the basis of a highly correlated set of characters of proven taxonomic reliability, it is essential not to re-erect any of the above 18 names on any pretext whatever, nor to create new names, nor to relate any such name (old or new) either to any of the six groups in section 7 or to any species (singular or plural) anywhere else. In other words, the world revision must be approached as a totality from a completely fresh beginning, directly from the specimens themselves; a piecemeal approach would be worse than useless, since what is done prematurely or insufficiently will only have to be undone and/or redone later, and


SRE 1 2 3 4 5 6 7 8 9 10
SOMITE 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
SEE FIGS. 2E+F.
A
R
A1
PRS
NO
ABDs 1+2
FR
OP
IRS
ABDOMEN
(PRE)
THORAX
(6)
B
A1
A1
A2
R
MD
Mx1
Mx2
Mxp
P1
P2
P3
P4
P5
P1
OP
FR
PRE
THORAX
C
PED 1
PED 2
PED 3
PED 4
PED 5
SRE 6
D
PED 5
ABD 1 =♂ PED6
ABD 2
ABD 3
ABD 4
ABD 5
P5
P6
E
MD
DL
VL
MV
LV
1

thus cause far more trouble than if it had never been done at all in the first place.

A serious obstacle to this world revision is the apparent dearth of types; from my own rather meagre information, it appears that Brehm (see section 2), Monard (p. 477 of Hamond 1973*a*) and probably many other early authors simply threw away their specimens after they had finished drawing and describing them, or at any rate failed to ensure their survival for posterity. Lang (1948, p. 905) was prevented by contemporary circumstances (probably World War II, although he does not say so) from examining Chappuis' 'fabulously rich' collection, in order to elicit all the details that Chappuis had failed to show or describe, and I do not know where any of it is now, although at least some of his *marine* material could not be found by Lang (1965, p. 6).

I regard the figures of Canu (1892) to be the finest of all figures of copepods to date and the best modern line drawings (of freshwater harpacticoids) to be by Bowman *et al.* (1968) and by Ito and Takashio (1980), and of marine ones by Lang (1965) and Wells (1980) as well as those in various papers by Bodin, Gamo, Geddes, Ito, Mielke, C. G. Moore, Scheibel and Soyer, to name only the best delineators among authors whose papers are listed by Bodin (1979). Subsequent students of freshwater copepods should emulate these authors as far as is technically possible. If they cannot produce drawings as good as theirs they should stay away from the formidably exacting demands of modern taxonomic practice.

4. Material and Methods

The specimens dealt with in this paper came from Tasmania, all over south-eastern Australia, and more rarely from elsewhere in Australia. After collection and preservation in dilute formalin (1 volume of full-strength formalin to 10 or 12 parts of water), the sorted and cleaned whole specimens (Hamond 1969 and unpublished data) were examined under bright field, and permanent mounts of dissections in gum-arabic-based media under phase-contrast (Zeiss–Oberkochen) or Nomarski (Olympus), for taxonomically helpful details; husks (those exoskeletons from which the living matter has more or less disappeared) can be examined in any of these ways.

When counting specimens, an expression such as 15, 0, 2, 2 (see p. 1054) means 15 adult females of which 0 bore eggs, 2 adult males, and 2 subadults. Most of the less-common species occurred in each of their samples in even fewer numbers, which seemed hardly worth enumerating (other than in Appendix 3) in an entirely taxonomic paper such as the present one.

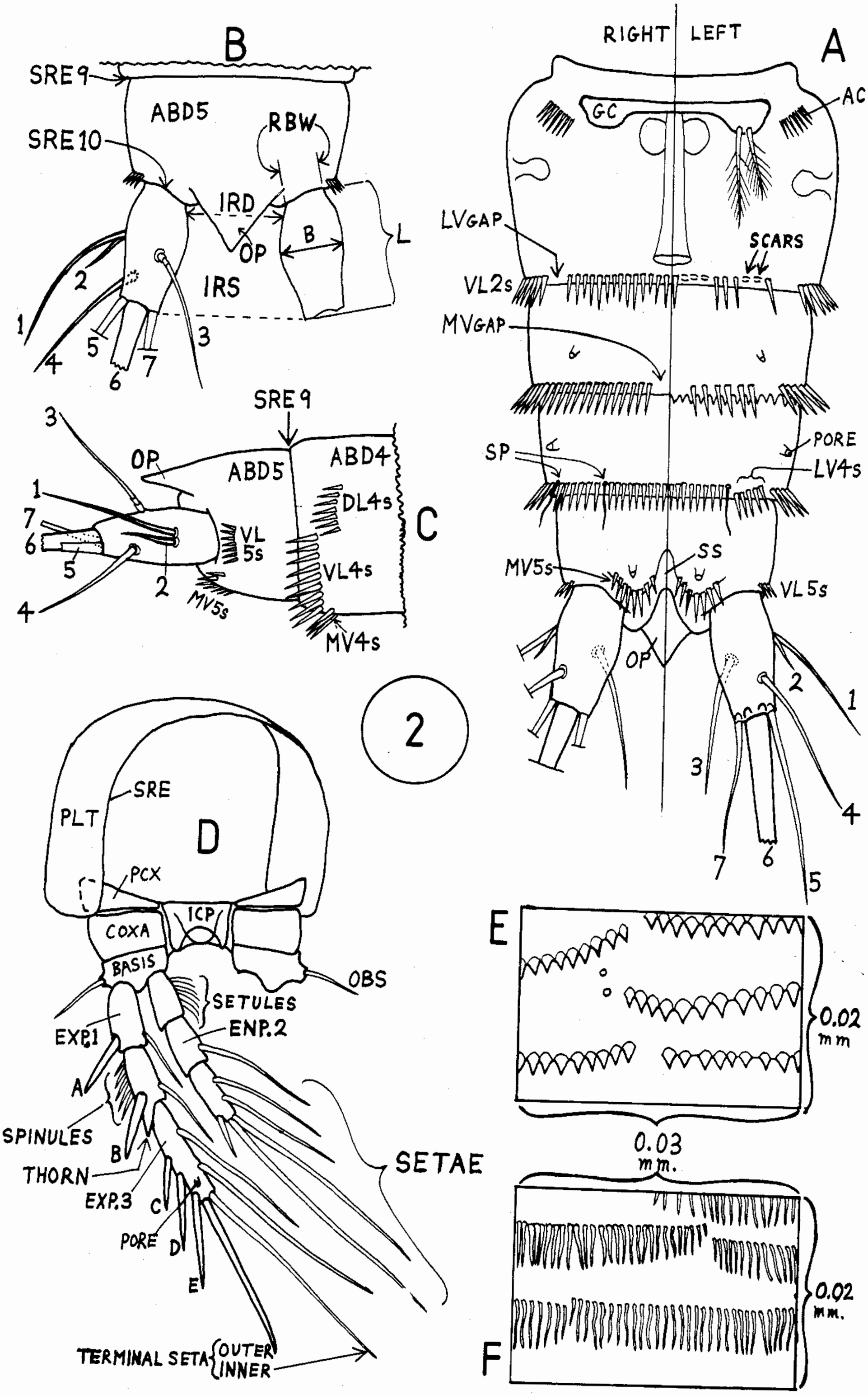
5. Morphological, Terms, and Abbreviations, Including a Glossary of Terms

The following survey is needed to introduce all the terms used below, many of which are new (Hamond 1969; Hamond, unpublished).

The harpacticoid body (Figs 1*A*, 1*B*) consists of a row of 16 *somites* [i.e. body divisions, as distinct from *segments* (segs) which are limb divisions; see below]; the term somite is used here for a body division of a fully adult animal (to which this paper is largely confined), without any developmental connotations. Each visible *somitic rear edge* is labelled SRE, and numbered as in Fig. 1. Subadult specimens cannot be identified to species with the aid of this account, but can be recognized by the imperfect development or total absence of SRE9 (if very young, of SRE8 and perhaps even SRE7 as well) together with the flabby ill-defined appearance of the limbs with more or less imperfect segmentation and setation. The *rostrum* (R) and the *furcal rami* (FRs; singular = *furcal ramus*, FR) lie respectively in front of, and behind, the series of somites.

The easiest kind of somite to explain is a thoracic one (Fig. 2*D*), consisting of a horseshoe-shaped *pleurotergite* (PLT) whose ends are linked to the *precoxae* (PCXs) of its pair of legs; in the midline of the ventral surface, the left and right PCXs and *coxae* (singular = *coxa*) are linked by the *intercoxal plate* (ICP). The thoracic somites are free, in other words connected only by thin flexible intersomitic membranes (not shown) which allow a somite to turn

Fig. 1. Diagrams to illustrate the divisions of the harpacticoid body, as explained in section 5. *A*, dorsal, and *B*, side, views of an entire female whose prosome has 7 somites; *C*, front half of a female whose prosome has 6 somites; *D*, rear half of a female; *E*, transverse section of an abdominal somite to show zones.


B
SRE9
ABD5
RBW
SRE10
IRD
OP
B
L
IRS
1
2
3
4
5
6
7
3
SRE9
OP
ABD5
ABD4
1
DL4s
7
6
VL 5s
C
5
VL4s
2
4
MV5s
MV4s
RIGHT
LEFT
A
AC
GC
LVGAP
SCARS
VL2s
MVGAP
SP
PORE
LV4s
SS
MV5s
VL 5s
OP
2
1
3
4
7
6
5
D
SRE
PLT
PCX
ICP
COXA
BASIS
OBS
SETULES
ENP.2
EXP.1
A
SPINULES
B
THORN
EXP.3
C
PORE
D
E
SETAE
TERMINAL SETA {OUTER INNER
E
0.02 mm
0.03 mm.
F
0.02 mm.

2

relative to its neighbour, or to telescope in and out of the preceding somite; the otherwise essentially similar prosomal somites cannot do either of these things because of being immovably fused together, their fused PLTs forming the *prosomal shield* (PRS, usually, as here, even if not quite accurately, called the prosome, a term which should also include everything under the shield except the limbs). The vertical lines linking Figs 1*A* to 1*D* indicate the relationships of somites to SREs and limbs in the following instances.

In three rare families (of which the Phyllognathopodidae and Darcythompsoniidae, but not the Chappuisiidae, have been found in Australia) the prosome consists of only 6 somites (Fig. 1*C*) and its rear edge is therefore the true *prosomal rear edge* (PRE), the hindmost prosomal limb being the maxillipede (Mxp), whereas ped1 (= the first *pediger* or foot-bearer) is free and constitutes the first thoracic somite, its rear edge being SRE1. In all other families including the Canthocamptidae, the prosome includes ped1 as well (i.e. it has 7 somites instead of 6, leaving the thorax with 4 instead of 5), so that the *apparent* prosomal rear edge is really SRE1 (Figs 1*A*, 1*B*); ped1 is only partly fused with the prosome in at least one species [*Leptocaris brevicornis* (van Douwe), see Gurney 1920]. All the foregoing alternatives fit nicely into the present scheme, the advantage of which is that the naming of peds 2–5 (also ped6, in the male alone) and of SREs 2–10 always remains the same.

This scheme also allows successfully for the sexual differences in the abdomen, which are quite independent of prosomal variations. In Fig. 1*D*, the male abdomen has all 5 somites clearly separated from one another by fully developed SREs, but in the famale (Figs 1*A*, 1*B*) SRE6 has more or less disappeared, being represented by a rib in the wall of the rigidly fused first and second abdominal somites (Abd1 + Abd2) which form the 'genital double-somite'. The male also differs in having P6 (in the vast majority of harpacticoids of all families, and in all in this paper save *C. grandidieri*) so that Abd1 can also be regarded as ped6, whereas the female's rearmost limb is P5. Between Figs 1*A* and 1*B*, the symbols PRE and 6 are put in brackets to indicate that they have more or less disappeared in these figures, whereas PRE is present in Fig. 1*C* and SRE6 in Fig. 1*D*. Likewise, the first few somitic boundaries are shown by dashed lines in Figs 1*A* and 1*B* to indicate that, while they themselves have disappeared, the only outward surviving trace of each somite is the pair of limbs that it once bore (A1 to P1 in Fig. 1*B*, or A1 to Mxp in Fig. 1*C*).

Non-somitic structures in the dorsal midline include the *rostrum* (R) at the extreme front end, the *nuchal organ* (NO) on the top of the prosome, and the *operculum* (op) at the rear extremity between the FRs. In all the species in this paper, the rostrum is much smaller than in Fig. 1*A*, is deflexed as in Fig. 1*B* so as to be difficult to see in dorsal view, is completely fused with the prosome and is of almost no taxonomic importance. The various forms of the nucnal organ are fairly important, and those of the op are of great importance, in the determination of species; in fact, Abd5 together with the op and both FRs, in other words the ensemble shown in Fig. 2*B*, is almost as important in this respect as the setal formula and other details of limb structure. In this figure, the area IRS bounded by a dashed line between the tips of the FRs is the *interramal space* (of interest chiefly in the extent to which the op overhangs it); the separation of the FRs at their bases is measured at the level of SRE10 (IRD = *interramal distance*), as is the *ramal basal width* RBW, whereas *B* is the maximum (not the basal) width of the ramus, related to the length *L* in the ratio *L* : *B*. Finally, both in the present group of species and in the family Harpacticidae (Hamond 1987 and unpublished data), every species has 7 FR setae arranged as in Figs 2*A*–2*C*, even though at times one or other of them (particularly seta 2) may be more or less masked by spinules or even lost due to injury; their respective lengths may be of specific importance, and the presence and kind of basal swelling on any FR seta is often of great importance.

Another group of important taxonomic features is shown by the abdominal spinulation (Figs 2*A*, 2*C*). In Fig. 2*A*, 'LEFT' and 'RIGHT' refer to the orientation of the abdomen shown, not of the observer; the ventral surface of the female Abd1 bears the genitalia, consisting of left and right *genital complexes* (GC) connected by chitinous bridgework (across the ventral

---

Fig. 2. Diagrams of the external anatomy of harpacticoids, as explained in section 5.

midline) from which the rest of the genital tract (too imperfectly understood to be of any taxonomic importance) extends backwards through Abd2 nearly to SRE7. Each GC bears 1 or 2 pinnate or smooth (according to species in each case) genital setae (shown only on the left GC) and abaxial to each GC is the *adgenital comb* of spinules (AC), alike in all species and hence of no taxonomic importance. The male has no such genitalia, but his solitary bottle-shaped spermatophore can often be seen lying inside the forepart of the abdomen (unless, of course, it has previously been fixed to the genital area of a female during coition).

The two sides of Fig. 2*A* have intentionally been drawn differently in order to demonstrate variations in spinulation. In transverse section (Fig. 1*E*) the abdomen may be divided into the following zones: mid-dorsal (MD), dorsolateral (DL), ventrolateral (VL), and midventral (MV), to which most groups of spinules, as well as the gaps between combs, conform fairly closely as in Fig. 2*C*. The lateroventral (LV) zone is a sort of optional extra zone, to be invoked only when necessary. A spinule-comb bears the letters of its zone followed by the number of its abdominal somite, so that the VL spinules on Abd4 (Fig. 2*C*) are referred to simply as VL4s. On average, the VLs are the most frequently present comb on any somite from Abd2 to Abd5, and usually have the longest spinules.

In Fig. 2*A*, the MV2s form a continuous comb right across their zone, with an LVgap at each end between the MV2s and VL2s. On the right, the MV2s are shown as a mixture of long and short spinules; on the left, the remaining spinules are more even in length, but some have fallen off to leave scars which are hardly visible with bright field, and only slightly more so with Nomarski optics, but are most clearly seen with positive phase-contrast, in all cases preferably under oil-immersion; they are helpful chiefly in determining the former extent of a comb in brittle material, as long as one remembers that the scar directly matches only the position and basal width of its spinule without giving a reliable estimate of the latter's length. Scars are highly magnified in Fig. 74*G*.

On the right of Abd3 the MV3s and VL3s are *confluent*, in other words they form a single comb whose zonal divisions are not (or hardly) worth trying to make out; on the left these combs have been drawn sparsely, and with a distinct LVgap between them, in order to show how the teeth of an SRE can continue around the body even though more or less hidden by the spinule-combs just ahead of it. The MV4s are likewise confluent with the VL4s on the right, but the sensillary pores SP act as zonal boundary markers, so that there is a possibly distinct zone or subzone (either VL or outer MV) between the main MVcomb and the LVs; on the left, the VLcomb is shown as *discrete* (i.e. distinctly separated from neighbouring combs), either by being out of line with them (as here, and also the VL4comb in Fig. 2*C*) or because of an intervening gap. The MV5s may or may not curve round onto the outer edges of the more or less triangular *subanal sinus* SS (see Hamond 1971, p. 3). The total spinulation pattern, including in some species combs or groups of spinules that may occur ahead of SRE5 (e.g. *C. hirsutus*), is often highly characteristic of one sex of a given species, but may show more or less strong sexual dimorphism.

The projecting integumental structures of the body and limbs fall into two main categories, namely those in which the structure is planted in a special hole in the integument and those in which it stands directly upon the integument without such a hole. In the first category, apart from sensilla [arising from plain pores in Figs 2*A* (labelled SP), 6*A*, 6*B* and 75*A*, and from tunnel-pores in Figs 67*A*, 67*B*, 71*B*, 73*B* and 127*F*)], there are *spines* and *setae* (= bristles), distributed on the legs basically as in Fig. 2*D*; as explained later, each limb consists of 2 rami, the outer ramus or *exopod* (exp) and the inner ramus or *endopod* (enp), each of which consists of 3 or fewer segments (those labelled in Fig. 2 are exp1, enp2, and exp3), that nearest the basis being segment 1 (seg1). The outer spines of the exopod are numbered A to E, so that instead of a cumbersome expression such as 'the middle outer spine of the third segment of the exopod of the fourth pair of legs' one simply writes P4D. On P2–P4, the 2 terminal setae give rise to a certain difficulty in that the inner one is clearly no more than a stout seta whereas the outer one is far more like a spine, so that the boundary between spines and setae is by no means clear on structural grounds; this is circumvented by regarding all spines and setae as setae in the first instance, of which some have become more or less transformed into spines (A to E, as above). The arrangement of setae and spines on these legs (and often on P1 and P5 as well) is expressed as a formula, to be discussed later.

The second category consists of setules and spinules (both in Fig. 2*D*), slender limp *microsetules*, slender stiff *microspinules*, short, triangular-pointed, separately inserted *microdenticles*, and very minute, sharp *microserrations* which arise from a more or less obvious basal strip (as do the teeth from the blade of a hacksaw). True setules and true spinules are much larger than any of the others, being clearly visible under a ×40 or even a ×16 objective, whereas the others (collectively known as micro-ornamentation, and positioned either singly or in *microcombs*) require a ×40 objective merely to detect their presence and higher powers to resolve them properly; however, this is at present only a rule-of-thumb distinction (pending study of a greater variety of species) and does not seem to be nearly as useful at the species level as some other characters. The combs of microsetules in Fig. 2*F* are from *C. australicus*, and the combs of large microdenticles in Fig. 2*E* from the type species of *Canthocamptus* (the European *C. staphylinus*, which has no micropores), in each case from the dorsal surface of Abd2 under Nomarski optics using a ×100 S-Plan objective. In all the species described here microdenticles, if present, are much smaller than in Fig. 2*E* and grade into microserrations according to the extent to which they are joined together at their bases like the teeth of a saw; they are accompanied by more or less scattered micropores (see below) which may or may not be hard to see (Figs 6*B*, 7*M*). Microspinules (MSP), microsetules (MST), true spinules (in this case VL4s), and their scars, are all shown on a very large scale for *C. grandidieri* in Fig. 74*G*; spinules occur near the SREs and are preceded by several rows of microsetules in Figs 81*B*, 81*C*, 82*B*, 82*D* and 82*E*, but are shown enlarged with microspinules and scattered hard-to-see micropores in Fig. 127*F*. Spinules and microspinules are stiff, broad-based, and pointed, whereas setules and microsetules are slender and limp. Both microspinules and microsetules may be found anywhere on somites (PLTs), usually as transverse or slightly sloping or sinuous combs; the combs of the latter are often much more numerous and closely packed than those of the former. On the prosome, microsetules may form a continuous pilosity (Figs 89*A*, 92*A*, and a patch in Fig. 102*A*) which neither microspinules nor microdenticles ever do, at least among the species described here.

Lastly with respect to the integument, we have a rather miscellaneous category of non-projecting structures, which can be divided into extensions of the integument itself [namely thorns, which can be either hollow, as in Fig. 2*D*, or almost solid, as in the prong of male *Canthocamptus* (see below) or the thorns on SRE10, arrowed in Figs 117*A*, 117*B*, and 117*D*, or the dorsal thorn on the FRs of *C. bidens* as in Figs 89*A*, 92*B* and 92*E*, or the Mx fang (see below) in all species], pleats (only in *C. australicus*, Figs 75*A*, 75*B*, 79*A*, 79*B*), and perforations. The latter can be divided into coarse *pits*, more or less confined to the prosome and especially to its frontal region between the rostrum and the nuchal organ (only in the *longiseta*-group, e.g. Figs 93*B*, 94*B*, 96*B*), *true pores* (either plain, labelled 'PORE' in Fig. 2*A*, or sensillary, as already mentioned; all those described here have plain pores, and most if not all have sensillary pores as well), and the very much smaller *micropores*, which are densely distributed and obvious even under medium powers all over the prosome (but less so on the body) of many species, or are much less dense (and usually less obvious as well, or even almost invisible) in certain others; yet others again seem to lack micropores entirely. They are shown as dense and obvious in a band across the prosome in Fig. 28*A*, and much sparser in Figs 7*M* and 127*F*; as already stated, only the less-dense micropores are ever accompanied by microcombs of any sort (most often of microdenticles). In this category also belong the teeth found on the SREs of many species, and the rearward mid-dorsal extensions of SRE9 (the pseudoperculum) and of SRE10 (the true operculum); only the latter is found in the species described here.

Turning now to the limbs, whose order of placement is shown in Figs 1*B* and 1*C* for the female (to which P6 must be added in the male alone, as in Fig. 1*D*), the kind of limb shown in Fig. 2*D* certainly exhibits all its parts in the most easily understood form, whether or not it is 'primitive' in any sense of that overworked term. This limb consists of 3 stem-segments, namely the precoxa (PCX), the coxa (CX), and the basis; from the distal edge of the basis arise 2 rami or branches, the outer ramus or *exopod* (exp) and the inner ramus or *endopod* (enp), each with at most 3 segments (segs) of which the nearest to the basis is counted as the first segment (exp1 or enp1) and the others as in Fig. 2*D*. Each segment of either ramus has a wall of integument which is more or less thick and rigid all over except where setae or spines emerge from their proper holes in it, or where the joint between it and the next segment is covered by the thin and flexible arthrodial membrane (not shown) which is usually shielded by a finely pectinate hyaline frill (Moore 1976, fig. 2; closest to his figs 2*B*, 2*E* and 2*F*) at the distal ends of exps 1 and 2, although not on any of the other joints. In order from the rostrum backwards, the limbs (Fig. 1*B*) are:

(1) The first antenna (A1), in the females in this paper, consists of 8 (rarely 7, see Fig. 94*B*) segments separated by more or less transverse joints. Seg4 (see Fig. 38*A*) is produced distally on its front surface into a short hollow projection, the *aesthetophore* (ASP), which partly overlaps the frontal aspect of seg5 and carries a long limp cylindrical filament, the *aesthetasc* (aes always shown dotted, and traditionally presumed to have a sensory function), together with 2 very long setae. On the tip of the terminal segment is found another, much smaller aesthetasc, also with 2 long setae; instead of saying that 'the first antenna has 8 segments, with an aesthetasc on the fourth segment and another on the eighth', one simply writes A1 = 8 (4, 8), as on p. 3 of Hamond (1971), the aesthetascs themselves being referred to as aes4 and aes8*. The female A1 is very similar in all the species in this paper, and is therefore of hardly any taxonomic value.

The rather vague distinctions given on p. 42 of Lang (1948) make it difficult to be certain whether the species in this paper are best regarded as having strongly haplocerate or variably subchirocerate male A1s. The total number of segments is unclear (probably 8 or 9), but the same two aesthetascs are present as in the female. In the present paper an important specific character is whether the last segment is set directly on the end of the preceding segment (the direct type, Fig. 5*D*), is attached subterminally to it (the offset type, Fig. 39*E*), or (rarely) occupies an intermediate position (Fig. 61*F*).

(2) The second antenna (A2) has, in all species in this paper, its basis and enp1 fused without trace into an allobasis (ABS in Fig. 42*A*; no other limb has an ABS), which usually bears 2 *abexopodal* (abexp) setae on its leading edge, as well as the exp on the outer slope of its rear (*exopodal* = exop) edge. The so-called enp (in fact enp2) has a total of 8 spines and setae, lettered A–H in Figs 42*A* and 42*B*, and all regarded here as setae of which some (usually A–D) have become more or less spiniform; the bases of A–H run in a more or less continuous (but not necessarily straight) line down the abexp side of enp2 and across its tip. All groups in this paper except the *longiseta* and *longipes* groups also have the seta B1 (Fig. 42*B*), and some harpacticoids (none here) have a second such seta, B2. The enp also has the wrap-around comb (WAC), so named from the way in which it curves around the enp tip; it may form a continuous single spinule-row, may be interrupted by a gap in an otherwise continuous row, or may be split into two half-WACs which are out of line with one another and may even slightly overlap. The type of WAC and the coarseness or fineness of its spinules furnish fairly good specific characters, and some species have only one abexp seta or none at all; otherwise A2 is broadly similar in all the present species. The allobasis also bears the proximal and distal spinule-groups (PG and DG in Fig. 60*B*); Fig. 60*C* shows a multiseriate PG, but otherwise both groups are uniseriate in all species in this paper (with rare, probably individual, exceptions).

(3) The mandible (Md, Fig. 41*S*) consists of a PCX, ending adaxially (= adorally) in a row of teeth, and bearing a palp consisting of a *coxa-basis* (CXB) and a single-segmented enp; the setal complements of the CXB and the enp each depend upon the species.

---

*Where the segmentation is variable, uncertain or unspecified, the terminal aesthetasc may be written aesT.

(4) The first maxilla (Mx1, Fig. 42*D*) also has a PCX (whose arthrite, PCXA, bears 2 alternating rows of slender teeth and either 1 or 2 rear-surface setae), a coxa and a basis each ending in a group of setae pointing adaxially, and a group of (usually) 4 or 5 *ramal setae* marking the sites of the exp and enp which have vanished in the course of evolution; however, I cannot always be certain as to which setae are ramal and which are not.

(5) The second maxilla (Mx2, Fig. 30*F*) has a syncoxa (SCX, = fused PCX + coxa) bearing 2 *endites*, one proximal (PE) and the other distal (DE), each with 3 setae; the proximal seta of the PE may be separate from the endite or be fused with it, and may show a useful species-character in being either straight and forked (Figs 86*G*, 90*G*), recurved like an extended thumb and ending in a sharp point (Fig. 30*F*), or a third type (*Fibulacamptus* spp.). The basis is prolonged adaxially into a massive and slightly hooked *fang* (flanked by setae, and slightly longer than the endites), and the enp may consist of a segment with 1–3 setae, or be even more reduced than this (affording good specific characters); the exp has vanished without trace.

(6) The maxillipede (Mxp) has a 'forearm' (= basis), ending in a 'wrist' with a single wrist-seta, and articulating with the 'hand' (= enp1) whose front face bears a lengthways comb of moderate-sized spinules and whose rear face (except in most *Fibulacamptus* spp.) bears a similar comb usually of finer spinules (or finer spinules arranged in patches, in Fig. 94*G* alone). The terminal claw consists of enp2 fused with a long, thick, incurved, sharp-pointed seta, flanked on its rear face by a *simple* (= unornamented, evenly tapering and flexible) seta.

(7) The legs are numbered P1–P5 in both sexes, with the addition of P6 in the male alone (P from the Latin *pes* = foot; these limbs are called legs or feet more or less interchangeably). All species in this paper have P1–P4 each with an exp of 3 segs; P1enp has only 2 segs in *Fibulacamptus* spp. and in *C. longipes*, but has 3 segs in all the other *Canthocamptus* spp. In most of these species the females have only 2 segs in the enps of P2–P4, of which enp1 is usually very short and enp2 a good deal longer. In the text and keys, instead of the customary, long drawn out and cumbersome expressions such as 'the second segment of the endopod of the third pair of legs', one simply writes P3enp2; and instead of 'in the endopod of the second pair of legs, the second segment is slightly more than twice as long as the first, but does not quite reach to the distal extremity of the second segment of the exopod', one writes 'P3, enp2 : enp1 = 9 : 4, and enp2 reaches to 0·8 of exp2'. Notice that the use of ratios and proportional measurements makes this statement not only more concise, but more precise, than it would have been otherwise.

The *L* : *B* (= the length to breadth ratio) of a segment or of anything else can be presented as a simple ratio, such as 7 : 4 or 2 : 3, care being taken that the segment is lying flat. If the midline length of a segment (e.g. P1enp3 in Fig. 45*D*), from 0·0 proximally to 1·0 distally, be taken as the basis for a scale of arbitrary units parallel to this midline but extending beyond it, then the inner seta arises at 0·9 and would extend (if pulled out straight so as to lie parallel to the scale) to about 1·9, which makes this seta about as long as the segment itself; in other words

$$\underset{\text{(to about 1·9)}}{\text{length of reach}} - \underset{\text{(at 0·9)}}{\text{insertion distance}} = \underset{\text{(about 1·0)}}{\text{true length}}$$

If necessary, this system can be extended to other segments, e.g. 'the inner seta of exp2 inserts at 0·7 (i.e. 0·7 of its *own* seg), and reaches to 0·9 of exp3'.

In all the species in this paper P2–P4 are basically as in Fig. 2*D*, and very similar among themselves; also in these species, P1 bears a far closer resemblance to P2–P4 than in many other harpacticoids of this and other families (see, for instance, Lang 1965).

To read the setal formula of the female of a given species (in this case, *C. australicus*), and having named the parts of Figs 77*B*–77*D* from Fig. 2*D*, it is seen that P1 (Fig. 77*B*) has no inner seta on exp1, but does have 1 on exp2, and exp3 has no inner seta but has a terminal group of 4, so that the formula for P1exp is written 0.1.0(4), putting full stops for the joints between the segments. Neither setules or spinules enter into the formula. In the same way, enp1 in Fig. 77*B* has an inner seta, as does enp2, and enp3 has a terminal group of 3, so that the complete formula for P1 (putting the exp before the enp, with a comma between the rami) reads 0.1.0(4), 1.1.0(3), and will be found in the P1 column at the top left of Table 1. Semicolons indicate the boundaries between consecutive legs, whose formulae are read in the same way except that, in P2–P4 of the species described here (and in most other harpacticoids), it is possible to specify which setae are respectively inner, terminal, or outer, in that order; thus, in Fig. 77*C*, the formula for exp3 by itself reads

Table 1. Setal formulae for females of *Canthacamptus* and *Fibulacamptus* species

Setal formulae (to be read as on pp. 1035–7) of the females of all species in this paper except *C. sublaevis*, whose formula would not fit into this table and is therefore given on p. 1090. In this table the horizontal lines indicate that each formula agrees exactly with the formula written out in full at the top, except where different numbers are substituted. From this, one can reconstruct the complete formula for any species lower down; thus, the reconstructed formula for P1 of any species of *Fibulacamptus* would be 0.1.0(4), 1.0(3). Alternative formulae for the same ramus (due to variation) are separated by a solidus

Species	P1	P2	P3	P4	P5
		Canthocamptus			
australicus *billwilliamsi* *hirsutus*	0.1.0(4),1.1.0(3);	0.1.123,1.221;	0.1.223,1.321;	0.1.223,1.221;	5 and 6
dumonti *howardorum* *longiseta*	, ;	, ;	, ;	, ;	4 and 6
mammillifurca	,1.120 ;	,1.110;	,1.221;	, ;	4 and 6
dedeckkeri *echinopyge* *fimbriatus* *globulisetosus* *henryae* *lacinulatus* *longifurca* *longipes* *timmsi*	, ;	,1.121;	, ;	, ;	4 and 6
mortoni	0.0.0(4), ;	,1.121;	, ;	, ;	4 and 6
tasmaniae	, ;	,1.021;	,1.221;	,1.221/0.220;	4 and 6
caecosetosus	, ;	,1.120;	, ;	, ;	4 and 6
clavifurcatus	, ;	,1.121;	0.1.123, ;	0.1.123, ;	4 and 6
bidens *grandidieri*	, ;	0.1.122, ;	0.1.122, ;	0.1.122,0.220;	5 and 4
		Fibulacamptus			
victorianus	,1.0(3) ;	,1.021;	,1.221;	0.1.222, ;	4 and 4
tasmanicus	,1.0(3) ;	,1.021;	, ;	0.1.222, ;	4 and 3
bisetosus	,1.0(3) ;	,1.021;	,1.121;	0.1.222,1.110/1.010;	4 and 2
gracilior	,1.0(3) ;	,0.121/0.121;	,1.221;	0.1.222, ;	6 and 4

1 (inner) 2 (terminal) 3 (outer, = exp spines C–E in Fig. 2*D*), and the formula for the whole exp of this leg (P2) is written 0.1.123 in Table 1. By convention, exp spines A and B, as well as OBS (on P1–P4) and the inner basal seta (on P1 only) are excluded from the formula because of being always present except through injury, abnormality, or as in couplet 8 of Lang's key to genera (1948, p. 151). No such formula has yet been devised for the limbs anterior to P1.

Table 2. Glossary of terms and abbreviations

A1	First antenna, the first prosomal limb (Fig. 1*B*)
A2	Second antenna, the second prosomal limb (Fig. 1*B*)
abd	The adjective abdominal, as in 'abd somite'
Abd (without a number)	The entire abdomen (Figs 1*A*, 1*B*)
Abd1–Abd5	The first to fifth abd somites (Fig. 1*D*)
Abaxial/adaxial	Further from/nearer to, the sagittal plane of the animal
Abexp	Abexopodal, i.e. away from the exopod
Adexp	Adexopodal, i.e. towards, facing, or nearest to, the exopod
Adgenital comb	AC in Fig. 2*A*, of no taxonomic importance because always present
Aesthetasc	The long slender bodies shown dotted in all figures of A1
Aesthetophore	The projecting tubular extension of A1seg4, from which the aesthetasc arises together with 2 long smooth setae
Arthrodial membrane	That covering the joint between adjacent segs on certain limbs, especially P1–P4
B	Maximum breadth of a structure, as in the *L* : *B* ratio (*q.v.*)
Benp	Basiendopod, i.e. the fused basis and enp of P5
Biramous limb	One (Fig. 2*D*) with 3 stem-segments, from the distalmost of which (the basis) extend the 2 rami, namely the exp and enp
Basis	The distalmost of the 3 stem-segments of a limb (BS in Fig. 2*D*)
Confluent	Running into one another, so that the boundary between them is not (or hardly) visible; applied mostly to adjacent spinule-combs
Coxa	The middle stem-segment of a biramous limb (Fig. 2*D*)
Coxabasis	A fused coxa and basis (CXB in Fig. 41*S*)
DG	Distal spinule-group of A2enp (Fig. 60*B*)
DL	Dorsolateral zone (Fig. 1*E*), whence DLs = dorsolateral spinules (dorsolaterals); DL4s = dorsolateral fours (i.e. the DLs of Abd4); DLcomb = dorsolateral spinule-comb
Endite	An adaxial projection of the maxilla; PE = proximal endite, and DE = distal endite, in Fig. 30*F*
Enp	Endopod, i.e. the adaxialmost of the 2 rami of a limb (Fig. 2*D*)
Enp-lobe	The lobe of the benp, representing the fused enp (Fig. 7*L*)
Epi-integumental	Sitting on the integument and adhering to it, but not inserted into a hole piercing it
Exop	Exopodal, i.e. pertaining or applying to the exopod
Exp	Exopod, i.e. the abaxialmost of the 2 rami of a limb (Fig. 2*D*)
Fang	The adaxial thorn on the basis of Mx2 (Fig. 30*F*)
Frons	The dorsal surface of PRS between R and NO (Fig. 1*A*)
FR	Furcal ramus (Fig. 1*A*; pl. FRs = furcal rami)
FRsetae	Furcal ramal setae, numbered 1–7 in Figs 2*B* and 2*C*
Gap	The gap in a spinule-row (e.g. MVgap in Fig. 2*A*) or between neighbouring spinule-rows (LVgap, between the MV2s and VL2s in Fig. 2*A*)
Genital complex	GC in Fig. 2*A*, in which the genital system consists of left and right GCs connected across the ventral midline of Abd1
Genital double-somite	The traditional collective term for Abds 1 and 2 when they are rigidly fused together (female only, as in Figs 1*A* and 1*B*); the line of fusion is shown by an internal rib in Figs 1*A* (as SRE6), 1*B*, and 2*A*
Grapnel-seta	The pincerlike outer terminal seta of P4exp3 in male *Fibulacamptus* spp. (= OTS in Figs 115*E* and 115*F*)

Table 2 (*continued*)

Half-WAC	See WAC
Haplocerate	The type of male A1 defined by Lang (1948, p. 42) as being only slightly modified, and with a variable number of segs distal to the swollen part, which is only slightly broader than the segments proximal to it
Hyaline frill	The transparent lamina, usually with a toothed edge, covering the arthrodial membrane on the adaxial sides of the joints at either end of exp2 of P2–P4
Intercoxal plate	ICP in Fig. 2*D*
Integument	The exoskeletal armour-plate of the body and limbs
Interramal distance	IRD in Fig. 2*B*, measured between the bases of the FRs
Interramal space	IRS in Fig. 2*B*, extending from the IRD to the dashed line connecting the inner distal corners of the FRs
$L:B$	Length-to-breadth, i.e. the ratio of the maximum length of a structure (L) to its maximum breadth (B), B being measured at right angles to L
LV	Lateroventral zone (Fig. 1*E*), whence LVs, LV4s, and LVcomb, as for DL (above)
MD	Mid-dorsal zone (Fig. 1*E*), whence MDs, MD4s, and MDcomb, as for DL (above)
Md	Mandible, the third prosomal limb in Fig. 1*B*
Micro-ornamentation	All the projecting epi-integumental structures that are too small to be classed as normal spinules or setules (see p. 1033)
Micropores	Tiny pores more or less densely scattered over the integument as in the prosomal band in Fig. 28*A*, almost always smaller than true pores and never bearing sensilla
MV	Mid-ventral zone (Fig. 1*E*), whence MVs, MV4s, and MVcomb, as for DL (above)
Mx1	The first maxilla, i.e. the fourth prosomal limb (Fig. 1*B*)
Mx2	The second maxilla, i.e. the fifth prosomal limb (Fig. 1*B*)
Mxp	Maxillipede, i.e. the sixth prosomal limb (Fig. 1*B*)
NO	Nuchal organ (Fig. 1*A*), an elongate area on top of the PRS
OBS	Outer basal seta (Fig. 2*D*)
Oligoarthran	Those harpacticoids after p. 170 of Lang (1948), in which A2exp never has more than 4 segs
op	Operculum, the mid-dorsal rearward extension of SRE10 (i.e. op in Fig. 1*A*)
PCX	Precoxa, the proximal stem-segment in a limb (Fig. 2*D*)
PCXA	Precoxal arthrite, the toothed structure fused to the adaxial side of the PCX of Mx1 (Fig. 42*D*)
ped1–ped5	The 5 thoracic pedigers (Fig. 1*C*) or, in most harpacticoids, the prosomal pediger and 4 thoracic pedigers (Fig. 1*B*), = somites 7–11 in either case (from Latin *pediger* = foot-bearer)
PG	Proximal spinule-group of A2enp (see DG, above)
PLT	Pleurotergite (Fig. 2*D*), the single arch of integument covering every side of a pediger save the ventral
PRE	The true prosomal rear edge (see SRE), as in Fig. 1*C*
Prong	The enormously elongated adaxial thorn on P3enp2 of male *Canthocamptus* spp. (Fig. 40*H*)
PRS	Prosomal shield, usually simply called the prosome (Fig. 1*A*)
Pseudoperculum	The mid-dorsal rearward extention of SRE9; not in any species in the present paper
R	The rostrum, a downward-pointing beak-like structure (Figs 1*A* and 1*B*) on the front end of the prosome
Ramal	Belonging, or relating, to a ramus
Ramus	Either of the two branches (exopod or endopod) of a limb (Fig. 2*D*)
RBW	Ramal basal width, measured as in Fig. 2*B*
Scar	The scar left when a spinule falls off (Fig. 2*A*)

Table 2 (*continued*)

SCX	Syncoxa (Fig. 30*F*), formed (only in Mx2) by the fusion of PCX and coxa
Segment	The fundamental division of a limb; in Fig. 2*D* the stem-segments are PCX, coxa, and BS, from which arise the 2 branches (rami), exp and enp each with at most 3 segments (segs)
Segmentation	The fact of having segments in the fully formed limb, and how many segs, etc.; here, not used in the embryological sense of forming segs during development
Sensillum (pl. sensilla)	The hairlike filament arising from a sensillary plain pore (SP in Fig. 2*A*) or sensillary tunnel-pore (STP in Fig. 127*F*)
Seta; also simple seta	Long flexible structure, formed by a single epidermal cell, and with its base securely planted in a hole in the segmental integument of a limb or the integument of the FRs. A seta is simple when it is perfectly flexible and free from any kind of modification or ornament
Setal formula (Table 1)	The almost unvarying pattern according to which the setae and spines are distributed on P1–P5 in females
Setiform	Having the form of a seta, whether a seta or a spine ought normally to occur in the position in question
Setophore	The tubular socket (resembling a bottle-neck) into which the OBS inserts; the only part of the P5benp that is abaxial to the exp (Fig. 7*L*)
Setule	A structure resembling a small seta in appearance, but epi-integumental, not formed by an epidermal cell, and not distributed according to a rigidly determined pattern (Fig. 2*D*)
Somite	One of the 16 fundamental divisions of the harpacticoid body (Fig. 1*A*). Here, the R is regarded as pre-somitic and the FRs as post-somitic
Spine	A rigid and usually thick-walled version of a seta, which it otherwise resembles. On a swimming-leg (as Fig. 2*D*) spines are normally found only on the abaxial edges of the exp segs (spines A–E), and setae on the adaxial edge of the exp and both edges of the enp; the 2 terminal setae of exp3 are, however, more or less intermediate
Spiniform	Having the form of a spine, irrespective of position (as in setiform, *q.v.*)
Spinule	A structure resembling a setule (*q.v.*), but stiffer and usually with a sharper point; it bears the same relation to a setule that a spine does to a seta (see Fig. 2*D*)
Split	A WAC (*q.v.*) is said to be split when its half-WACs are out of line with one another, or even overlapping (apart from the usual meanings of split when applied to other features)
SRE	Somitic rear edge, related to the somites as at the top of Fig. 1; only those somites which are actually or potentially free need an SRE number
Subchelate	That kind of clawed limb (in this paper, only the Mxp) in which the terminal claw folds right round so as to shut against the segment proximal to it, along the latter's adaxial surface
Subchirocerate	The range of types of male A1 defined by Lang (1948, p. 42) which vary at one extreme towards the haplocerate condition (*q.v.*) and at the other towards the fully chirocerate condition (not in this paper)
SS	Subanal sinus (Fig. 2*A*), a shallow more or less triangular depression, just ventral to the anus and usually edged by the adaxialmost MV5s
Thorax	All the body (less limbs) that lies ahead of SRE5 without being covered by the PRS; if the PRS covers 6 somites (Fig. 1*C*), the thorax comprises the next 5; but if the former covers 7 (Fig. 1*B*), the thorax comprises only the next 4, as in all species in this paper

Table 2 (*continued*)

Thorn	A hollow extension of a limb-segment with a sharp or blunt tip (Fig. 2*D*)
Tubepore	Projecting thin-walled tubes (TP in Fig. 22*B*; also pp. 1040–1) which may be mistaken for the broken-off basal parts of setae
Tunnel-pores	A kind of pore, usually sensillary, found mainly along SREs 1–5 (both dorsally and laterally) but less often elsewhere, in which the sensillary pore forms the external opening to a small tunnel (STP in Fig. 127*F*)
VL	Ventrolateral zone (Fig. 1*E*), whence VLs, VL4s, and VLcomb, as for DL (above)
WAC	Wrap-around comb (of spinules), running around the tip of A2enp (Fig. 42*B*)
Zone	Part of the circumference of a somite, in transverse section (Fig. 1*E*)

P3 is sexually dimorphic in all the genera considered here, in that the male enp2 has an extremely prolonged thorn (the *prong*, Fig. 40*H*) in *Canthocamptus* spp. and a different and less spectacular modification in *Fibulacamptus* spp.; the latter genus also has the *grapnel-seta* (see Table 2) on P4exp3. P2 and P4 are sexually dimorphic only in minor ways (which should, however, be carefully observed), and in some species their enp formulae may vary, giving a good reason for examining more than one male of each species, if available. Both dimorphism and variation conspire to make it far less practicable to give a setal formula for a male than for the conspecific females, and in any case the males are best identified by characters other than the setal formula.

In both sexes (where known), P5 is much smaller than, and very different from, any of the other feet, in being plate-like or leaf-like. The *basiendopod* (benp) consists of the fused basis and enp, the latter surviving only as the *endopodal lobe* (enp-lobe) which bears all the benp-setae that are included in the setal formula for P5 (numbered 1–6 in Fig. 7*K*, of female *C. henryae*, and from which Fig. 7*L* is traced in outline). The outer (abaxial) part of the basis is produced into a *setophore* bearing an OBS as in Fig. 2*D*, and in the *fimbriatus*-group alone there is also an *adexopodal* (adexp) *thorn* (Fig. 7*L*) which appears to be a large plain pore on the apex of a conical projection on the benp edge. The exp is a leaf-like flap hinged to the benp, and is also provided with setae (4 in Fig. 7*K*; by analogy with the swimming-legs as above, seta1 is the innermost on each ramus). The formula for Fig. 7*K* is thus 4 and 6, which once again never includes the OBS; when reading the formula, care must be taken over setae which are unusually small (Figs 86*K*, 86*L*, 88*G*), missing (check for empty socket-holes) or masked by spinules or dirt.

P5 is strongly sexually dimorphic in almost all harpacticoids, and in most of them (as in all in this paper, where known) it is distinctly larger in the female than in the male, especially with respect to the enp-lobe. In both sexes of *Canthocamptus*, and in the females alone of *Fibulacamptus*, the exp is clearly separated from the benp along a hinge-line, and the rami of P5 are thus said to be 'discrete' (=separate from one another, see Hamond, 1971, p. 3—not to be confused with 'discreet'!); however, in the males of *Fibulacamptus* the rami of P5 are fused.

SRE6 is fully developed in the male, but is at most hardly visible in the female, of every species in this paper; in the males of all of them except *C. grandidieri* it bears P6, which consists of a narrow plate (presumably equivalent to the fused rami) bearing a group of setae (2 in *F. gracilior*, Fig. 123*C*, but 3 in each of the other species in this paper).

Lastly with regard to the limbs, there are rare cases of ambiguous segmentation, in which the flexible thin-walled joint between adjacent segments is defined on one face of the limb but not on the other (Fig. 120*F*, and the description of A1 of *C. bidens*), or in which the thin integument is distributed in patches so that nobody can be quite certain how many segments are involved or where their respective boundaries are (Figs 30*D*, 38*D*, 55*B*, 55*C*). Another set of pitfalls in identification are misinterpretations of what I call *tube-pores* (on the surface in Figs 120*F*, 120*H*, 120*K*, and on the front surface next to the adaxial edge of enp2 in Fig. 114*G*), which may sometimes be mistaken for the broken-off bases of setae, but are always far more delicately transparent, and with much thinner walls in proportion to their outer diameter.

A glossary of terms and abbreviations used in this paper is given in Table 2.

6. Diagnosis of *Canthocamptus* s.lat.

This generic diagnosis of *Canthocamptus* s.lat. has been framed with special reference to the species assigned to it in this paper, without regard to the 18 dubious taxa mentioned in section 3 (p. 1027). Lack of essential information (see section 3) makes it impossible to give a more satisfactory definition of *Canthocamptus* at present, either in the wide or the narrow sense, or to construct a key to all known genera of the Canthocamptidae; however, in a later paper I hope to give keys to all the Australian canthocamptid (and other non-marine) genera.

Body of conventional harpacticoid form, in other words moderately but not excessively elongate, and without being markedly depressed, compressed, or expanded, either as a whole or in part. SREs 1–9 are toothed in some species, but the somites themselves are not produced into excrescences of any kind; SRE10 smooth (except in *F. tasmanicus*, q.v.). The prosome (incorporating ped1) is slightly wider than the rest of the body, which appears to taper away from it towards the furca. Rostrum small, bluntly pointed, and triangular, not basally demarcated from the prosome. Nuchal organ present on top of the prosome in all species here (although it may be hard to see in *C. longiseta*). Pedigers and abdominal somites grading more or less evenly into their respective neighbours, intersomitic boundaries distinct (but not conspicuous unless the SREs are toothed), all somites with fairly thin walls, thoracic pleura never markedly expanded and abdominal pleura not discernible at all as such. Integument with scattered true pores (which may or may not be sensillary), apart from which some species have micropores or coarse prosomal pitting; integument also with microcombs of microsetules, microspinules, or microdenticles (the latter sometimes grading into microserrations).

True spinules never on Abd1 except in the *australicus*-group (see section 7, pp. 1043–4), and never run completely across the dorsal surface of any somite; only in *C. hirsutus* (Figs 67*A*, 71*B*) are spinules found forward of Abd1 (on the adoral edge of the prosome, and on the flanks of ped5). Pseudoperculum absent; operculum well defined and highly specific in shape and ornamentation, but with a completely smooth edge only in abnormal *C. timmsi* (which, however, has a row of fine spinules just under the edge, Fig. 44*D*), *C. mammillifurca*, and *C. sublaevis*. FR in most species basically conical or cylindrical from any point of view, but in several species with thorns, humps, or other excrescences; FRs parallel or slightly divergent (less often convergent), IRD never more than thrice or less than half the RBW, FR $L:B$ never more than about 4 : 1 and usually much less.

A1 constantly 8(4,8) except in *C. longiseta*, *C. dumonti*, and *C. bidens*. A2exp of a single moderate-sized seg with 4 setae (Fig. 90*B* is abnormal in having only 3). Allobasis about as long as the enp; abexp side of the allobasis usually with 2 setae (of which the proximal is more or less masked by long spinules in *C. billwilliamsi*), but with only 1 such seta in a few species, and in the *bidens*-group with none at all but with a clump of spinules instead. Enp-setae A–H present (but not J, although this occurs in the Harpacticidae; Hamond, unpublished), B1 present except in the *longipes*- and *longiseta*-groups, A–D spiniform with (in most species) hooked tips, E–H setiform, E–G long and kinked (but G usually less so than E or F), the very small and simple H usually fused to the very base of G.

PCX of Md with strongly developed teeth; CXB with or without an apical seta, totally without exp but with an enp of 1 seg bearing 3, 4 or 5 setae according to species.

Mx1 rami represented solely by some setae, PCXA with 2 rear-surface setae in *C. longiseta* but with 1 such seta in all the other species, mx1 otherwise very much as in most oligoarthran harpacticoids (closest to *h* rather than *a* to *g* in Abb. 24 of Lang 1948, p. 56).

Mx2 with 2 endites each bearing 3 setae; the proximal seta of the promimal endite is sometimes free, sometimes fused to its endite as if it were a thorn, and with its apex resembling a recurved thumb, a tiny 2-pronged fork, or (rarely) something in between. Of the 3 setae on an endite, that lying furthest from the microscope objective is often more or less concealed by the other 2, making it necessary to draw the Mx2 from both sides (quite apart from whether it has significantly different ornamentation on its 2 faces). Enp of 1 seg with at most 3 simple setae, or more reduced than this, borne slightly on the rear face of the basis (in other words, not quite distally).

Mxp distinctly subchelate, the hand basically a long oval (broadest at about 0·3 or 0·4, or else more parallel-sided), with both of its edges, as well as the row of spinules on each face (the row replaced by spinule-patches on the rear face, in *C. longiseta*), all roughly parallel to the long axis of the hand, although the spinules themselves lie at from 70–90° to their row while projecting at most only slightly from the surface on which they stand. Forearm never very long, and bears only 1 wrist-seta. No heel or other feature delimiting the palm from the prepalmar edge, and no palmar setae, flange, or callus (as in Harpacticidae; Hamond, unpublished). Claw slender, from 0·5 to 1·1 the length of the hand and slightly curved here or there according to the species, the tip usually hooked inwards (towards the hand) more than the rest of the claw, from whose base arises a single simple seta on the rear face but none on the front face.

P1–P4 all of roughly the same length. P1 with each ramus of 3 segs (except in *C. mammillifurca*, Fig. 104*A*); neither ramus is definitely prehensile, although their respective terminal claws and setae tend to be slightly hooked abaxially. P1exp segs all of about the same length, and basically alike in being mostly a little longer than wide; exp1 and exp3 never have an inner seta, but exp2 does so in every species save *C. mortoni* (Fig. 35*A*), and exp3 has a group of 4 setae, the longest innermost and the shortest outermost, of which the 2 adaxial (innermost) are terminal and setiform and the 2 outer are spiniform. P1enp as least as long as exp, enp1 as long as, or longer than, either enp2 or enp3; enp1 and enp2 each have an inner seta, and enp3 has 3 terminal setae of which the innermost is setiform and either smooth or with pinnules, and short; the middle seta is kinked and much the longest, resembling the innermost on exp3; and the outer seta is in most species by far the thickest of the 3, spiniform, and is straight or slightly curved except for a very small outwardly hooked tip and a row of closely set micropectinations all along the distal two-thirds or so of its outer edge. In several species the innermost terminal seta of enp3 appears to be in reality an inner seta, being set at about 0·9 of the inner edge, but there does not seem to be any sharp dividing line between this condition and the terminal one.

P2–P4 each with an exp of 3 segs and (except in *C. sublaevis*, Figs 111*J*, 111*K*) an enp of 2 segs. OBS (as in many other harpacticoids of various families) spiniform on P2 but setiform on P3 and P4. Coxa and basis not excessively prolonged in any particular direction. The *L* : *B* of any exp seg may be 9 : 2 (as in *C. grandidieri*), but is usually much less; the outer distal corners of exp1 and/or exp2 (i.e. just distal to exp-spines A and B) may be prolonged into a thorn in some species, as may the integument just above (proximal to) either of these spines, depending upon the species. Most species have the outer spines reasonably alike on all 3 pairs of legs, except that spines A–C are about the same length, D somewhat longer, and E longer still; however, *C. grandidieri* (and, to a much lesser extent, *C. bidens* and *C. longipes*) are anomalous in that spines D and E (C being missing except in *longipes*) are much smaller on P4 than on P3 or P2, and are also much smaller than A and B on their own leg (P4). The setal formula varies with the species (Table 1), but P2exp3 always has one inner seta. Enps of P2–P4 much shorter than exps, enp1 (excluding *sublaevis*, see above) only about as wide as long and only from 0·2 to 0·5 of the length of enp2.

P5 with discrete rami, the form and setation of each ramus varying with (and, to a lesser extent, within) the group.

The foregoing applies to both sexes, apart from which:

Female. Abds 1 and 2 are completely fused to form the genital double-somite, no trace of SRE6 remaining either externally (except in the *longiseta*-group), or internally except as a vertical rib in almost all species. MV2s, if present, always with an MVgap (narrowest in Fig. 3*C*). A1 about half as long as the prosome and with 8 (rarely 7) segs, none of which are unusually long and some of which (in certain species) may be quite short; all segs are smooth-walled and basically cylindrical, without thorns or other excrescences. All setae are simple, with very few exceptions which may bear pinnules; aes4 and aesT are as usual.

Male. Usually a bit smaller than the female, and with all the abd somites clearly separate from one another; MVs confluent with VLs on Abds 2, 3 and 4, right across the ventral surface, except that Abd4 has an MVgap in the *howardorum*-group. Op as in female or slightly different. A1 with rather indistinct segmentation, haplocerate or weakly subchirocerate. P3enp2 has a prong, shortest in Figs 87*D* and 87*E* but usually much longer than this, tapering away to a fine 2-barbed point (3-barbed in *fimbriatus*) rather like a harpoon. In some species, certain spines or setae on the swimming legs may be more or less modified. P5exp smaller than in the female, with as many setae, or fewer; enp-lobe very reduced and always with fewer setae than in the female, benps united across the midline to form a transventral plate. P6 also forms such a plate in each species (save *grandidieri*, which totally lacks a P6), bearing on either side a group of 3 (rarely 2) setae.

7. Suggested Grouping of Australian *Canthocamptus* spp.

(1) *The* fimbriatus-*group*

Micropores all over the body, always dense and obvious on the prosome (as in Fig. 28*A*), equally dense and obvious over the rest of the body in some species, but tending to become either less dense per unit area, or less conspicuous, or both (the minimum density being about as in Fig. 7*M*) in the remaining species. The abdomen may have some microdenticles (always, when present, in transverse microcombs as in Fig. 7*M*) and/or microsetules which are few and scattered (except in *C. echinopyge*, in which they are dense and arranged in microcombs, Fig. 20*A*). SREs always toothed, the coarsest teeth as in Figs 49, 51, 53 and 56, whereas even the finest (about as in Figs 37*A* and 37*B*) are never as small as in Figs 74*F* or 74*G*. Abd1 never has spinules. Op triangular (usually with a fringe of fine denticles, spinules, or setules) except in Figs 44 and 57. A2 always has seta B1, allobasis with the usual 2 abexp setae. Md has a seta either on the CXB or on the inner edge of the enp (placement frequently uncertain due to ambiguous segmentation). P1 has enp1 distinctly longer than either enp2 or enp3, and as long as the entire exp in Fig. 4*C* but otherwise only from 0·72 (Fig. 45*D*) to 0·87 (Fig. 47*F*) of the enp.

Female. P5 always 4 and 6 and of a characteristic shape, benp with an adexp thorn (Fig. 7*L*).

Male. A1 of the direct type in *fimbriatus* and *echinopyge*, somewhat less than truly direct in *mortoni* and *tasmaniae*, and of the offset type in all the others. P3 does not have an inner seta on either enp1 or enp2. P4exp3 does not have any of its setae modified. P5 formula 3 and 2, the potential taxonomic value of the shape of the exp being curtailed by the small numbers of males of each species that I have seen. P6 consists of 2 setae.

In all, 13 species, namely *fimbriatus*, *henryae*, *lacinulatus*, *echinopyge*, *longifurca*, *globulisetosus*, *mortoni*, *timmsi*, *dedeckkeri*, *clavifurcatus*, *caecosetosus*, species 1 and *tasmaniae*.

(2) *The* longipes-*group*

Micropores dense and obvious on prosome but hardly perceptible on the abdomen, which is covered with microcombs of microsetules (as in *bidens* or *billwilliamsi*). SREs all with teeth of an extreme regularity and evenness (far more so than in any other group). Op a smooth curve, with fewer teeth than in groups 3 or 4 but otherwise similar. A2 does not have B1, allobasis with the usual 2 setae. MdCXB has the single seta on its rear face rather than on its adaxial edge. P1,enp1 far longer in proportion to the exp than in any other group.

Female. P5 also 4 and 6, but of a unique shape, quite unlike those in group 1 and without an adexp thorn.

Male. Incompletely described.

One species, namely *longipes*.

(3) *The* australicus-*group*

Micropores usually almost impossible to see except under high-power Nomarski optics on an isolated abdomen in a gum-arabic medium; they are fairly dense all over the body in *hirsutus* (which has no microsetules) but are absent from or, at most, extremely few in both the other species, each of which is covered with transverse microcombs of slender limp microsetules. SREs smooth, pleated in nearly all *australicus* (q.v.), but not in either of the other species. Op an even curve, fringed with numerous close-set spinules. A2enp has B1, allobasis with both abexp setae. MdCXB has an apical seta, P1 has all 3 enp-segs about equally long.

Female. DL1s present only in *billwilliamsi*; P5 always 5 and 6 and without an adexp thorn.

Male. All three species have DL1s. A1 of the direct type; P3enps 1 and 2 have no inner seta; and P4exp3 outer terminal seta has a few large barbs in *hirsutus* [Figs 70*F* (arrowed), 74*C*] and *australicus* (Fig. 80*C*), but not in *billwilliamsi*. P5 5 and 2; P6 has 3 setae, of which seta3 is much shorter than seta2.

Three species, namely *australicus*, *hirsutus*, and *billwilliamsi* (see also Appendix 4).

(4) *The* bidens-*group*

Agrees with group 3 (except *hirsutus*) in having combs of microsetules but no micropores, and in the op being a smooth curve set with stiff teeth or spinules placed more or less edge to edge; but, whereas *grandidieri* has only minutely crenulated SREs, *bidens* has them moderately strongly toothed. In this group alone, Abd5 has few or no spinules, and the few that are present are never organized into a comb or combs. A2enp has B1, but allobasis (in this group alone) has a group of spinules opposite the exp and completely lacks the usual 2 setae. MdCXB has an apical seta. P1 as in group 3.

Female. P5 formula 5 and 4 (unique to this group, as is its shape), no abexp thorn. P2–P4, exp3 has only 2 outer spines, instead of 3 as in all the other groups.

Male (grandidieri *only*). A1 of the direct type; P3enps 1 and 2 have no inner setae; and P4exp3 has all setae much as in the female. Alone of all species in this paper, *grandidieri* lacks a P6; unlike group 3, its P5 has 4 and 0 setae.

Two species, namely *bidens* and *grandidieri*.

(5) *The* longiseta-*group*

Prosome in dorsal view with broad and vaguely defined valleys running backwards as they proceed dorsally, like the carapace folds of certain cumaceans. The frons (between R and the nuchal organ, from the axial plane to the first valleys) is coarsely pitted in all three species, and is bare of microsetules (except in its rear quarter, where they are densely distributed in *mammillifurca*); the rest of the prosome is covered in all species with microsetules, in transverse rows near SRE1 but irregularly and fairly dense everywhere else. The extent to which the coarse pitting extends beyond the frons varies with the species; however, coarse pitting and prosomal furrowing are both unique to this group in this paper. No micropores anywhere. SREs 1–9 with very strong, thick-walled, spiky-looking and often jagged teeth, not closely rivalled by any other species save *caecosetosus* and *clavifurcatus*. VLs confluent with MVs, and possibly with a few DLs, to form a continuous girdle of not very closely-set spinules (all of much the same size and shape, except in Fig. 98*E*) on Abds 3 and 4. Op a smooth unornamented curve in *mammillifurca* but a triangle edged with fine spinules in both the other species. A2 never has B1, WAC split, each half-WAC transverse so that the half-WACs do not overlap; allobasis with both abexp setae present. MdCXB lacks an apical seta. P1enp1 long (but shorter than in *longipes*, group 2), narrow and parallel-sided in all three species.

Female. SRE6 clearly defined, thickened all round the dorsum and flanks, and with moderate to large teeth which extend almost all along the thickened portion in *mammillifurca* but are confined to the DLzone in each of the other species. Abd2, and everywhere ahead of it, without spinules. P5 4 and 6, benp-edge concave just where the adexp thorn is found in group 1; enp-lobe short, with each of its 6 setae bipinnate with a filamentous tip, the pinnules proximally long and limp but distally shorter, stiffer, and more closely set. P5exp long, with a straight or slightly sinuous outer edge, and with tufts or short rows of long slender spinules curving from the front face onto the outer edge. Exp-setae 1 and 2 terminal, 3 and 4 on the outer edge; 1, 3, and 4 long, strongly built, and more or less bipinnate, whereas seta2 is shorter and differently (if at all) ornamented.

Male. Abd2 with a confluent hoop of MVs and VLs which, unlike the hoops on Abds 3 and 4, does not appear to reach into the DLzone. A1 always of the direct type, P3enps 1 (except in *mammillifurca*) and 2 always have a short slender inner seta each, and all the setae on P4exp3 are normal. P5 4 and 2, enp-lobe small but abruptly projecting, exp like that of the female but smaller and with setae 3 and 4 shorter in proportion to the exp itself. P6 always with 2 setae.

However, one of the most eye-catching characters of the *longiseta*-group, the strongly toothed condition of SREs 1–9, is shared (even if not to quite the same extent) by two members of the *fimbriatus*-group, namely *caecosetosus* and *clavifurcatus*. *Longiseta*-group characters not found in these two species are as follows (characters 1–4 refer to both sexes, 5–9 to females only, 10–12 to males only):

(1) The prosome has coarse pits, mainly but not always exclusively all over the frons (between the rostrum and the nuchal organ), but lacks micropores; on the other hand, *caecosetosus* and *clavifurcatus* are densely covered with obvious micropores, among which shallow dents (not coarse pores) are more or less numerous and not confined to the frontal area. These dents (Fig. 49*A*) look as if they had been made by gently tapping with a ballpeen hammer.

(2) Especially in dorsal view, the prosome has 2 or 3 shallow valley-like depressions sloping obliquely backwards and dorsalwards, rather like the carapace-folds in certain cumaceans; *caecosetosus* and *clavifurcatus* have no such folds, although they may have slight DL humps behind the nuchal organ (as in Fig. 53*B*).

(3) The abdominal spinules are not particularly long, extend only a little way up the flank of each somite, and never comprise the distinctly separate and sharply curved DLcomb which is found in *caecosetosus* (Fig. 53*B*) and *clavifurcatus* (Fig. 49*B*).

(4) P1enp1 is parallel-sided, narrow, and longer than in any other species in this paper save *longipes* (Fig. 64*F*); in *caecosetosus* (Fig. 55*D*) and *clavifurcatus* (Fig. 50*G*) it is distinctly shorter and less parallel-sided.

(5) SRE6 is well defined and has at least some teeth, whereas in *caecosetosus* and *clavifurcatus* it has disappeared.

(6) At least 1 of the genital setae is very long, which is not the case in either *clavifurcatus* or *caecosetosus*.

(7) Each of the species discussed here* has its own distinctively shaped FR, mainly in side view but to some extent also in dorsal or ventral view.

(8) For their respective setal formulae, see Table 1.

(9) P5 lacks an adexp thorn, which is clearly visible in Figs 54*K* (*caecosetosus*) and 50*J* (*clavifurcatus*), just as in all members of the *fimbriatus*-group.

(10) A1 is of the direct type, whereas in *caecosetosus* and *clavifurcatus* it is offset.

(11) P3 in the *longiseta*-group has a small rear-surface inner seta on enp2, and (except in *mammillifurca*) on enp1 as well; otherwise, *howardorum* has a small seta in each of these positions, and none of the other species in this paper has a seta on either enp1 or enp2.

(12) P5exp is long and narrow, with 4 setae of which 2 are terminal and 2 outer; in *caecosetosus* and *clavifurcatus* it is short and broad, with 3 setae, all more or less terminal.

Characters 6, 8, and 11 are hardly ever (if at all), and characters 4, 9, and 12 not always, visible without dissection, whereas the others should be reasonably easy to see except in damaged, abnormal, or immature specimens.

---

*This refers not only to the *longiseta*-group but to *caecosetosus* and *davifurcatus* as well.

Apart from the *longiseta*-group, *howardorum* and *grandidieri* each have 4 exp-setae on the male P5, but the former has 2 and the latter no benp-setae, their respective enp-lobes and exps are each quite differently shaped, and (like all the other species in this paper) their setae are all distinctly slimmer. *C. australicus* also has a fairly long exp, but this has convex sides and exp-seta1 is on the inner edge; *hirsutus* has a short and rounded exp; *billwilliamsi* has one of intermediate form; and these last-named three all share a male P5 formula of 5 and 2. All other species in this paper, whose males are known, have a P5 with a short and rounded exp (approached only by *hirsutus* among the species just mentioned) bearing only 3 setae, giving 3 and 2 as the formula; the males of *bidens*, *longipes*, and *sublaevis* are unknown.

This is a good illustration of one of the main difficulties besetting the study of *Canthocamptus* s.lat., which is, that, merely because a given state of a particular character (in this case, the form and setation of the male P5exp) correlates well enough with other characters to be included in the ensemble of characters which defines a group of species (in this case, the *longiseta*-group), it does **not** mean that any alternative state of the same character will correlate well enough with other characters in another group, to be eligible for inclusion in the definition of that group, which might for its part be founded on an ensemble of characters which are of very low correlative importance in the first group. Admittedly, the many species whose male P5 has a formula of 3 and 2 are exactly those which appear to be most alike on the basis of female setal formulae (*dedeckkeri* to *clavifurcatus* in Table 1), confirming my view that, in this table, *dedeckkeri* to *timmsi* form a close-knit inner cluster to which the other members of the *fimbriatus*-group (*mortoni*, *tasmaniae*, *caecosetosus*, and *clavifurcatus*) are rather more distantly related, because each of them has at least one clearly marked character which sets it apart from the inner cluster.

Three species, namely *longiseta*, *dumonti* and *mammillifurca*.

(6) *The* howardorum-*group*

Body broadest at about the level of SRE1, from which the prosome tapers forward and the thorax backwards; Abd more or less cylindrical, tapering backwards (if at all). Nuchal organ elongate shoe-shaped, its front corners rounded or angulate. SREs totally smooth. Micropores very numerous but not densely crowded, and even harder to see than in group 3, so that the integument appears completely without them unless examined very carefully in a gum-arabic-based medium under high-power phase-contrast or Nomarski. No microsetules, but a few transverse microcombs of microspinules or of microserrations whose points may be often worn away so as to leave the back of the microcomb standing proud of the integument like a minute transverse ridge; further abrasion leaves a row of closely spaced tiny holes, resembling micropores but varying greatly in size. Spinulation only on Abds 2–5, VLs and DLs confluent on Abds 2–4, DL combs never curve forward. FRs slightly divergent, IRD at least equal to RBW, FR $L:B$ in dorsal or ventral view from 5 : 4 to 2 : 1, with almost straight thick-walled sides, conically tapering to a distal end that seems oblique in dorsal or ventral view because seta5 is mounted on the tip of a protuberance; the dorsal hump crowned apically by seta3 is low and not at all obvious in side view, but in dorsal view has its adaxial slope much steeper than its abaxial one. Op forms either a smooth curve with a few large spinules planted in its edge (Fig. 106*D*), or a thin straight edge without any ornament at all (Fig. 110*E*).

A2allobasis with 1 (*sublaevis*) or 2 (*howardorum*) abexp setae; enp-setae unusual in that C is slightly shorter than B, B1 present, WAC split into 2 widely separated half-WACs, each of which is a distinctly oblique comb of fine spinules. MdCXB lacks an apical seta (a feature shared only by group 5) and has an extremely oblique (almost lengthways) spinule-comb; enp has 1 inner seta, and a small spinule-comb close to the bases of the 4 terminal setae, the most abaxial of which is a little out of line with the others. Mx1, PCXA has only 1 rear-surface seta, and the ramal setae appear to consist of 1 exop and 3 endop setae. Mx2 proximal endite, proximal seta of the recurved-thumb type; enp of a clearly defined seg with 3 setae, of which the front seta is much shorter than either of the 2 rear ones. Mxps as in other groups.

P1, inner basal seta stoutly spiniform and without a terminal filament (characters shared only with the *longiseta*-group) although it may have a subterminal one; in all other groups, this seta is setiform and has a moderately long terminal filament. Enp1 reaches to about the end of exp2 and is about as long as enps 2 and 3 combined.

P2–P4 each with a very small blunt thorn above exp-spines A and B, and (except for P4A) a much longer and more pointed thorn below each of them. P5 with an orbicular exp and a long enp-lobe, both almost entirely without spinules, and in all these respects utterly unlike the P5s of the *longiseta*-group, although having the same formula in each sex.

Female. No MV2s, MV5s rather few and much larger than any of the MV3s or 4s (except for the few abnormally large MV3s present, among some much smaller ones, in *sublaevis*). P5 formula 4 and 6 without an adexp thorn.

Male (howardorum *only*). DLs, VLs, and MVs form a completely confluent girdle on Abds 2 and 3, but fail to do so on Abd4 owing to the few and abnormally small MV4s. A1 of the direct type; P3 has a small smooth inner seta on enps 1 and 2; and P4exp3 has all setae about as in the female. P5 formula 4 and 2.

Two species, namely *howardorum* and *sublaevis*.

8. General Notes on the Descriptions of Species which Follow

Subadult Specimens

These are mentioned only where they raise points of taxonomic importance (e.g. *C. australicus*), or would give wrong identification if compared against the keys, group-diagnoses, descriptions and Table 1, all of which are specifically restricted to fully adult specimens (see the beginning of section 5, p. 1029).

Descriptions and Figures

Under the title of each species, OD denotes the original description (in some cases cited from Lang 1948) and LD the later descriptions (i.e. those papers which have at least one figure and/or some descriptive matter, whether new or quoted from the OD); records merely of finds, without any kind of figure or description, are cited for each species under the headings 'range of habitats' and/or 'geographical distribution'.

To eliminate needless repetition, the description of each species has been pruned of every character found in the diagnosis of its group, whose own diagnosis has in turn been pruned of every character found in the generic diagnosis; the resulting description of a species is therefore often short, simply because that species differs so little from its immediate relations.

The drawings have deliberately been made as detailed as possible, in order to offer a basis for subsequent studies of intraspecific variation (which, in most cases, appears to be extremely small) as well as every possible visible character for identification. However, such details as micropores, microsetules, plain pores, or sensillary pores have had to be wholly omitted because they would clutter up the drawing, or are shown only as and where they could be seen with sufficient certainty.

Length

The overall length of a specimen (from the tip of the rostrum to the free end of the FRs) is given more in compliance with convention than from any conviction of its usefulness; not only does it genuinely vary between specimens, but is difficult to measure accurately in a given specimen because the body (living or dead) can alter its length due to the somites telescoping in and out of one another, either because of some long-term change such as dessication and re-soaking (compare Figs 101*A* and 101*C*), or due to the altered stresses put upon the body when it is rolled from lying on its side to lying on its ventral surface (this change, either way, almost always brings about a small change in apparent length), assuming in the latter instance that the specimen is held straight under a coverslip with the necessary minimum of compression.

Deposition of Specimens in Museums

The principal figured specimens of every species in this paper have been registered with the Museum of Victoria under the numbers J11101 to J11149 inclusive, given at the end of each species description. All of Professor Dumont's specimens have been returned to him; named specimens of several species have been presented to the Zoology Department, Monash University, Clayton, Vic.; and I have kept the remainder for comparison with species from other countries.

9. Notes on the Keys, and Keys 1–5

(1) Cp1 (=couplet 1) of Key 1 will serve to distinguish between the sexes of almost any harpacticoid (at least in certain respects), but the reader is warned that members of other genera and/or families, mostly smaller than either *Canthocamptus* spp. or *Fibulacamptus* spp., may be found with them, and will be described in subsequent papers, in which I also intend to give keys to all Australian non-marine genera of this and other families.

(2) An entire specimen should be examined whole in side and dorsal views in a drop of water under a coverslip, carefully noting all external features before attempting any dissection; difficult as the species in this paper are to distinguish, many of them can be identified at sight by this procedure alone (or by the group characters in section 7). On the other hand, a dissection already mounted on a slide should be checked against Table 1 or section 7 before using the keys, because one can often get at least part of the way to an answer by these means, and also because dissection loses or obscures many whole-body features. The dissection should include the prosomal shield, which affords valuable characters concerning its micropores and/or microcombs (if any), nuchal organ, and SRE1.

(3) A difficult or deficient specimen should not be thrown away, but should be referred as far as possible to the most appropriate group in section 7, until it can be compared with subsequent specimens and/or subsequently published descriptions; it is quite surprising how such a specimen, which had at first defied identification, will yield to it at the second or third attempt (or later, if one is very unlucky), especially if compared side by side with normal and complete specimens (entire or dissected).

(4) Even when a provisional identification has been made with the keys, group diagnoses, and Table 1, no verdict should be arrived at until the specimen has been carefully compared in every respect with the relevant descriptions and figures. Moreover, the keys and group diagnoses of *Canthocamptus* are to a limited extent independent of one another, so that a possible answer may be arrived at by one means if not the other.

(5) All *F. tasmanicus* that I have seen had the teeth on SRE10, but in Keys 2 and 3 allowance has been made for any specimen lacking them.

Key 1. Key to Adults of the Australian species of *Canthocamptus* Westwood s.lat. and of *Fibulacamptus* gen. nov. (for page numbers, see p. 1246)

1. A1 with each of its segments cylindrical and with more or less evenly thickened walls, the segs fitting together like those of a fishing-rod or a telescopic aerial; P2–P4 have all their exps, and all their enps, very much alike; P5 with the enp-lobe well developed, both exp and benp fairly large and leaf-like; SRE6 present only in the *longiseta*-group, otherwise hardly visible even as a trace, P6 always absent; Abds 1 and 2 rigidly fused to form the 'genital double-somite', Abd1 bears the paired genital complexes ventrally, joined midventrally by chitinous bridgework; the specimen may or may not bear eggs; spermatophore, if present, dangles freely under the Abd by its neck, which is attached to the middle of the genital area .... Females, 2

Several of the A1 segs have irregularly thickened walls, and some (particularly seg4) are lumpy or swollen; either P3 or P4 has at least 1 ramus sexually modified (both P3 and P4 in *Fibulacamptus*, but only the former in *Canthocamptus*); P5 small, the enp-lobe very reduced by comparison with the exp; SRE6 as well-developed as SREs 5 or 7 (so that Abd1 is fully separate from Abd2) and bearing P6 (except in *C. grandidieri*, q.v.) in the form of a group of 2 or 3 setae; Abd1 has no genital area or genital complexes; the specimen never bears eggs; spermatophore, if present, always inside the forepart of the abdomen .... Males, 3

2. P1, enp only about as long as exp, and of 2 segs, enp1 being distinctly longer and broader than enp2; exp3 has 3 outer spines on P2 and P3, but only 2 on P4 (in other words, these spines run 3, 3, 2) .... Female *Fibulacamptus*, Key 2

P1, enp as long as, or to a greater or lesser extent longer than, the entire exp, and either of 2 approximately equal segs (both long and thin, Fig. 104*A*) or of 3 segs; exp3 outer spines of P2–P4 run either 2, 2, 2 or 3, 3, 3 .... Female *Canthocamptus*, Key 4

3. P1 as in the congeneric female; P3enp2, prong always short and part of a more complex structure; P4exp3 outer terminal seta transformed into a sort of grapnel (Figs 115*D*–115*F*) .... Male *Fibulacamptus*, Key 3

P1 as in the congeneric female; P3enp2, prong always long and slim, projecting far beyond enp3 and never part of a more complex structure; P4exp3 outer terminal seta as in female (except for *hirsutus* and *australicus*, in which it has a few large barbs), never transformed into anything resembling a grapnel .... Male *Canthocamptus*, Key 5

Key 2. Key to Females of the Genus *Fibulacamptus*, gen. nov.

1. SRE10 has a pair of short blunt teeth above the FR (arrowed in Figs 117*A*, 117*B*, 117*D*) .... *tasmanicus*

SRE10, these teeth definitely absent or else not observed 2

2. Abds 2–4 bear long, mostly confluent, combs of short spinules, which include MV4s (Figs 125*A*–125*C*) (P5 4 and 2, Fig. 126*K*) .... *bisetosus*

Abds 2–4 have all spinules rather long, and in short (mostly discrete) combs, MV4s lacking ... 3

3. Body slender, FRs rather long in ventral view (Figs 121*A*–121*G*); no MV3s (P5 6 and 4, Fig. 124*C*) .... *gracilior*

Body stouter (as is that of *bisetosus*, above), FR in ventral view only slightly longer than broad; MV3s in the form of a series of combs, each with longer central spinules flanked by progressively shorter ones (Figs 113*C*, 117*C*) 4

4. Mxp rear face has a short comb of very small spinules (Fig. 114*D*); P3enp (Fig. 115*B*) clearly 2-segmented; P5 (Fig. 114*F*) 4 and 4, benp-seta 4 unusually small .... *victorianus*

Mxp rear face has no spinules (Fig. 118*E*); P3enp (Fig. 118*H*, enlarged in Fig. 120*F*) indistinctly 3-segmented; P5 4 and 3 (Figs 120*D*, 120*E*), rarely 4 and 4 (other side of Fig. 120*E*) .... *tasmanicus*

Key 3. Key to Males of the Genus *Fibulacamptus*, gen. nov.

1. SRE10 has teeth (Figs 119*A*, 119*B*), about as in female, above .... *tasmanicus*

SRE10, these teeth definitely absent or else not observed 2

2. Abds 2–4 each have VLs confluent with MVs and DLs to form a continuous row of short spinules (Figs 127*C*, 127*D*); P4enp2 (Fig. 128*H*) very small, and with only 1 seta (P3enp1, Figs 128*F*, 128*G*, produced into a broadly rounded lobe-like thorn) .... *bisetosus*

MVs, VLs, and DLs, wherever present (no MV4s), form generally isolated short combs of long spinules; P4enp2 has 5 setae 3

3. P3enp1 had a broad lobe-like thorn (Fig. 119*E*) (FR short, Figs 119*A*, 119*C*; P3,enp1 fairly long (Fig. 119*E*), and enp2 as in Figs 119*F* and 119*G*) .... *tasmanicus*

P3enp1 has no thorn of any kind 4

4. FR short (Figs 116*A*–116*C*); P3,enp1 long (Fig. 116*E*), and enp2 with a long terminal point (possibly a fused seta) .... *victorianus*

FR long (Figs 123*A*–123*C*), P3,enp1 short (Figs 123*J*, 124*E*), and enp2 with no such long point .... *gracilior*

Key 4. Key to Females of the Genus *Canthocamptus*

1. Op smooth-edged and square-cut (Figs 110*A*, 110*E*); A2 allobasis has only 1 abexp seta (Fig. 111*B*); P2 and P3, enp has 3 segs (Figs 111*J*, 111*K*) .... *sublaevis*

Op smooth-edged only in some species (rarely, abnormally in others) and never as square as above; A2 allobasis has either 2 or 0 abexp setae; P2 and P3, enp has 2 segs 2

2. Teeth on SREs extremely regular (Figs 63*A*, 63*B*); P1 has enp1 distinctly longer than entire exp (Fig. 64*F*) .... *longipes*

Teeth on SREs never as regular as this, or absent altogether; P1 has enp1 at most slightly longer than entire exp (Fig. 99*H*), or just shorter (Fig. 95*A*), and usually shorter still 3

3. A2 allobasis (Figs 86*B*, 90*B*) has no abexp setae, but merely a tuft of slender spinules directly opposite the exp; P2–P4, exp3 has only 2 outer spines; P5 formula 5 and 4 (integument without micropores) 4
A2 allobasis has 2 abexp setae, neither directly opposite the exp although the proximal seta is sometimes nearly so; P2–P4, exp3 has 3 outer spines; P5 formula other than 5 and 4 5

4. All SREs smooth except under the highest magnification (Fig. 74*G*); FR in side view (Fig. 85*B*) has no dorsal thorn, but has seta6 arising from below the modified apex; P5 exp (Figs 86*K*, 86*L*) has setae 4 and 5 unusually small .... *grandidieri*
All SREs toothed, even under medium powers (Figs 89*A*–89*C*, 92*A*–92*C*); FR in side view (Figs 89*B*, 92*B*, 92*E*) had a strongly tooth-like dorsal thorn pointing straight backwards; P5 exp (Fig. 90*J*) has setae 4 and 5 about as long and as thick as seta 1 .... *bidens*

5. A2 allobasis (Figs 81*E*, 83*C*) has the distal abexp seta exposed but the proximal seta masked by a group of very long spinules; FR (Fig. 81*D*) in side view has a strongly chitinous conical tip from whose underside setae 5, 6 and 7 arise (integument without micropores) ... *billwilliamsi*
A2 allobasis has both setae unobscured by spinules or by anything else; FRs has a tip which may be cut obliquely but is never conical, and has setae 5–7 arising terminally or nearly so 6

6. SREs 1–9 smooth; op never triangular (P5benp never has adexp thorn) 7
SREs 1–5 and 7–9 toothed (except the flanks of SRE1 in *fimbriatus*, Figs 3*A*, 3*B*); op very short in some species but always basically triangular (except when abnormal, Figs 44*A*, 44*D*, and in *mammillifurca*, Figs 102*B*, 102*C*) 9

7. P5 4 and 6 (Fig. 106*G*) (integument without micropores) .... *howardorum*
P5 5 and 6 8

8. SREs 1–3 faintly but closely pleated (Figs 75*A*, 75*B*), with very rare exceptions (see text); integument without micropores; prosome adoral edge lacks spinules; FR more or less humped dorsally in front of seta 3, setae 5 and 6 each never more than a little swollen at the base (Figs 75*D*, 75*E*); all segs of A1 usually rather slim (Fig. 77*A*); enp2 very long and narrow in P3 and P4, and usually also in P2 (Figs 77*C*, 77*D*, 78*C*); ped5 (Fig. 75*B*) has no spinule-comb above P5, whose exp has an *L* : *B* seldom less than 3 : 1 (Fig. 78*D*), and only very rarely of 2 : 1 or less (Fig. 80*D*) .... *australicus*
SREs never pleated; integument with micropores, prosome adoral edge has a multiseriate spinule-comb (Figs 67*A*, 71*B*); FR nowhere humped, seta5 strongly, but seta6 not at all, basally inflated (Figs 67*A*, 67*B*, 71*B*–71*D*); all segs of A1 (Figs 67*D*, 71*E*) clearly less slim than in the preceding species; enp2 of P2 and P3 elongate-oval, broadest at about 0·2 or 0·3 (Figs 68*G*, 69*A*, 72*B*, 72*C*), whereas that of P4 is of quite a different shape (Figs 69*B*, 72*D*); ped5 (Figs 67*A*, 67*B*, 71*B*, 71*D*) has a well-marked spinule-comb above P5, whose exp has an *L* : *B* of 2 : 1 or less (Figs 68*H*, 73*A*) .... *hirsutus*

9. Prosomal integument without micropores but pock-marked with many coarse pits, and SREs very strongly toothed, the teeth thick-walled and often jagged (Figs 93*A*, 93*B*, 98*A*, 98*C*, 102*A*, 102*B*); in side view the FRtip is cut obliquely (Figs 93*D*, 98*D*, 102*A*, 102*D*, 102*E*); P2enp2 formula 221 (Figs 95*B*, 100*A*) or 110 (Fig. 104*B*); P5 (Figs 95*E*, 100*D*, 105*D*) exp has an *L* : *B* of at least 3 : 1, and benp has no adexp thorn 10
Prosomal integument without pits but densely microporous, and SREs with teeth which (save in *caecosetosus* and *clavifurcatus*, below) are always smaller, thinner-walled, less (if at all) jagged, and more regular, than in the foregoing; in side view the FRtip is cut vertically; P2enp2 formula never 221 or 110; P5exp has an *L* : *B* of at most 3 : 1 and benp has an adexp thorn (arrowed in Fig. 7*L*) 12

10. In side view, FR (Figs 102*A*, 102*D*, 102*E*) has seta3 on top of an enormous hump; in dorsal view (Figs 102*B*, 102*C*) op is smoothly rounded .... *mammillifurca*
In view, FRseta3 is always on top of a much smaller hump than this; in dorsal view, op basically triangular and with a fringe of fine spinules 11

11. In side view, FR (Figs 98*C*, 98*D*) is very deep and almost rectangular, with seta3 arising at about 0·1 or 0·2; in dorsal view (Figs 98*A*, 98*B*) FRseta5 is only just longer than FR itself, and op is short with at most a short apex (if any at all) .... *dumonti*
In side view, FR (Figs 93*A*, 93*D*) is far less deep and rectangular, and seta3 arises at about 0·4; in dorsal view (Figs 93*B*, 93*C*) FRseta5 is at least twice as long as FR itself, and op is of moderate length with a distinctly produced and pointed apex (with rare exceptions, Fig. 93*C* and text) .... *longiseta*

12. FR (Figs 59*A*, 59*C*–59*E*, 59*G*) outer distal corner produced into a short acute-angled point; P2enp2 (Fig. 60*J*) formula 021; P3enp2 (Fig. 60*K*) formula 221 .... *tasmaniae*
This corner rounded off, and never produced into a point; P2enp2 formula other than 021; P3enp2 formula 321 13

13. FRseta5 basal part grossly swollen (like a thick-walled bag) from which the rest of the seta arises subterminally (Figs 53*A*–53*D*); P2enp2 (Fig. 55*E*) formula 120 .... *caecosetosus*

FRseta5, even if swollen basally, never quite like this; P2enp2 formula 121 14

14. P3 and P4 (Figs 51*A*, 51*B*), exp3 formula 123 .... *clavifurcatus*

P3 and P4, exp3 formula 223 15

15. P1exp2 (Fig. 35*A*) without an inner seta .... *mortoni*

This seta present 16

16. Op fringe very spiky and ragged (Fig. 19*A*); FR *L* : *B* about 4 : 3, and seta5 at least 5 times as long as seta7 .... *echinopyge*

Op fringe never so ragged as this; FR *L* : *B* 3 : 2 or 4 : 3 only in *longifurca*, and close to 1 : 1 in each of the others; FR, seta5 at most 4 times as long as seta7, and usually much less than this 17

17. FRseta5 base swollen into a very marked dorsal globule (Figs 28*D*, 29*G*, 29*H*) .... *globulisetosus*

FRseta5 base swollen as in Figs 46*A*, 46*E* .... *dedeckkeri*

FRseta5 base, if at all swollen, not as in either of the above 18

18. FR *L* : *B* about 4 : 3 or even 3 : 2 (SREs 7–9 with long spike-like dorsal teeth, op elongate heart-shaped) (Figs 23*A*, 23*B*, 24*A*) .... *longifurca*

FR *L* : *B* close to 1 : 1 19

19. FR has a frontal inner-edge spinule-comb (=FIC), arrowed in Fig. 37*D*, may be missing from either FR but not so far from both FRs); SREs 7–9 with teeth which, at their longest (Figs 44*A*, 44*B*), are shorter than those of *henryae* (see below); op broadly heart-shaped (Figs 41*D*–41*Q*), abnormally rounded (Figs 44*A*, 44*D*) .... *timmsi*

Both FRs lack FIC (except in certain *henryae*, q.v.); op never quite as in Figs 41*D*–41*Q* 20

20. SREs 7–9 with all dorsal teeth long and pointed (Figs 6*A*, 6*B*) .... *henryae*

These teeth in the form of small equilateral triangles, whose tips are often more or less bluntly rounded (Figs 10*C*, 14*B*) 21

21. SRE1 smooth (save mid-dorsally, Figs 3*A*, 3*B*) .... *fimbriatus*

SRE1 cut into small rounded teeth (Figs 10*A*, 10*C*, 14*A*, 14*B*) .... *lacinulatus*

Key 5. Key to Males of the Genus *Canthocamptus*

[Notes: (1) The male of *C. longipes* was lost before its description could be completed, but can be seen in Fig. 66*B* to have a P1 like that of the female (Fig. 64*F*). (2) *C. mammillifurca* has a P1 distinctive enough to key out this species in couplet 1; however, if P1 is lost, damaged, or concealed among the other legs, this species will lead to couplet 10.]

1. P1enp has 2 segs (each very long and thin, as in the female (Fig. 104*A*), and thus quite unlike the P1enp of *Fibulacamptus* spp., *q.v.*) .... *mammillifurca*

P1enp (if not lost, hidden, damaged, or missing) has 3 segs 2

2. P2–P4, exp3 has only 2 outer spines; op not triangular (Figs 88*A*, 88*D*) .... *grandidieri*

P2–P4, exp3 has 3 outer spines (unless abnormal, Fig. 13*C*); op triangular or not 3

3. Teeth on SREs extremely regular (Figs 66*A*, 66*B*); P1enp1 very long (Fig. 66*B*, probably as in female, Fig. 64*F*) .... *longipes*

Teeth never as regular as this, and may be absent altogether; P1enp1 no longer than in Fig. 99*H*, and usually shorter 4

4. SREs 1–9 smooth; op never triangular, and projecting at most only a little way over the IRS 5

SREs 1–9 toothed (except on the flanks of *fimbriatus* SRE1); op basically triangular, and (except in sp. 1, *caecosetosus*, and *clavifurcatus*) covering at least one-third of the IRS 8

5. P3exp, spine B much thicker (and usually longer) than spines, C, D, or E (Figs 69*C*, 74*B*, 80*B*); P4exp3 outer terminal seta thick, subspiniform, and with a few (usually 3 or 4) large barb-like spinules (lacking as a rare abnormality) on its outer edge (arrowed in Fig. 70*F*) (op, VL4s, and P5exp-setae, all as for *billwilliamsi* in couplet 7) 6

P3 has all exp-spines more or less similar; P4exp3 outer terminal seta never with barbs 7

6. SREs 1–3 pleated (Figs 79*A*–79*C*) with rare exceptions; DLs present on Abd1, but not on peds 4 or 5 (Figs 79*A*, 79*B*); FR *L* : *B* in ventral view rarely less than about 2 : 1 (Fig. 79*C*) .... *australicus*

SREs never pleated; DLs on ped5 and Abd1, and sometimes on ped4 as well (Figs 70*A*, 70*B*, 73*B*, 73*C*); FR *L* : *B* in ventral view hardly exceeds 1 : 1 (Figs 70*C*, 73*D*) .... *hirsutus*

7. No DLs on peds 4 or 5, or on Abd1 (Figs 109*A*, 109*B*); op teeth few and large (Fig. 109*B*); MV4s have an MVgap (Fig. 109*C*) with only tiny spinules; P5exp has 4 setae and is almost circular, with a smooth edge devoid of spinules (Fig. 108*E*) .... *howardorum*

DLs on ped5 and Abd1, and sometimes on ped4 as well (Fig. 81*C*); op teeth small and numerous (Fig. 82*F*); MV4s continuous, without an MVgap (Fig. 83*A*); P5exp has 5 setae, is long-oval rather than circular, and has surface spinules (omitted for clarity in Fig. 83*A*) often overlapping the setal insertions .... *billwilliamsi*

8. SREs with large thick-walled jagged teeth; P5exp (Figs 96*E*, 100*E*, 105*J*) *L* : *B* at least 2 : 1, widest at about 0·2, with a straight or slightly concave inner edge and 4 setae, of which 1 and 2 are together terminally, and 3 and 4 are on the outer edge 9

SREs with (except in *caecosetosus* and *clavifurcatus*) smaller, smoother, thinner-walled, and less jagged (if at all), teeth; P5exp *L* : *B* not exceeding about 4 : 3, its widest point being anywhere between 0·2 and 0·6, with a straight or slightly convex inner edge and 3 setae more or less evenly spaced around the distal and outer edges 11

9. FRseta5 (Fig. 96*C*) about 3 times as long as either seta7 or the FR itself; FRseta3 (Fig. 96*A*) set on a rather inconspicuous dorsal hump; P5 (Figs 96*C*, 96*E*) with the exp itself, and all setae on both rami, long and slender .... *longiseta*

FRseta5 (Figs 101*B*, 103*C*) about 1·5 times as long as either seta7 or the FR itself; FRseta3 (Figs 101*D*, 102*G*) set on quite a marked dorsal hump; P5 (Figs 100*E*, 105*J*) with the exp itself, and all setae on both rami, shorter and thicker than above 10

10. In dorsal view, the transdorsal teeth on SREs 4–7 are distinctly smaller than those on the flanks of these SREs (Figs 101*A*, 101*C*); both in dorsal (Fig. 101*B*) and in side (Fig. 101*D*) views, FR *L* : *B* does not exceed 2 : 1; sensillary pores flush with the surrounding integument .... *dumonti*

Transdorsal teeth of each of these SREs of about the same size as those upon its flanks (Figs 102*F*, 103*B*); FR *L* : *B* slightly greater from any aspect than in *dumonti*, and also of quite a different shape in side view (Fig. 102*G*); sensillary pores mounted on pustules (as in the female, see Fig. 102*A* and text) .... *mammillifurca*

11. SRE1 smooth-edged except mid-dorsally (Figs 5*A*, 5*B*), SREs 2–9 each with rather small even teeth; op (Figs 5*A*, 17*H*) an almost perfectly equilateral triangle whose edges are cut into a basically regular fringe of closely-set slender teeth pointing straight backwards (P2enp2 formula 020, Figs 4*G*, 5*E*; P4enp2 formula 021, Figs 5*H*–5*K*) .... *fimbriatus*

SRE1 bearing teeth all round, very much like those on SREs 2–9; op never quite as in the foregoing 12

12. FR outer distal corner produced into an acute-angled short point (Figs 61*A*, 61*D*, 61*E*) in dorsal or ventral view (P4enp2 formula 021, Fig. 62*D*) .... *tasmaniae*

This corner rounded off, and not produced into a point 13

13. Prosome so large as to give a somewhat 'big-headed' appearance to the animal (Figs 36*A*, 36*B*); neither P1exp2 (Fig. 35*A*) nor P4enp2 (Fig. 97*E*) have an inner seta .... *mortoni*

Prosome not as large as this (except in *dedeckkeri*, *q.v.*); each of these segs has an inner seta 14

14. P3 and P4, exp3 has 1 inner seta (Figs 52*D*, 52*F*, 58*C*, 58*D*) (P5exp, seta1 not much longer or more spinulose than setae 2 or 3, Figs 52*G*, 58*E*) 15

P3 and P4, exp3 has 2 inner setae 16

15. Op smooth-edged, prolonged into a smooth blunt tip (Figs 57*B*–57*D*, 57*F*); P2enp2 (Fig. 58*B*) long and narrow, almost parallel-sided, without either a papilla or an outer seta ..... sp. 1

Op edged with long uneven spinules which leave scars when they fall off, apex less prolonged than above (Figs 49*A*, 49*D*, 49*E*, 51*C*, 51*E*); P2enp2 (Figs 52*B*, 52*H*) wider proximally, and shorter in proportion to the exp, than in sp. 1, edges curved, and with a papilla (Fig. 52*C*) distal to which the outer seta is lodged in a step partly shielded by a thorn ... *clavifurcatus*

16. Op (Fig. 56*A*) much as in *clavifurcatus*; P5exp, seta1 not much longer or more spinulose than setae 2 or 3 (Fig. 56*G*) .... *caecosetosus*

Op longer than the above, with straight or evenly curved edges which are sometimes smooth but in most cases fringed with very small teeth or spinules; P5exp, seta1 far longer than setae 2 or 3, and rather more spinulose than seta3 (seta2 being smooth) 17

Op unique in this paper in having extremely long marginal spinules (Fig. 21*B*); P5exp, seta1 far longer than setae 2 or 3, but all 3 setae about equally spinulose in relation to their respective lengths .... *echinopyge*

17. FR *L* : *B* about 4 : 3 or even 3 : 2 (Figs 25*A*, 26*A*) .... *longifurca*

FR *L* : *B* very close to 1 : 1 18

18. SREs 7–9 with dorsal teeth like long sharply pointed isosceles triangles (Figs 8*A*, 8*B*) ... *henryae*

These teeth more like rather uneven small equilateral triangles (Figs 32*A*, 32*B*, 40*A*, 40*B*, 48*A*, 48*B*), often with rounded tips 19

19. Prosome unusually big in proportion to the rest of the body (Figs 48*A*, 48*B*), rather as in *mortoni* (couplet 13); P3enp3 with an outer-edge protuberance (Fig. 62*F*); P2 and P3 (Figs 62*F*, 62*G*) have exp-spines A and B not much thicker or less microbipectinate than spines C–E .... *dedeckkeri*

    Prosome not larger than normal (Figs 32*A*, 32*B*, 40*A*, 40*B*); P3enp3 (Figs 31*F*, 32*F*, 32*G*, 40*H*) without a protuberance; P2 and P3 (Figs 31*E*, 31*F*, 40*G*, 40*H*) have exp-spines A and B nearly or completely smooth, and distinctly thicker than spines C–E 20

20.* FR, seta7 about as long as seta4, and op heart-shaped with a fairly pointed apex (Figs 12*B*, 16*B*, 18*Y1*, 18*Y2*, 18*Z*, 40*A*–40*D*) .... *lacinulatus* and *timmsi*

    FR, seta7 to a greater or lesser extent shorter than seta4, and op as above or (less often) as in Figs 32*B*, 32*C* (i.e. more like that of *mortoni*, Figs 36*B*, 36*C*) .... *globulisetosus*

Note. *C. ablatifurcatus* was discovered too late to be included in keys 3 and 4.

**Nota bene*. These last three species are extremely difficult to separate as males, and even now I am by no means certain that the characters in couplet 20 are entirely reliable.

10. Descriptions of *Canthocamptus* spp.

Canthocamptus fimbriatus (Brehm)

Figs 3–5, 17*F*–17*H*

Delachauxiella fimbriata Brehm, 1950, p. 252, no figures. (OD)
Delachauxiella sp. Brehm, 1953, p. 56, figs 38, 39.

Female Neoholotype

Length 0·45–0·47 mm (Figs 3*A*–3*C*); shape slender, prosome moderately large with the thorax and abdomen tapering gracefully away from it in side view, whereas in dorsal view the body is almost linear with only minimal taper. Nuchal organ oval and of moderate size. SRE1 unique in this group in being completely smooth except for some vague, bilaterally symmetrical, sinuations in the MDzone; SREs 2–5 with very small and regular teeth which may be somewhat larger in the DLzone than elsewhere; SREs 7–9 with a more irregular mixture of very small teeth with distinctly larger ones, including usually 1 especially large DLtooth which, however, does not mark the rearward extremity of a DLkeel. Op an almost exactly equilateral triangle with perfectly straight sides, the free edges cut into a fairly even fringe of close-set, long, slender teeth that point directly backwards (parallel to the long axis of the animal); op at least as long as the FRs, and thus overhanging the whole middle part of the IRS; IRD at least as great as RBW. FRs parallel or slightly convergent, distal end of FR obliquely straight-cut, FR $L:B$ about 1 : 1, FRs without excrescences or surface ornamentation, seta3 unusually long compared with the other FRsetae. Genital region as in Fig. 3*C*. On Abds 2, 3 and 4, the MVs form a confluent comb with the VLs except for a small MVgap on Abd2; on all these 3 somites the DLs form a separate curved comb whose spinules grade downwards (i.e. they are shortest dorsally and longest ventrally), whereas those of the MV and VL combs are all of about the same length.

A1 (Fig. 4*A*) with segs 1 and 2 unusually large in proportion to the other segs. A2 (Fig. 3*D*) with allobasis and enp both fairly short, exp moderately large in proportion to either of them, exp-setae 1 and 2 unusually short and thick in proportion to exp-setae 3 and 4; the filamentous tips are also far more clearly defined on setae 1 and 2 than on 3 or 4. Of the 2 setae on the allobasis, the proximal (directly opposite the exp) is short and not tapering, with 2 outer spinules near the very tip, whereas the distal seta is much longer and tapers to a fine point, with a few pinnules mainly on its front edge. None of the enp-setae A–H are exceptionally long; A–D are conical spines with unhooked blunt tips, B–D have front-edge micropectinations along their distal halves; G is almost straight, slightly tapering, and only about half as long as E or F when complete (as far as can be estimated from them when broken, as here); G has a discrete terminal filament. WAC split, each half-WAC rather short and composed of many slender close-set spinules.

Md (Fig. 3*E*) PCXcomb long, straight, and composed of many small spinules; CXB with 2 combs of long setules and a single short and sharply pointed seta crowned with 2 or 3 spinules. Enp almost square, with 3 similar simple setae terminally.

Mx1 (Fig. 3*F*) normal, with 4 ramal setae. Mx2 (Fig. 3*G*) noteworthy only in that the proximal seta of the proximal endite has a perfectly straight, smooth, non-tapering shaft, ending in a slightly hooked tip whose rear face is excavated into a broad shallow depression bearing a slightly projecting spinule (enlarged in rear view in the inset to Fig. 3*G*, which itself shows the front view of Mx2). Mxp (Fig. 3*H*) not remarkable.

P1–P4 (Figs 4*C*–4*F*, in that order), exps 1 and 2 outer distal corner with a pointed adpressed thorn, setal formula as in Table 1; P5 (Fig. 4*B*) exp rather short and noticeably narrowed distally, all setae of both rami (especially exp-seta1) fairly long in proportion to the rami themselves.

Male Neoallotype

Length 0·36 mm (Figs 5*A*–5*C*); SRE6 very like SRE5; Abds 2, 3, and 4 each have the DLcomb almost confluent, but slightly out of line, with the VLs. A1 (Fig. 5*D*) of the direct type. P2 (Fig. 4*G*) enp2 (enlarged in Fig. 5*E*) outer edge has a marked proximal bulge ending distally in a sharp thorn, and near the distal end there is also a step-like thorn. P3 (Fig. 4*H*) prong (magnified in Figs 5*F*, 5*G*) unusual in having 3 barbs instead of merely 2; the inner terminal seta of enp3 is short, curved, and very spinulose, but the outer one reaches well beyond either the prong or the tip of exp3 and is unevenly bipinnate; abaxially, both enp1 and enp2 end in a distal thorn. P4 (Fig. 5*H*) enp1 small, without either thorns or setae; enp2 outer edge convex whereas the inner edge is straight, outer edge with a small and a large spinule distal to which is the outer seta that crosses over the outer terminal seta. Both terminal setae reach to about the end of exp3, the outer seta being much shorter than either of them (enp2 enlarged in Figs 5*J*, 5*K*).

P5 (Fig. 5*C*, *in situ*; exp magnified in Fig. 5*L*) enp-lobe well developed, with a very long simple inner seta and a much shorter outer one, the outer side of whose tip is pectinate. Exp about twice as long as the enp-lobe, exp $L:B$ about 1 : 1 or 4 : 3, with 3 setae of which only seta2 is smooth, seta3 is the shortest (pinnate only on its outer edge), and seta1 is longest and unequally bipinnate. P6 (Fig. 5*C*) with both setae sparsely bipinnate, the inner seta about half as long as the outer.

Remarks

Deposition. Female J11102, male J11103, in Museum of Victoria.

Origin of the specimens described. Selected from type lot, see below.

Variation. None noticed.

Colour. Not seen alive; when preserved, of the usual dull brownish grey.

Type locality. On the western slope of Companion Dam, in *Nothofagus* litter. The type lot of 15, 0, 2, 2, was collected with *C. howardorum* (*q.v.*), and on 1.iv.1982 I collected 7, 3, 0, 0 in the same place with Dr David de Little.

Synonyms. See the note below on '*Delachauxiella fimbriata*'.

Range of habitats and geographical distribution. In Big Lake Waterhouse (= BLW in Maps 5 and 6) by Brehm (1950, 1953), but not found there since, nor anywhere near it; and in the type locality.

Major distinctions from similar Australian species. The form of the operculum, and the fact that SRE1 is almost entirely smooth in contrast to the SREs immediately following it.

Major distinctions from co-occurring species. As above, if the other species belong to the *fimbriatus*-group; but dissection may be necessary for a precise identification. The other most likely co-occurrers, *C. australicus* and *C. longiseta*, are at once distinguished by their SREs.

Derivation of the specific name. Latin *fimbriatus* = fringed, presumably in allusion to the strongly fringed free edges of the operculum, although Brehm (1950, translated at the bottom of p. 56 of his 1953 paper) does not explicitly say so.

Note on Delachauxiella fimbriata

In this note I shall use two generic names, *Delachauxiella* for Brehm's original specimens (presumably lost or destroyed), and *Canthocamptus* for specimens I have examined; the aim of this note is to clarify the relationship between *D. fimbriata* on the one hand and *C. fimbriatus*, *C. henryae*, and *C. mortoni* on the other, these being in my opinion (after looking at many specimens from Tasmania and Victoria, including specimens from all Brehm's type localities for harpacticoids) the most likely species that he saw. If, in equating *D. fimbriata* with *C. fimbriatus*, I am considered to be running a substantial risk by venturing onto very dangerous ground, I can only plead that anyone trying to rely on any aspect of Brehm's work is doing exactly the same; to accord formal recognition to any of his taxa is to do them a favour which they hardly deserve.

Brehm's original German diagnosis (1950, p. 252) may be translated as follows:

"*Delachauxiella fimbriata* n.sp.

Male unknown. Female: rear edge of somites strongly serrated. Anal operculum triangular, its tip reaching to the end of the furcal ramus, its side edges deeply fringed. Rudimentary footlet (= P5) of the build typical for this genus. Finding-place Big Lake Waterhouse." [= BLW in Maps 5 and 6.]

The unnamed species in the bottom paragraph on p. 56 of Brehm (1953) can only be *D. fimbriata*, since according to him "it exhibits strongly denticulate posterior margins of the segments and is conspicuous by the fact that the operculum, the tip of which reaches somewhat beyond the end of the furca, possesses deeply fringed lateral margins (Fig. 38). The sample came from Big Lake Waterhouse."

Brehm gave no figure in his 1950 note, but in the 1953 paper did give a single rudimentary sketch (the Fig. 38 just mentioned) which contradicts the 1953 description in that the tip of the operculum in fact falls slightly short of the tips of the furcal rami. This might suggest that he took his 1953 description from a specimen of *mortoni* but his figure from one of *fimbriatus*; however, his 1950 description of this feature suggests *fimbriatus* or *henryae* rather than *mortoni*. Both papers agree in describing the serrations of the SREs as strong, but this is purely relative to some ideal of normality which he in any case failed to specify; in his Fig. 38 the serrations appear to be about right for *fimbriatus* or *henryae* rather than for a really strongly serrate species such as *longiseta* (which he gives no indication of having seen).

Really, there is only one potentially useful feature left to go on, which is that in both accounts he describes the opercular edges as being deeply fringed, and in his figure he shows the operculum as being an almost equilateral triangle with perfectly straight sides and with the fringe composed of rather long straight teeth which point directly backwards, instead of sticking out sideways at an appreciable angle, as in all other species in this paper that have an opercular fringe of any kind. A few specimens having just such an operculum were discovered and described as above; I feel justified for this reason in designating them as the neotypes of this species, although they were found a long way from Brehm's type locality and in a rather different sort of habitat.

Canthocamptus henryae, sp. nov.

Figs 6–9, 18*A*–18*O*, 18*Q*–18*U*, 65*C*–65*H*

Female Holotype

Length 0·4 mm (Figs 6*A*, 6*B*), prosome moderately large, nuchal organ shoe-shaped, body noticeably less slender than in *globulisetosus* or *timmsi*. There are numerous microcombs of triangular microdenticles (enlarged in Fig. 7*M*) all over the dorsum and flanks of ped2 to Abd4 inclusive, as in Fig. 6*B*. The teeth on SREs 1–5 are roughly equilateral triangles, but those on SREs 7–9 are far more even in size and much longer (in other words, they form isosceles triangles) and may have either sharp tips (like those on SREs 1–5), or rounded ones. Abd spinules all of much the same size save the dorsal-most DLs, DLcomb separate from, but overlapping, the VLs on Abds 2 and 3 although confluent with them on Abd4 (Fig. 6*B*); a very large MVgap (i.e. no MVs) on Abd2, a smaller MVgap on Abd3, and no gap at all on Abd4 (Fig. 7*A*). The MV5s extend well up into the subanal sinus. Op (Fig. 6*A*) with a slightly produced apex extending a little way beyond the FRs, its edges cut into a few irregularly spaced backward-pointing teeth. FR *L* : *B* 1 : 1 or slightly greater, setae unremarkable except that seta5 has a slightly swollen base (Figs 6*A*, 7*A*); all over the dorsal surface of this swelling the right seta5 has a transparent blister-like covering (stippled in Fig. 65*F*), which on the left seta5 has withered to form a ragged exterodorsal lengthways crest about as in Fig. 65*G*. FRseta7 very short (Fig. 7*A*, which also shows the genital region).

Prosomal limbs (Figs 7*B*–7*J*) not significantly different from those of related species. P1 (Fig. 9*G*) exp2 has an inner seta; P2 to P4 (Figs 9*A*–9*C*) with an outer distal thorn on exp1 and exp2, thorn large, blunt, and divergent on P2 and P3 but smaller, sharp-pointed, and adpressed on P4. P5 (Fig. 7*K*) benp outlined in Fig. 7*L* to show the adexp thorn, enp-lobe, setophore, and the OBS; the exp in Fig. 7*K* is abnormally broad, so that the other P5 of the holotype is shown in Fig. 65*C* with an enlarged view of its exp in Fig. 65*D*.

Male Allotype

Length 0·33 mm (Figs 8*A*, 8*B*); the teeth on SRE6 are of the isosceles type, like those on SREs 7–9. Abd spinulation and limb structure as in the male of *C. timmsi*, from which it may be distinguished as in key 5, and also by the enp-lobe of P5 (Fig. 8*E*) being far less prominent than in *timmsi* (Fig. 38*L*), the exp rather more rounded, seta3 pinnate instead of smooth, and seta1 only about 1·4 times (instead of twice) as long as seta2.

Remarks

Deposition. Female J11137, male J11138.

Origin of the specimens described. The type locality.

Variation. The op is moderately variable [holotype, Fig. 6*A*; other specimens, Figs 18*A*–18*U* (except 18*P*)]. The blister on FRseta5 is fully formed in a minority of specimens, but in the others it has withered to form a ragged exterodorsal lengthways crest (blister stippled in Fig. 65*F*, crests heavily outlined in Figs 65*G*, 65*H*). Apart from both P5s of the holotype (above), Fig. 65*E* shows an otherwise normal P5 with only 5 benp-setae, from paratype 2; these three figures show the constancy of the very characteristic shape of a normal female P5benp in this species.

Colour. Not noted alive; when preserved, translucent brown with a distinctly orange tinge not quite rivalled by any co-occurring species.

Type locality. Lake Bong Bong; see *C. henryae* in Appendix 1.

Synonyms. None.

Range of habitats. Similar to those of *C. australicus* and *C. longiseta*.

Geographical distribution. Apparently anomalous in being confined to the Victorian coastal areas near Portland (see Map 4), with an isolated find to the north-west at Meningee (= locality 6 in Map 1); on the mainland there is hardly any overlap with either *C. australicus* or *C. longiseta*, whereas the respective distributions of these three species in Tasmania (Map 5) are much more alike.

Major distinctions from similar Australian species. Before dissection, the most useful characters are the rather compact build, the moderately strong and very sharply pointed teeth on all SREs, and the orange-brown colour; after dissection, going through the keys, the most useful single character is probably the long sharply pointed isosceles teeth on SREs 7–9.

Major distinctions from co-occurring species. These depend on whether the latter are also members of the *fimbriatus*-group, and particularly of the inner group of very similar species of which *henryae* is one. Such species seem to occur with *henryae* more often in north-west Tasmania (Companion Dam and nearby; also Guide Falls, if *C. henryae* should ever be found there) than elsewhere; in other Tasmanian localities, as in western Victoria, its small-toothed SREs readily distinguish it before dissection from *C. longiseta* (with large teeth) or *C. australicus* (with no teeth at all); but distinction from other members of the *fimbriatus*-group is much more difficult, and usually involves dissection.

Derivation of the specific name. In honour of the late Marguerite (Madge) Cooper, née Henry, whose pioneering studies constituted until comparatively recently a major part of our knowledge of all Australian freshwater entomostracans (see under *C. longiseta*).

***Canthocamptus lacinulatus*, sp. nov.**

Figs 10–18

Female Holotype

Length 0·54 mm; SREs 1–5 and 7–9 with rather small and not quite even teeth, basically in the form of equilateral triangles but often (especially across the dorsal sides of SREs 7–9, Figs 10*A*, 10*C*) with rounded tips. MV2s with a very wide MVgap, and MV3s with a much smaller but still distinct gap (Fig. 10*B*). Op slightly heart-shaped and reaching just beyond the FRs, its edges raggedly torn (rather than distinctly cut) into small backwards-pointing teeth (Fig. 10*C*). FR *L* : *B* very close to 1 : 1, base of seta5 with an exterodorsal blister as in *timmsi* (*q.v.*). Limbs (Figs 10*D*–10*G*, 11, 13*A*) not remarkable.

Male Allotype

Length 0·44 mm; SRE6 with teeth about as on SRE5 (Figs 12*A*, 12*B*); op smooth-edged (Fig. 18*Z*). A1 (Fig. 12*D*) of the offset type. P2 has an inner seta on the left (Fig. 13*B*), but not the right (Fig. 13*E*), enp2; furthermore, the left P3exp3 (Fig. 13*C*) is abnormal in having only 2 outer spines, whereas the right-hand one (Fig. 13*F*) has the usual 3 spines. P5 (Figs 12*E*, 12*F*) and P6 (Figs 12*A*, 12*C*) as in closely related forms. As emphasized at the end of Key 5, the male of this species is almost impossible to distinguish from those of *timmsi* and *globulisetosus*, although the females of these species are fairly easy to identify with practice.

Remarks

Deposition. Female J11805, male J11806.

Origin of the specimens described. The type locality on 14.iv.1976.

Variation. Significant only in the operculum (Figs 18*P*, 18*V*–18*Z*).

Colour. Not seen alive, pale grey when dead.

Type locality. Map 6, locality 25.

Synonyms. None.

Range of habitats. Constantly present in moderate or small numbers in wet moss mixed with leaflitter at localities 8 and 11, and rather more numerous in wet *Sphagnum* at localities 23 and 25, all on Map 6.

Geographical distribution. Only as just quoted.

Major distinctions from closely allied Australian species. In both sexes the op is almost indistinguishable from that of *henryae* which, however, can be distinguished by the much longer and more pointed dorsal teeth on SREs 7–9 [compare Figs 18*P* (= *lacinulatus*) with 18*N* and 18*Q*, both of *henryae*]. Some opercula (Fig. 18 – *W1*, *X1*, *X2*, *Y1* and *Y2*) may cause confusion with those of several related species (Figs 23*A*, 28*D*, 41*D*–41*Q*, 46*D*, 59*D*), which can be resolved only by careful use of the relevant keys, descriptions and figures.

Major distinctions from co-occurring species. If of the same group, as just explained; if of other groups, see the characters of those groups.

On subadult specimens. None, mainly because they cannot yet be distinguished from corresponding stages of allied species in the same samples.

Derivation of the specific name. From the Latin *lacinulatus* = torn, like the ragged edge of a piece of cloth; referring to the opercular edge.

Canthocamptus echinopyge, sp. nov.

Figs 19–22

Female Holotype

Length 0·45 mm (Figs 19*A*, 19*B*); nuchal organ much shorter (even allowing for foreshortening in Fig. 19*A*, due to the slope of the prosome as in Fig. 19*B*), and teeth on SREs often much longer and sharper-tipped, than in *lacinulatus* (*q.v.*), although the SRE teeth are not as long or as regular as they are in *henryae* (*q.v.*). Uniquely in this group, the abd somites are covered with closely-set transverse microcombs of microsetules (Fig. 20*A*). MV2s with a wide MVgap, but MV3s without any such gap (Fig. 19*C*). FR *L* : *B* about 5 : 4 or 4 : 3. Op unique in this paper, in being irregularly cut into exceedingly long, thin, needle-like teeth or spinules (Fig. 19*A*). P2 (Fig. 20*C*), P3 (Fig. 20*D*), and P4 (Fig. 20*E*) not remarkable except that each has a rather slender enp2; other limbs not remarkable.

Male Allotype.

Length 0·36 mm (Figs 21*A*, 21*B*), SRE6 denticulate like SREs 5 and 7. The op and abd microcombs are exactly as in the female. A1 (Fig. 21*D*) of the direct type; other limbs not remarkable (Figs 21*E*, 22).

Remarks

Deposition. Female J11803, male J11804.

Origin of the specimens described. The type sample.

Variation. About a dozen specimens, mostly female but some male, had opercula which varied, if anything, less than those of *timmsi* in Figs 41*D*–41*Q*.

Colour. Dead, a rather opaque greyish white.

Type locality. On 13.ii.1976, when the type (and only) sample was collected in them, both ponds at locality 3 on Map 6 had a firm mud floor devoid of vegetation and covered by rather cold water (perhaps welling up from a subterranean source) with a maximum depth of *c.* 20 cm. Each pond had a surface area of *c.* 5 m^2. This species has not yet been found anywhere else.

Synonyms. None.

Range of habitats and geographical distribution. See above.

Major distinctions from allied and/or co-occurring species. The op (Figs 19*A*, 21*B*) and abd microcombs (Fig. 20*A*).

Derivation of the specific name. From the Greek *echino* = spiky or prickly, and *pyge* = rump or backside; alluding to the operculum.

Canthocamptus longifurca, sp. nov.

Figs 23–27, 65*J*, 65*K*, 65*L*

Female Holotype

Length 0·42 mm (Figs 23*A*, 23*B*); nuchal organ of average length for this species-group; teeth on SREs fairly long and sharply pointed, especially on SREs 7–9 (about as in *longifurca*, but more regular and less crowded than in that species). Integument without microsetules. DL2s and 3s rather few and not closely packed; MV2s with a wide MVgap, but MV3s without any gap (Fig. 24*A*, in which left-hand VL2s are obscured by a patch of dirt, shown stippled). Op almost an equilateral triangle, but to some extent heart-shaped (Fig. 23*A*), and with an even fringe of small closely set teeth. FRs (Figs 23*A*, 24*A*) by far the best distinctive character in this species, in being elongate-ovate, with an *L* : *B* of about 4 : 3 or even 3 : 2. In Fig. 24*C* the A2 is rather damaged, and its exp is abnormal in having only 3 setae (the usual number is 4); limbs otherwise not remarkable.

Male Allotype

Length 0·50 mm (Figs 26*A*, 26*B*), op and FRs basically very like those of the female, but teeth on SREs 7–9 proportionately smaller; A1 (Figs 26*C*) of the offset type, but limbs otherwise not remarkable.

Remarks

Deposition. Female J11801, male J11802.

Origin of the specimens described. Map 6, locality 14, on 24.v.1984.

Variation. Not appreciable.

Colour. See under *C. timmsi*.

Type locality. Given above, under origin of specimens described.

Synonyms. None.

Range of habitats. Only at two localities (23 and 25 on Map 6) was this species found among high-altitude *Sphagnum*; the other records came from a small rocky pool with a thick soft-mud bottom (locality 6), from fairly deep pools with much water weed and/or submerged grass near the edge (localities 5 and 12), or even from slowly moving rivers (localities 14, 15 and 18). It thus seems to demand a more continuous turnover of clean water, with a higher average oxygen tension, than do most of its allies; if confirmed, these requirements would make it a good potential indicator of certain kinds of pollution, even in traces. All localities are on Map 6.

Geographical distribution. Only as just quoted.

Major distinctions from closely allied species. Of these, only *echinopyge* has comparably long and slender FRs, but has a very different op.

Major distinctions from co-occurring species. Mostly as above, since most of the latter are of the same group.

Derivation of the specific name. From the Latin words for long and fork, alluding to the FRs being longer and slimmer than those of most of its immediate allies. Used here as a noun in apposition.

Canthocamptus globulisetosus, sp. nov.

Figs 28–32

Female Holotype

This is so like certain other members of this group, particularly *timmsi*, that one need mention only the most salient characters, by far the most important of which are the curious striations on the bases of FRsetae 5 and 6 (Fig. 29*G*). On seta5 the striations are confined to the globular dorsal protuberance on top of the basal swelling (side view in Fig. 29*H*), whereas they are about equally wide and extend about equally far along both dorsal and ventral surfaces of seta6 (being far more strongly marked, almost like grooves between ridges, on the dorsal side, but rather faint on the ventral side and therefore omitted from Fig. 29*J*).

These setae are present in all the rather few specimens that I have seen, but, if they should be lost, the best other characters are: (*a*) op (Figs 29*A*, 29*D*, 29*F*) free edges proximally slightly curved (see below, Variation) but straight elsewhere; thus the op of the holotype is like that of *mortoni* (Fig. 33*B*) in shape, although shorter in proportion to the FRs, and has a similar fringe. (*b*) The adaxial side of FR is moulded into 2 broad shallow humps of which the forward one is more dorsal (Fig. 29*D*) and the rearward one more ventral (Fig. 29*F*).

The limbs are practically indistinguishable from those of *dedeckkeri*, but the prosome of *globulisetosus* is of no more than normal size.

Male Allotype

Length 0·44 mm (Figs 32*A*, 32*B*). Indistinguishable from the male of *timmsi* except in the less projecting enp-lobe of P5 (Fig. 32*H*, as against Fig. 38*L*) and the long straight-sided op (Fig. 32*B*, as against Figs 37*A*, 37*D*, 37*F*); the 2 outer exp-setae of P5 also appear to be somewhat thicker in *globulisetosus* than in *timmsi*, and the former species has very long thick blunt teeth in the DLzone on SREs 6–9 (Figs 32*A*, 32*B*) which *timmsi* lacks (Figs 40*A*, 40*B*).

Remarks

Deposition. Female J11133, male J11134.

Origin of the specimens described. All on Map 6; Figs 14–17 from the type locality and Fig. 13 from locality 10 on 6.v.1982.

Variation. The op in some females (Figs 28*B*–28*D*, 28*F*) may be heart-shaped, as in *timmsi* but usually distinctly longer, whereas in others (Figs 29*A*, 29*C*, 29*D*, 29*F*) it is like that of *mortoni* but is much shorter. The male op is most often as in Figs 32*B* and 32*C*, but is otherwise shorter. Apart from these, there are no appreciable variations.

Colour. Not seen alive; when dead, a nondescript yellowish or brownish grey.

Type locality. Map 6, locality 11, on 15.ix.1981.

Synonyms. None.

Range of habitats. About as for *timmsi*, but much less common.

Geographical distribution. All on Map 6; fairly numerous at locality 11, but scarce at localities 10, 14 (at each of which it was swept into a river, perhaps by accident) and 25; a single male was also found in wet moss beside Lake Mountain Road, a few kilometres south of locality 22. The first specimens at locality 11 were submitted to me for identification by the South Australian Museum (coll. Mrs Greenslade), to whom they have been returned.

Major distinctions from allied Australian species. Hardly any, except as cited below (see Derivation of the specific name) and as given in Keys 4 and 5.

Major distinctions from co-occurring species. See under this head for *C. timmsi*.

Derivation of the specific name. From the Latin meaning 'seta with a globule', alluding to the appearance (solely in the female) of FRseta5 in Figs 29*G*, 29*H*.

Canthocamptus mortoni, sp. nov.

Figs 33–36, 97*D*–97*F*

Female Holotype

Length 0·52 mm, R small and pointed (Fig. 34*B*); prosome very deep in side view (giving the animal a characteristically 'big-headed' appearance as in Fig. 33*A*) but only just wider than the rest of the body in dorsal view (Fig. 33*B*). Nuchal organ shoe-shaped, with a number of coarse pores (not of great taxonomic value, because they occur at least sometimes in several other species). In Fig. 33*B* the micropores are shown end-on in the middle of the dorsal surface, but as dashes on the sloping flanks, of the prosome; they seem to be like little tunnels drilled at right angles to the surface of the fairly thick but almost transparent integument. In Fig. 33*A* the stippling represents micropores only on the prosome; elsewhere it indicates structural relief with a view to emphasizing the teeth on the SREs, the arrangement of the eggs in the egg mass, and the way in which the partly translucent P5 overlies the latter. As in all members of this group, however, the density with which micropores are scattered all over the body (apart from the prosome) is at least twice that of the stipple in Fig. 33*A*.

The teeth on SREs 2–5 and 7–9 are markedly stronger in the DLzone than in any other zone, whereas on SRE1 the strongest teeth are in the abaxial part of the MDzone. Dorsal teeth of SREs 2–5 and 7–9 mostly small and blunt; lateral teeth of SREs 1–5, 7, and 8, moderate-sized, sharply pointed, and slightly uneven in size (on SRE9 they appear to be similar, but are almost entirely masked by spinules). Op (Figs 33*B*, 34*A*) highly characteristic, forming a straight-sided isosceles triangle which almost completely covers the IRS and reaches to between 1·0 and 1·5 of the FRs. IRD not more, and usually rather less, than the RBW. Op edge with a close-set fringe of minute spinules which diverge from the body axis at *c*. 30–40°. FRs roughly parallel, each FR a rather irregular oval with a square-cut tip but without excrescences, *L* : *B* about 3 : 2 or 4 : 3. FRsetae 1, 3, and 4 each fairly long, seta2 very small; by comparison with seta6, seta7 is very short but seta5 is quite long and thick; none of the FR setae are swollen, either basally or elsewhere, Genital region as in Fig. 34*A*. Spinulation on Abds 2, 3, and 4 as usual in this group except that there are no MV2s at all and that the various sub-combs of MV3s are confluent right across the ventral surface (this is even more pronounced as regards the MV4s). Microcombs aligned transversely all over the flanks of Abds 1–4 and the dorsal surfaces of Abds 3 and 4, each microcomb consisting of a single close-set row of triangular microdenticles, all very much as in *henryae*.

Prosomal limbs as usual in this group, except that A2enp (Figs 34*C*, 34*E*) has 2 rather small and clearly transverse WACs; Md enp (Fig. 34*F*) has 3 terminal setae and the adaxialmost spinules of the PCXcomb are far longer than any of the others; Mx2 (Figs 34*H*, 34*J*) proximal endite, proximal seta is of the recurved-thumb type but with only 2 or 3 spinules. Uniquely in this paper, P1exp2 (Fig. 35*A*) has no inner seta. On P2–P4, exp1 and exp2 each have a stout triangular thorn above the outer spine, as well as a longer one below it (Figs 35*B* = P2, 35*C* = P3, and 35*D* = P4). P5 (Fig. 34*L*) with its adaxial benp-edge even more strongly curved than in most of its relations; the exp, although fairly long, is also notably broad and distally almost rectangular, exp-seta1 being extremely long and heavily spinulose. Setal formula in Table 1.

Male Allotype

Length nearly 0·45 mm (Figs 36*A*, 36*B*), in general very like the female; SRE6 with teeth about as on the adjacent SREs; Abds 2–4 each have the DLs, VLs, and MVs confluent in a single row. A1 rather curled up when first drawn (Fig. 35*E*) soon after mounting, but after about 3–5 years the coverslip had settled sufficiently to press down upon it, so that it straightened out enough for the distal part to be redrawn to a larger scale (Fig. 35*F*), showing it to be of the direct type but more like the slightly atypical A1 of *tasmaniae* (Fig. 61*F*) than that of any other species in this group. P2 (Figs 97*D*, 97*F*) enp1 outer distal corner less thorn-like than in the female, inner setae of enp1 and enp2 each very small, enp2 outer edge with both outer thorns markedly deflexed and sharply pointed. P3

(Fig. 36*D*) and P4 (Fig. 97*E*) not remarkable. P5 (Figs 36*C*, 36*E*), enp-lobe only very slightly projecting, exp-setae 2 and 3 both smooth (and each only about half as long as seta1) but all the other P5 setae coarsely bipinnate.

Remarks

Deposition. Female J11129, male J11130.

Origin of the specimens described. In the type locality on 16.viii.1974.

Variation. None noticed.

Colour. Not observed alive; when dead, dull grey with glassy golden-yellow integument.

Type locality. Map 6, locality 9.

Synonyms. None.

Range of habitats. Ponds with (locality 9) or without (locality 4) weeds; in moss and *Nothofagus*-litter at locality 8 (with *C. howardorum*, *q.v.*) all localities on Map 6.

Geographical distribution. Map 6, all in Tasmania. 1 female at locality 4; a few at locality 8; and at locality 9, numerous on 16.viii.1974 but scarce there two days later (both coll. D. W. Morton), and I could find only *C. australicus* and *C. henryae* there on 10.ii.1975.

Major distinctions from similar Australian species. Within the *fimbriatus*-group, the big-headed appearance is shared only by *C. dedeckkeri*, whose integument is thinner, more flexible, and not golden-yellow. No other species lacks the inner seta on P1exp2, and hardly any have an operculum anywhere near as long, even if about the same shape.

Major distinctions from co-occurring species. As above; and furthermore the teeth on the SREs are not strong enough to be mistaken for *caecosetosus* (let alone the *longiseta*-group, which also show other differences from the *fimbriatus*-group), although they are comparable with those of *clavifurcatus*, which has an utterly different operculum.

Derivation of the specific name. I have much pleasure in naming this in honour of Mr David W. Morton, distinguished for his researches on Australian freshwater cyclopoids, to whom I am indebted for all the non-marine harpacticoids found by him over much of Tasmania and south-eastern Australia.

Canthocamptus timmsi, sp. nov.

Figs 37–41, 42*A*–42*H*, 43*A*–43*D*, 44, 45

Female Holotype (Figs 37–39)

Length 0·53 mm (Figs 37*A*, 37*B*), of moderately slender build, R small (Fig. 38*A*), prosome not unduly large, nuchal organ shoe-shaped, SREs 1–5 and 7–9 cut into small equilaterally triangular teeth, even-sized except for some distinctly larger MDteeth on SRE1 and a few very slightly larger DLteeth on SREs 7–9. Sensillary pores moderately numerous. VLs apparently out of line with (and slightly overlapping) the MVs as well as the DLs, on both Abd2 and Abd3, whereas all these groups are more or less in line and confluent on Abd4. Op about as long as the FRs, covering about half the IRS, and gracefully heart-shaped (Figs 37*D*, 37*F*), its smoothly curved edge closely set with a very slightly uneven row of short sharply pointed denticles pointing straight backwards. FRs short and rounded, *L* : *B* about 1 : 1, the outer corner not produced or thickened, RBW a little less than IRD. FRsetae not noteworthy except that seta5 has a strong dorsal swelling basally (Figs 37*D*, 37*E*, and more clearly in the inset to Fig. 37*E*) which is covered by a transparent ‘blister’ on the right-hand seta5 of Fig. 37*D*; seta4 inserts almost on the very tip of the FR. Abds 1–4 with many transverse microcombs of microserrations (not shown), whose teeth are bluntly triangular and contiguous but are too small to be seen clearly except under the highest powers of Nomarski optics.

A1 (Fig. 38*A*) with the proximal segs not unusually large; ASP = aesthetophore, and aes4 and aes8 are the aesthetascs on segs 4 and 8. A2 (Figs 38*B*, 38*C*) WAC single. Md (Fig. 38*D*) PCX with a short comb of relatively few strongly radiating spinules, the middle ones far longer than those at either end; palp segmentation ill-defined, CXB with some long and unusually thick setules, enp with an inner seta bearing a few long limp pinnules and with 3 terminal setae. Mx1 (Fig. 38*E*) and Mxp (Figs 38*G*, 38*H*) not remarkable. Mx2 (Fig. 38*F*) has the 'recurved thumb' type of proximal seta on the proximal endite. P1 (Fig. 38*J*) exp2 has an inner seta. P2–P4 (Figs 39*A*–39*C*), exp1 and exp2 each have a long triangular thorn on the outer distal corner, but none above the exp-spine (A or B, as the case may be, see Fig. 2*D*); on P2 and P3 these thorns are divergent and have blunt tips, but on P4 they are sharply pointed and closely adpressed to the exp, as well as being somewhat smaller (in Fig. 39*C* they are masked by spinules). P5 (Fig. 38*K*) with both enp-lobe and exp fairly long (for a member of this group) in proportion to the main part of the benp, exp inner edge unusually straight.

Male Allotype

Length 0·48 mm (Figs 40*A*, 40*B*), very like the female in general appearance and in the details of the op and FRs (Figs 40*D*–40*F*). The teeth on SRE6 are just like those on the other SREs. DLs on Abds 2–4 slightly but distinctly separate from VLs. A1 (Fig. 39*E*) of the offset type, seg6 with a large thin-walled adpressed thorn pointing distally. Of the 2 outer thorns on P2enp2 (Fig. 40*G*), the proximal is more distinctly hooked than the distal. P5 (Fig. 38*L*, exp enlarged in Fig. 38*M*) exp heart-shaped, exp-seta1 much longer and stouter than either exp-setae 2 or 3, enp-lobe projecting only slightly.

Remarks

Deposition. Female J11135, male J11136.

Origin of the specimens described. The type locality, see below.

Variation. Three females taken with *C. howardorum* (*q.v.*) had each been more or less completely drawn before being discovered to belong to this species; Figs 44 and 45 show one with an abnormal op, and Figs 41–43 the salient features of the others (numbered as Burnie females 1 and 2). The opercular variations (Figs 41*D*–41*Q*) are in general slight.

Colour. In the filtrate from the type locality, long after the larger and more lively *C. australicus* had swum rapidly in numbers up to the waters' edge nearest the light, this species and *C. longifurca* (not recognized as a distinct species until much later) were seen lethargically twisting, like maggots wriggling in slow motion; the body was of a pale whitish or straw-yellowish grey, with a tinge of palest orange-pink in the intestine. They emerged from the dirt only after 10–30 min, as if with extreme reluctance; when dead, they were of the usual pale grey.

Type locality. Map 6, locality 14 (also cited in Appendix 1 under *C. australicus*), numerous among weed-washings, coll. A. J. Boulton and R. Hamond, 24.v.1984.

Synonyms. None.

Range of habitats. All on Map 6; moss under spray from waterfall at locality 16; weeds in slowly moving stream at locality 14; thick damp moss with abundant *Nothofagus* litter at locality 8; and among high-altitude *Sphagnum* at localities 24 and 25.

Geographical distribution. Only as above (all on Map 6): numerous at localities 14 and 16, frequent but in varying numbers in the many small samples which collectively made up localities 24 and 25, and only a few at locality 8.

Major distinctions from similar Australian species. See Keys 4 and 5, in each of which the last half-dozen or so species are by far the most difficult to tell apart (*timmsi* among them). However, if normal, the op is fairly distinctive.

Major distinctions from frequently co-occurring species. Once again, as in Keys 4 and 5 (and Keys 1–3 if *Fibulacamptus* is present).

Derivation of the specific name. In honour of Dr Brian V. Timms, an Australian limnologist renowned for his researches on the taxonomy and distribution of Australian Cladocera, to whom I am indebted for specimens and information.

Canthocamptus dedeckkeri, sp. nov.

Figs 46–48, 62*E*–62*H*

Female Holotype

Length 0·7 mm (Figs 46*A*, 46*B*), the prosome large (but less so than in *mortoni*, Figs 33*A*, 33*B*). R small, nuchal organ long-oval and broadest across its middle. Microcombs distributed as in Fig. 46*A*, composed of microdenticles about as in *henryae* (Fig. 7*M*). True pores not charted, but apparently about as in *mortoni.* The first 5 SREs have small rounded teeth (somewhat larger, but flatter and more squashed together, across the MDzone of SRE1), whereas those on SREs 7–9 are equilaterally triangular in form. Op heart-shaped as in *timmsi*, but with the marginal denticulations (Figs 46*B*, 46*D*) a little coarser and more widely spaced. FR *L* : *B*, general appearance and setae all very much as in *mortoni*, but seta5 quite unique in this paper in the way that its strong dorsal swelling is crowned by a further abrupt dorsal basal hump (Figs 46*A*, 46*E*). Abd spinulation (Figs 46*A*, 46*C*) almost exactly as in *timmsi*, but the present species lacks the inner comb of MV3s shown in Fig. 37*C*, and its MV5s do not extend onto the edge of the subanal sinus. Genital region also unusual in this group, in having 2 setae on each complex instead of only 1 (Fig. 46*C*).

Certain limbs (A1, Fig. 46*F*; A2enp, Figs 47*A*, 47*B*; P1, Fig. 47*F*; and the exp3s of P2–P4, Figs 47*G*–47*J*) differ from those of related species only in being noticeably more slender. A2enp has 2 short WACs; Md (Fig. 46*G*) PCX spinule-comb has some very long spinules as in *mortoni* (Fig. 34*F*) but only a very few short ones in contrast to that species, Mdenp with 3 setae; Mx1 (Fig. 47*C*) has a short comb of stiff and pointed spinules on the basis, just rearward of the insertions of the 5 ramal setae; Mx2 (Fig. 46*H*) proximal endite, proximal seta of the recurved-thumb type but far less recurved than in several other members of this group; Mxp (Figs 47*D*, 47*E*) not remarkable. P1 (Fig. 47*F*) exp2 has an inner seta; P2–P4 (Figs 47*G*–47*J*), exp1 and exp2 each have a long outer-distal-corner thorn just below the exp-spine, and a much shorter one just above it and adpressed against it. P5 (Fig. 47*K*) with all setae, especially the longer ones, noticeably shorter than in several related species, in proportion both to their own thicknesses and to the size of the rami; adexp thorn quite large and apically rounded, exp shape about as in *henryae* (Figs 7*K*, 65*C*–65*E*).

Male Allotype

Length 0·44 mm (Figs 48*A*, 48*B*), nuchal organ parallel-sided with rounded ends, SRE6 like SREs 7–9 in being denticulate with 1 or more extra-prominent teeth in the DLzone. VLs confluent with the DLs on Abds 3 and 4 but separate from them on Abd2 (Fig. 48*B*). FRs proportionately somewhat shorter than in the female, setae the same except that seta5 does not have a thickened base.

A1 (Fig. 48*G*) of the offset type. P2 (Figs 62*E*, 62*H*) and P4 (Fig. 62*G*) not remarkable except that P2enp may have the formula 1.120 (Fig. 62*E*) or 0.020 (Fig. 62*H*). P3 (Fig. 62*F*) enp3 has a noticeable outer-edge fold at about 0·7, and the inner seta of exp2 and the upper inner seta of exp3 are each very short with long pinnules. P5 (Fig. 48*H*) enp-lobe strongly projecting, all P5setae rather short with thick bases.

Remarks

Deposition. Female J11106, male J11107.

Origin of the specimens described. The type locality.

Variation. None noticed.

Colour. Not seen alive, pale grey when dead.

Type locality. Map 6, locality 23.

Synonyms. None.

Range of habitats. Among dirt and rotten plant-remains at locality 22 (see *C. mammillifurca*), and in or under *Sphagnum*-cushions at localities 23 and 24; moderately numerous in all these places. As far as is known at present, this species is more narrowly confined to the highlands of eastern Victoria than any others except the much rarer *C. sublaevis* and *C. longipes*, and *C. mammillifurca* at a lower altitude than either of the foregoing.

Geographical distribution. Only as just quoted.

Major distinctions from closely allied species. The operculum is moderately distinctive, but the two best distinctions in the entire animal are visible in side view, namely the 'big-headed' appearance, and the base of FRseta5 as in Fig. 46*E*.

Major distinctions from co-occurring species. The above serve to distinguish this species from all others in localities 22–25 on Map 6.

Derivation of the specific name. I have pleasure in dedicating this species to Dr Patrick De Deckker, distinguished for his important contributions to the taxonomy and distribution of Australian freshwater ostracods, to whom I am indebted for several interesting samples of harpacticoids.

Canthocamptus clavifurcatus, sp. nov.

Figs 49–52

Female Holotype

Length 0·55 mm, general appearance not unlike that of *caecosetosus* both in side view (Fig. 49*B*) and in dorsal view (Fig. 49*A*, in which the prosome is unavoidably somewhat depressed by the coverslip, in order to prevent the animal from falling over sideways). R small and triangular (Fig. 49*F*). Prosome distinctively and densely malleolate (with dents all over the integument, as if repeatedly but lightly struck with a ballpeen hammer). Micropores dense all over the body including both within and around the prosomal dents. The shoe-shaped nuchal organ has numerous medium-sized pits in it. Microcombs as in Figs 49*A* and 49*B*, very much as in *caecosetosus* but with even fewer microserrations (i.e. the vast majority are of microsetules). SREs 1–3 have their largest teeth across the MDzone, whereas SREs 4–9 (excluding 6) have theirs in the DLzone, including (on SREs 7–9) a spectacularly large thorn-like tooth which is merely the rear end of a not very marked keel along the somite in this zone. Abd spinulation (Figs 49*A*–49*C*) exactly as in *caecosetosus*; each genital complex has 2 setae (Fig. 49*C*).

Op and FRs both diagnostic (Fig. 49*A*); op (Figs 49*D*, 49*E*) almost exactly like that of *caecosetosus* (Fig. 53*C*) but FRs distinctly less lumpy (*L* : *B* is about 3 : 2 or 4 : 3 in dorsal view), and with all setae normal. The base of seta5 is symmetrically swollen, from which it tapers rapidly at first and then more gradually; setae 5 and 6 are both finely striated on their dorsal and ventral surfaces only, from the insertion to well beyond the breaking-plane, about as for seta6 in Fig. 29*G* but more faintly.

A2 (Figs 50*A*, 50*B*), exp slender and distally curved with fairly long setae, WAC split so that the spinules of the proximal half, which are coarser, curve distinctly out of line with the finer spinules of the distal half. Md (Fig. 49*G*) PCXcomb of extremely long spinules, enp with 3 terminal setae; Mx1 (Figs 50*C*, 50*D*) remarkable only in that the single suture separating both the coxa and basis from the PCX runs at an equally steep angle on each face, instead of there being (as in most other species) a suture between PCX and coxa, and another between coxa and basis. Mx2 (Fig. 49*H*) with the proximal seta of the proximal endite being of the recurved-thumb type, but much less recurved, and with fewer and larger spinules, than in most related forms. Prosomal limbs otherwise not remarkable. P2 (Fig. 50*H*) almost exactly like that of *caecosetosus* (Fig. 55*E*) except for having an outer seta on enp2; P3 (Fig. 51*A*) and P4 (Fig. 51*B*) differ from P3 and P4 in that species mainly in having only 1 inner seta on exp3. P5 (Fig. 50*J*) also almost exactly like that of *caecosetosus* (Fig. 54*K*), except that the inner shoulder of the exp is more angular and exp-seta 1 is proportionately much longer (it is smooth in both these species, but pinnate in all other members of this group).

Male Allotype

Length 0·43 mm; general appearance (Figs 51*C*, 51*D*) very much like that of the female, SRE6 in general very like SREs 5–9 (except for the prominent DLthorn on SRE7). On Abds 2, 3, and 4 the DLs curve forward but are ventrally confluent with the VLs (Figs 51*D*, 51*E*). A1 and remaining limbs (Figs 52*A*–52*G*) very much as in *caecosetosus*, except that (as in the female) exp3 of P3 and P4 has only 1 inner seta instead of 2; P2enp2 has the outer-edge papilla (Figs 52*B*, 52*C*) found otherwise only in *caecosetosus* (Figs 56*H*, 56*J*). Fig. 52*H* shows P2enp after it had settled in the preparation so as to lie flatter than in the other figures. The benp-setae of P5 (Fig. 52*G*) are strongly bipinnate, instead of smooth as in *caecosetosus* (Fig. 56*G*), and the benp itself is also more protruding than in that species.

Remarks

Deposition. Female J11121, male J11122.

Origin of the specimens described. The type locality.

Variation. None noticed.

Colour. Alive, not seen; dead, grey with a strong golden-brown tinge.

Type locality. Map 6, locality 8, with *C. howardorum* (*q.v.*).

Synonyms. None.

Range of habitats and geographical distribution. A single husk in locality 7, which, being a large body of open water, was probably not a suitable habitat anyway; otherwise a few each, at locality 10 among wet moss, and at locality 8 among *Nothofagus* litter.

Major distinctions from similar and/or co-occurring species. Nearest to *caecosetosus*, from which it is distinguishable as described above; other good characters are the prosomal dents and the op and FRs.

Derivation of the specific name. From the Latin *clava* = a club, and *furcatus* = forked; intended to suggest an animal with club-shaped FRs.

Canthocamptus caecosetosus, sp.nov.

Figs 53–56

Female Holotype

Length 0·63 mm; both in dorsal (Fig. 53*A*) and ventral (Fig. 53*B*) views, the animal is of average build, with a moderate-sized prosome bearing a shoe-shaped nuchal organ. The teeth on SRE1 are largest by far in the MDzone, those on SREs 2–5 are a mixture of large and small but tend to be largest in or near the DLzone, and those on SREs 7–9 are all small (fairly evenly so) except for 1 very large, strong, pointed DLtooth. Microcombs on Abds 1–4, mostly in the DLzone but spreading down the flanks of Abds 1–3 as both larger microspinules and much smaller microserrations (the latter well forward, near the preceding

SRE), although down the flanks of Abd4 only as microserrations closely behind SRE8; no microcombs middorsally or midventrally (Fig. 54*A*). Scattered sensillary pores from the prosome to the rear of Abd3 (Fig. 53*B*). Abd spinulation very much as in related species (other than *tasmaniae*, *q.v.*), except that the DLs on Abds 2–4 form very sharply curved combs (Fig. 53*B*) which are clearly separate from, and out of line with, their respective VLcombs. The inner comb of MV5s extends well into the subanal sinus.

Op and FRs diagnostic (Fig. 53*C*) in that op hardly overhangs the IRS at all (IRD distinctly more than RBW) and is a very short isosceles triangle, with slightly curved edges and a small but distinct apex broadly rounded at the tip; the edges are fringed with long, thin, pointed, somewhat untidy-looking spinules which readily fall off, leaving scars that are hard to see. FRs slightly divergent, each FR somewhat irregularly barrel-shaped (with very lumpy contours), setae normal except for the quite unique FRseta5 whose basal part forms a thick-walled hollow cul-de-sac or caecum with a rounded bag-like end, from whose inner side the disproportionately short and slender setal remainder arises subterminally (Figs 53*A*–53*D*, 54*A*, 54*B*).

A1 (Fig. 53*E*) with the first 4 segs distinctly wider than average for their length. A2 (Figs 53*F*, 54*C*) with the exp rather long and more or less evenly curved throughout its length, the WAC split (each half-WAC short and with rather fine spinules). Md palp (Fig. 54*D*) indistinctly segmented (Figs 55*B*, 55*C*, the thin intersegmental membranes shown dotted), enp with 3 terminal setae; Mx1 (Figs 54*E*, 54*F*) with 1 rear-surface seta on the PCXA, and with 5 ramal setae; Mx2 (Fig. 54*G*) as in *clavifurcatus* (*q.v.*); Mxp noteworthy only in that the lengthways spinule-comb on the front surface of the hand (Fig. 54*H*) turns up sharply at its distal end; P1 (Fig. 55*D*) exp2 has an inner seta; prosomal limbs otherwise not remarkable. P2 (Figs 55*E*, 55*F*), P3 (Fig. 55*G*) and P4 (Fig. 55*H*) each have normal-sized thorns below exp-spines A and B, but the thorns above each of these spines (especially that above B) are not only rather small but tend to be deflected behind the spine so as to be rather difficult to see. In Fig. 55*E* the thorn below spine A is abnormally rounded off, and therefore I have shown the normal condition in Fig. 55*F*. The inner seta of exp-segs 2 and 3 are all very small on P3 (Fig. 55*G*), and on P4exp3 (Fig. 55*H*) the inner distal seta is only half the length and thickness of the proximal one. P5 (Fig. 54*K*) with a rather slender enp-lobe but a broad (and distally square-cut) exp, an average adexp thorn, and with all setae of both rami moderately short; exp-setae unusual in that seta4 is the most bipinnate, seta3 has only 2 or 3 outer pinnules, and setae 1 and 2 are completely smooth (cf. *clavifurcatus*).

Male Allotype

Length 0·60 mm (Figs 56*A*, 56*B*); DL4s confluent with their VLs, but DL 2s and 3s separate from their VLs and are as in the female but markedly less curved. FRsetae all normal, including seta5. A1 (Fig. 56*C*) of the offset type. The exps of P2 and P4 are not figured because of being exactly like those of the female. P2enp2 (Fig. 56*H*) has a curious papilla (highly magnified in Fig. 56*J*) with thin walls and an apparently hollow conical centre, at about 0·5 on the outer edge, which at its very end has a front-surface thorn overhanging the insertion of the outer terminal seta. This papilla is also found in *clavifurcatus* (*q.v.*) but in no other species in this paper. P3 (Fig. 56*E*), enps 1 and 2 each with a thorn on the outer distal corner, and the setae of enp3 very unequal; P4enp as in Fig. 56*F*, P5 as in Fig. 56*G*, and P6 with 2 setae (Fig. 55*A*).

Remarks

Deposition. Female J11124, male J11125.

Origin of the specimens described. The type locality.

Variation. No genuine variation noticed; however, the operculum may look deceptively different, according to whether it has kept its spinules, or shed them (in which case the scars will be large but very faint, requiring careful search).

Colour. Not seen alive; dead, of a rich horny brown (but this is approached by several other species).

Type locality. Map 6, locality 20, on 4.iv.1975.

Synonyms. None.

Range of habitats and geographical distribution. All on Map 6. In wet moss in waterfalls at localities 10 (a few) and 20 (moderately numerous); also (at most very few) in a high-altitude stream at locality 22, and in a lowland river draining a mountainous area at locality 19.

Major distinctions from similar and/or co-occurring species. In the females only, the bag-like FRseta5 offers an instant distinction from all other species in this paper; the males are more difficult (especially in the *fimbriatus*-group, to which this and all other species in locality 10, save *hirsutus*, belong) and must be determined by careful comparison with the relevant descriptions as well as Key 5 and Table 1. *C. hirsutus* co-occurred at both localities 10 and 20, but can be distinguished at once from all other species in this paper by its band of spinules on the prosome near the adoral edge, and by its combs of DLs on ped5.

Derivation of the specific name. From the Latin *caecum* = a blind-sac or closed-off bag, and *setosus* = (in this case) pertaining to a seta; intended to suggest an animal with a caecum-like seta, namely the female FRseta5.

Canthocamptus, sp. 1

Figs 57 and 58

Female

Not yet found.

Male

A detailed description is not warranted, owing to the absence of the female, and also because this male is so like those of *caecosetosus* and (to a lesser extent) *clavifurcatus.* It differs from both of them in: (1) the operculum (Fig. 57*D*), which is diagnostic in having a smoothly curved edge produced into an extended apex with a rounded tip; an almost straight row of spinules stretches across the upper surface of the opercular base, but the opercular edge itself is everywhere fairly thick and completely smooth, without the slightest detectable trace of scars showing where spinules might have once been; (2) the absence of a papilla on P2enp2 (Fig. 58*B*), which is found in both these other species.

It is closer to *caecosetosus* in the absence of dents on the prosome (or elsewhere) and the types of microcombs and their arrangement (especially on the abdomen, Fig. 57*A*); but on the other hand P3 (Fig. 58*C*) and P4 (Fig. 58*D*) each have only 1 inner seta on exp3, as in *clavifurcatus.*

The A1 (of the offset type) was disadvantageously oriented when first mounted (Fig. 58*A*), but after a few years has settled down enough to allow the distal part to uncurl enough to be drawn as in Fig. 58*F*.

Remarks

Deposition. Male J11123.

Origin of the specimen described. In locality 10 on Map 6, which thus becomes the type locality, on 8 or 9.ii.1975; in wet moss on the Guide River Falls, Tasmania. This comprises the entire range of habitats and geographical distribution.

Synonyms. None.

Colour. Not seen alive, nondescript grey when dead.

Major distinctions from similar and/or co-occurring species. As above, assuming that one has firstly either gone through Key 5, or has traced the specimen to the *fimbriatus*-group and then checked all the males in that group.

Canthocamptus tasmaniae (Chappuis)

Figs 59–61, 62*A*–62*D*

Attheyella (Delachauxiella) tasmaniae Chappuis, 1951, pp. 110–12, figs 16–23. (OD)

Female Neoholotype

Length 0·60 mm. In side view (Fig. 59*B*) this species has a rather long-bodied and slim-waisted appearance; whereas, in dorsal view, and in the teeth on SREs 1–5 and 7–9 (Fig. 59*A*), it is very like *timmsi* or *globulisetosus* except for having 1 or more exceptionally large DLteeth on each of the above SREs. Nuchal organ shoe-shaped, sensillary pores much less numerous behind ped5 than in front of it, Abd without microcombs but with vague transverse lines (not shown) to indicate where they might have been. Most of the abd spinules have fallen off, leaving scars (visible only under high-power Nomarski) from which it would not be safe to attempt to reconstruct the complete spinulation; therefore I have drawn only those spinules that are still in position, and left it at that. Genital region as in Fig. 59*C*.

Op and FRs the most diagnostic features of this species. Op an almost equilateral triangle with only very slightly rounded basal corners and very nearly straight sides fringed with spinules that diverge at between 30 and 40° to the axis (Figs 59*D*, 59*E*, 59*H*, 59*J*); apex not distinct from the rest of the op to any appreciable extent. Fig. 59*G* is a tracing of Chappuis' fig. 20, showing remarkably good agreement with my Fig. 59*D* next to it. In dorsal view the FRs are moderately but distinctly divergent, rather thick-walled, and of a very characteristic shape in which they widen rapidly from 0·0 to 0·2 and thereafter have the form of thick-walled lumpy cylinders without any taper either way (apart from a very slight narrowing between 0·4 and 0·6 approximately); the outer distal corner forms a short stout thorn, and the inner distal corner is also thick-walled although rounded off. All FRsetae are unusually short (other than setae 3 and 6), and seta5 is heavily sclerotized and peg-like with a blunt tip. Setae 5 and 6 are dorsally striated from the base to just beyond the breaking-plane (like seta6 in Fig. 29*G*, but much more faintly; striations omitted in Fig. 59*D*, so as not to clutter up the drawing). In side view (Fig. 59*F*) there is a long, low, rounded, ventral hump in the FR, deepest at about 0·2, and a similar dorsal hump with seta3 on its apex at about 0·8; there is also a low adaxial bulge just in front of, and dorsal to, the insertion of seta7 (which is only about half the length of FR). Seta4 far more lateral than in preceding species, and behind setae 1 and 2 rather than adaxial to, and on a level with, them.

Noteworthy limb features. A2 and P2–P4 are each rather stumpy and ruggedly built (Figs 60*B*, 60*C*, 60*J*–60*L*); A2enp unique except for that of *C. longipes* in having the PG (Fig. 60*B*) multiseriate (better shown in Fig. 60*C*). Md (Fig. 60*D*) unfortunately damaged, but enp with 3 terminal setae; Mx1 (Fig. 60*E*) with 5 ramal setae; Mx2 (Fig. 60*F*) proximal endite, proximal seta of the recurved-thumb type; P2 (Fig. 60*J*), P3 (Fig. 60*K*), and P4 (Fig. 60*L*), exp1 and exp2 each have a short, stout, blunt thorn above the exp-spine and a similar but longer thorn below it; setal formula in Table 1. P5 (Fig. 60*M*) as usual in this group, but with both rami short, broad, and thick-walled, exp with a straight inner edge and rectangular distal half, adexp thorn prominent, all P5-setae unusually short.

Male Neoallotype

Length 0·48 mm (Figs 61*A*, 61*B*); general appearance and all details of op and FRs (Figs 60*C*–60*E*) very much as in the female except that FRseta5 has the form of a normal seta (Fig. 61*D*) instead of peg-like, is not at all heavily sclerotized, and has multiseriate outer-edge setules (Fig. 61*C*). Incidentally, Chappuis' fig. 20 (copied in Fig. 59*G*) is stated by him to be of a female, and agrees with this sex except for having an apparently male

FRseta5! He found both sexes, and therefore may have drawn this seta from one of his males to fill in the missing setal space in his drawing of the female FR, failing to notice that this seta is sexually dimorphic.

The op of the neoallotype is also proportionately longer than that of the neoholotype, and is in fact more like that of *mortoni* or *globulisetosus*. Abd spinulation (Figs 61*B*, 61*E*) consists of DL, VL, and MV groups of seldom more than 5 or less than 4 spinules; unlike the neoholotype, there is no evidence that more than a very few (indicated by scars) have fallen off, and therefore this grouping of the spinules is potentially a useful specific distinction from the other members of this group, all of which have these spinules more or less even-sized. DL5s and MV5s each very few and small, the latter in two groups of which the adaxial only just reaches the outermost corner of the subanal sinus.

A1 (Fig. 61*F*) nearer the direct than the offset type, but not wholly referable to either; no thorn on seg4. P2–P4 (Figs 62*A*, 62*C* and 62*D*, in that order) with short and stumpy segs, especially segs 1 and 2, whose thorns and spines are about as in the female but are masked by epaulettes of much longer and stronger spinules than the few small ones on exp3. P2 (Fig. 62*A*) enp2 with an outer-edge thorn and a formula of 020, although the other P2enp2 (Fig. 62*B*) lacks the thorn and has a formula of 121; P3 (Fig. 62*C*), enps 1 and 2 each without an outer thorn, and enp3 without any lumps or folds (both its terminal setae rather short); P4 (Fig. 62*D*) enp2 very short; P5 (Fig. 61*G*) not remarkable.

Remarks

Deposition. Female J11104, male J11105.

Origin of the specimens described. In the type locality; the female on 8 or 9.ii.1975, and the male on 1.vi.1982.

Variation. The holotype has the formula 0.220 on the left P4enp, and 1.221 on the right.

Colour. Alive, unknown; dead, dull grey with a brownish tinge.

Type locality. Guide River Falls, Tasmania (Chappuis 1951) = locality 10 on Map 6.

Synonyms. None.

Range of habitats and geographical distribution. In thick wet moss hanging all down the Guide River Falls, on several occasions; a single male (lost after Figs 61*A*–61*D* had been drawn from it) among *Nothofagus* litter at locality 8 of Map 6, with *C. howardorum* (*q.v.*).

Major distinctions from similar and/or co-occurring species. The operculum, and the FRs with their setae.

Derivation of the specific name. From the Latin *tasmaniae* = of, or living in, Tasmania.

Canthocamptus longipes, sp. nov.

Figs 63–66

Female Holotype

Length 0·43 mm; general appearance (Figs 63*A*, 63*B*) gives a strong immediate impression of trimness and neatness without the body being slenderer than usual in this family. Nuchal organ oval, full of circular pits, each with a few granules in it. True pores (both plain and sensillary) moderately numerous, but not charted. FR $L:B$ about 4 : 3, genital region as in Fig. 63*C*; if the total absence of adgenital combs (AC in Fig. 2*A*) is an abnormality, it is one that I have never encountered in any other species in this paper. DL 2s and 3s separate from their respective VLs (lying slightly ahead of them, and forming a moderately curved comb), but DL4s confluent with VL4s (Fig. 63*B*); in ventral view (Fig. 63*C*) there appear to be no MV2s or MV4s at all, but Abd3 has a comb either of LVs or of outer MVs (at the moment I have no way of deciding which they are, in a case like this). In Fig. 63*B*, some features which could not be shown precisely with a sufficient degree of reliability have been indicated by dashes.

A1 (Figs 63*A*, 63*B*, 63*F*) moderately long and distinctly slender. A2 (Fig. 63*G*) with a rather slim and curved exp, WAC split, each half-WAC of fine spinules, PC biseriate. Md,enp with 3 setae, all terminal. Mx1 (Fig. 64*B*) PCXA with 1 rear-surface seta, basis with 3 or 4 (according to interpretation) ramal setae. Mx2 proximal endite, proximal seta is of the recurved-thumb type with about 4 very adpressed spinules, enp has 3 setae. Mxp (Figs 64*D*, 64*E*) not remarkable. P2–P4 (Figs 64*G*, 65*A*, 65*B*) slender, exp-spines C–E much smaller on P4 than on P2 or P3; setal formula in Table 1. P5 (Fig. 64*H*, outline of exp repeated in Fig. 64*J*) shape quite unique in this paper, as are the relative lengths of the benp-setae; enp-lobe with a front-surface pore, benp with an edge-pore just where the adexp thorn would be in any member of the *fimbriatus*-group, and exp with a rear surface pore just in from the adaxial edge (arrowed) as well as a front-surface pore near its tip.

Male Allotype

This, the only male found so far, was lost by an unfortunate accident immediately after drawing Figs 66*A*–66*C*, from which it can be seen that the male agrees very closely with the female in general appearance (SRE6 being serrated just like the other SREs) and in the structure of P1, but differs in being only 0·306 mm long (from Fig. 66*A*), in having the DLs confluent with the VLs on Abds 2–4, and in having an MV gap on Abd4 but not on either Abd2 or Abd3.

Remarks

Deposition. Female J11118.

Origin of the specimens described. In one of the many samples from locality 25 on Map 6 (which thus becomes the type locality) there were the holotype, paratypes 1–3, and the allotype. This represents the entire range of habitats and geographical distribution.

Variation. None noticed.

Colour. Not seen alive; dead, a rather distinctive pale steely grey.

Synonyms. None.

Major distinctions from similar and/or co-occurring species. The general body shape, the colour, the extremely regular teeth on the SREs, the operculum, the very long enp1 of P1, and (in the female only) the form of P5.

Derivation of the specific name. From the Latin *longipes* = long-legged, in allusion to the very long enp1 of P1.

Canthocamptus hirsutus (Chappuis)

Figs 67–74

Attheyella (Chappuisiella) hirsuta Chappuis, 1951, pp. 107–10, figs 6–15. (OD)

Female Neoholotype

Length 0·61 mm, general appearance average (Figs 67*A*, 67*B*). R pointed (Fig. 67*D*), nuchal organ shoe-shaped (Fig. 67*B*), the whole body peppered with micropores, which tend to be arranged in confluent groups interspersed here and there with isolated clear spaces only a few micrometres across, and among which are a few sensillary pores and fewer still plain pores (not shown in Fig. 67*A*, and only a few in Fig. 67*B*). As shown in these figures, most of the sensillary pores are tunnel-pores just ahead of the SREs. The prosome is unique, in this paper, in having a narrow multiseriate band of rearwards-pointing spinules on the outer surface just above its lower edge, level with the mouthparts. The vertically elongated oval area (shown dotted in Fig. 67*A*) on the flank of ped2 indicates where the thickened cytoplasmic edge of a curious organ forms an attachment scar to the PLT inner surface; this scar is extremely difficult to see in a whole specimen in water or dilute formalin, but its appearance in the holotype slide is rather like that of the 'integumental lateral discs' described by Gurney (1932, mainly on p. 22, also pp. 18, 28, 32, 264, and 270). The comb of setules on ped4 is seen by transparency through the PLT in Fig. 67*A*, in which (and in Fig. 67*B*) the 2 DLcombs, one above the other, on ped5 constitute another highly diagnostic character. There is nothing to show the former site of SRE6 except a row of sensillary pores, but Abds 2–4 each have a confluent comb of DLs, VLs, and LVs, themselves confluent with much smaller MVs on Abds 3 and 4, although Abd2 has a large MVgap (i.e. with no MVs at all). FR *L* : *B* about 4 : 3, FRs rounded and rather pear-shaped; setae 5–7 arise in a line across the square-cut end; seta5 has a slightly swollen base, but otherwise none of the FRsetae are modified. Seta2, although arising as usual just ventral to seta1, turns upwards and rearwards over the surface of the FR (Fig. 67*B*), whereas seta1 sticks out sideways at the normal angle of about 45°. Op forms a smooth shallow arc of a circle, with an even fringe of short slender closely set spinules all pointing straight rearwards. Abdominal microcombs consist of transverse rows of triangular microdenticles (not shown).

A2 (Figs 67*E*, 67*F*) WAC interrupted, all its spinules rather coarse. Md (Fig. 68*A*) enp with 4 terminal setae. Mx1 (Fig. 68*B*) has 5 ramal setae and its PCXA has 1 rear-surface seta. Mx2 (Figs 68*C*, 68*D*) proximal endite, proximal seta straight and ends in a tiny 2-pronged fork, enp has only 2 setae. P1 (Fig. 68*F*) exp2 has an inner seta. Prosomal limbs otherwise not noteworthy.

Setal formula of legs as in Table 1; P1 (Fig. 68*F*), P2 (Fig. 68*G*), P3 (Fig. 69*A*), and P4 (Fig. 69*B*), only moderately long, the distal outer corner of exps 1 and 2 of P2–P4 not produced into a thorn; otherwise the only specific character of note is the broadly oval shape of enp2 of P2 and P3, which tapers evenly from its widest point (at about 0·2 or 0·3) to a narrow distal end. P5 (Fig. 68*H*) with a rather short exp.

Male Neoallotype

Length 0·53 mm (Figs 70*A*, 70*B*), very like the female except that SRE6 is fully developed and has a row of DL1s, and that all MVs on Abds 2, 3 and 4 are of the same size and have no gaps anywhere. A1 as in Figs 70*D*, 70*E*. P2 and P4 as in the female; P3 (Fig. 69*C*) enp modified as usual (enlarged in Figs 69*D*, 69*E*), and exp-spines A and B (especially B) very much longer and thicker than C, D, or E; spine B is also notable in being closely adpressed so as to lie parallel to the exp. P5 (Fig. 69*F*) and P6 (Fig. 70*C*) not remarkable for this group.

Remarks

Deposition. Female J11112, male J11113.

Origin of the specimens described (Figs 67–70). Topotypes collected by me on 8.ii.1975.

Variation. Negligible. Figs 71–74 show specimens from locality 20 on Map 6, drawn before I had been able to collect at locality 10 on Map 6, and it will be seen how closely these specimens agree with one another, even though separated by more than the width of Bass Strait.

Colour. Not seen alive; nondescript pale grey when dead.

Type locality. Guide River Falls, Tasmania (Chappuis 1951), = locality 10 on Map 6.

Synonyms. None except as in the original description (above).

Range of habitats and geographical distribution. Map 6; at locality 10 (Chappuis 1951; found there by me a few times, numerous only on 1.vi.1982), several at locality 25, and singly at localities 17 and 20.

Major distinctions from similar species. By far the best characters are the band of spinules along the adoral edge of the prosome, and the DLcombs on ped5.

Major distinctions from frequently co-occurring species. As above; also the smooth SREs.

Derivation of the specific name. From the Latin *hirsutus* = hirsute, or hairy; Chappuis gives no reasons for thus naming this species.

Canthocamptus australicus (Sars)

Figs 75–80

Attheyella australica Sars, 1908, pp. 18–20, plate IV, figs 9–26. (OD)
Attheyella australica Henry, 1922, p. 567, no figures; Lang, 1948, p. 990, Abbs. 380:5 and 394:2. (LD)
Chappuisiella australica Brehm, 1953, pp. 54–6, figs 49–51. (LD)

Female Neoholotype

Length 0·85 mm, prosome not unduly large (Figs 75*A*, 75*B*), the rest of the body tapering away more or less evenly from SRE1 to SRE10, all of which are smooth (SRE6 represented only by an internal rib, as usual). Nuchal organ keyhole-shaped. Sensillary pores numerous on the prosome, but less so between SREs 1 and 7, after which they are very few. Just ahead of SREs 1–3 the integument is pleated; these pleats (shown dashed in Figs 75*A* and 75*B*) may be seen on a whole specimen far better by the lit-from-within method (see Postscript, p. 1247) than by normal bright field or by any other method, but in a gum-arabic medium preferably by phase-contrast or Nomarski. No micropores, but numerous microsetules in transverse microcombs (confined to Fig. 75*F*, so as not to clutter up Figs 75*A* and 75*B*, and much enlarged in Fig. 2*F*) more or less spaced apart all over the abdomen.

DLs reach furthest dorsally on Abd2 and successively less so on Abds 3 and 4, being confluent on all 3 somites with the VLs, which are in turn confluent with the MVs that run continuously across Abds 3 and 4 (there are no MV2s). All the spinules in these combs are of much the same size, except that all the MV2s are unusually small (about half as long as the VL2s, or even less). VL5s consists of a short comb of small spinules, and MV5s of only about 4 large spinules of which the most adaxial extend onto the walls of the subanal sinus.

Op (Fig. 75*A*) a shallow arc of a circle, its smoothly curved edge fringed evenly with slender, closely set microspinules. FRs roughly parallel to the axis (and thus to one another), IRD at least equal to RBW, FR in dorsal or ventral view tapering conically and not quite smoothly, but in side view with seta3 on the apex of a distinct hump after which the FR tapers rapidly to a much smaller tip bearing setae 5–7 in a straight line across its end. Setae 1 and 2 very far forward (at about 0·2; seta2 shown black in Figs 75*D*, 75*E*), seta3 at about 0·4, and seta4 at about 0·7; inner surface of FR covered with long sparse setules, some of which may perhaps be better described as slender spinules because of seeming to be stiffer than the others. None of the FR setae have basal swellings or other modifications. Genital region as in Fig. 75*C*.

A1 (Fig. 77*A*) rather slender. A2 (Figs 78*A*, 78*B*) slender overall, allobasis proximal abexp seta flanked but not masked by moderately long spinules lying adpressed to the limb surface, exp curved, long and very slender, enp with a single long WAC, composed of many fine spinules, that runs to some extent lengthways before curving round the end of the segment. Md (Fig. 76*A*) PCX parallel-sided, CXB with an apical seta, enp with 1 inner and 4 terminal setae. Mx2 (Figs 76*D*, 76*E*) proximal endite with the proximal seta fused, thick-walled, only very slightly recurved, and not precisely of either the recurved-thumb or the miniature-fork type (see all Australian congeners) although perhaps nearer the former (it is greatly enlarged in Fig. 76*F* to show its ornamentation). Mxp (Figs 76*G*, 76*H*) with longer palm and claw than in many other species, but not otherwise noteworthy. P1 (Fig. 77*B*), P2 (Fig. 77*C*), P3 (Fig. 77*D*), P4 (Fig. 78*C*), and P5 (Fig. 78*D*) each with an exp which is slenderer than in most other species in this paper; setal formula as in Table 1. P5benp has very few spinules, and the exp has rather more (in groups of 2 or 3).

Male Neoallotype

Length 0·67 mm; in dorsal view (Fig. 79*A*) the prosome is proportionately larger than in the female, and the nuchal organ is similar but narrower. SRE6 resembling the other SREs. FR simply conical, with hardly a trace of any hump. Abds 2, 3, and 4 each have a continuous hoop of confluent and same-sized DLs, VLs, and MVs, and in addition there is a comb of DL1s just above P6 in Fig. 79*B*.

A1 (Fig 79*D*) of the direct type, with the swelling on seg4 directed somewhat back towards seg1. P2 (Fig. 80*A*) differs only in enp2, which lacks an outer seta and has a short deflexed thorn on the outer edge at about 0·8; P3 (Fig. 80*B*) exp-spine B enormous and closely adpressed to the outer edge of exp3, spine A smaller and projecting at about 30° to the long axis of exp2, and both these spines quite smooth, spines C and D each with only a very few small blunt microserrations on the rear face, spine E alone with microserrations that stick out sideways (in the limb plane) so as to be visible. P3enps 2 and 3 each without an outer thorn, outer front surface of the prong with a row of small excrescences (arrowed in Fig. 80*B*). P4 (Fig. 80*C*) differs from that of the female (Fig. 78*C*) only in having the inner seta of exp2 not longer than the upper inner seta of exp3, no inner seta on enp1, and only 1 inner seta on enp2. P5 (Fig. 78*E*) with its setae numbered, to show how seta5 crosses behind seta4; the insertion of seta5 is shown dotted. As in *C. hirsutus* (*q.v.*), P6seta1 (Fig. 79*C*) is only about as long as seta3 whereas seta2 is much longer than either of them.

Remarks

Deposition. Female J11139, male J11140, and the short-tailed female (from which Fig. 75*E* was drawn) J11141.

Origin of the specimens described. Locality 2 in Map 2, collected by the late Mr Paul Genery and myself in flooded wheel-ruts full of grass next to the gate leading into Mr Genery's property, beside the Melbourne–Ballarat road about 0·5 km east of Gordon, on 23.x.1976. The sample contained large numbers of *C. australicus* but no other harpacticoids; also fairly numerous cyclopoids, a few ostracods and cladocerans (including the large endemic cladoceran *Saycia cooki*—see table 6 of Morton and Bayly 1977 and plate 4 of Chapman and Lewis 1976), and a few coleopteran larvae about 5–8 mm long (possibly dytiscids) that appear to prey on *C. australicus* by sucking out the soft parts and discarding the husk, because the dytiscids' intestines were full of structureless reddish orange material which exactly matched the colour of *C. australicus* but was nowhere near that of anything else in this sample.

Variation. The most important variation seems to be in the form of the female FR in side view; in most specimens it is about as slender as in Figs 75*B* (see Origin, above) and 75*D* (from the lake in the Jock Marshall Reserve at Monash University, Clayton, Victoria, on 20.ix.1974), but in a small minority, about 1 in 20 or less, it is shorter (an extreme example, Fig. 75*E*, came on 24.v.1984 from Sailor's Falls, Vic.). All normal females on my slides have the fine setules in combs on the underside of the FRs (Fig. 75*D*), but these are lacking in Fig. 75*E* and in all the (so far few) males examined for this character. Although Figs 75*D* and 75*E* are very different at first sight, I have seen a few intermediates from scattered Victorian localities (listed, along with normal finds, in Appendix 1); further, I cannot at present correlate either the bulging base of seta5 in Fig. 75*E* as against the slim base in Fig. 75*D*, or the different numbers in these two figures of spinules on SRE10, with FR length or indeed with any other character. The female in Fig. 75*E* also appeared to lack pleats, but such pleats were found on SREs 1–3 of other short-tailed females (from the Sheepwash Lagoon, Vic.—see Appendix 1). The female P5exp has an *L* : *B* of 5 : 3 in the short-tailed female (Fig. 80*D*) as against 9 : 4 in normal ones (Fig. 78*D*), with a short and broadly rounded enp-lobe as against a longer and more pointed one; P5exp-seta5 reaches to at most 1·5 of exp-seta1, and benp-seta6 to at most 1·5 of benp-seta5 (more often to 1·0 in each case), in normal females, but to about 2·0 in each case in short-tailed ones.

Other variations noted were as follows: some females do not have even a trace of SRE6 (the internal rib); of nine dissected females from all over Victoria, two had MV2s as large as DL2s, the others had MV2s from two-fifths to two-thirds as long as the DL2s; a single female from Sheepwash Lagoon, Vic. had only 1 inner seta on both its P4enp2s (Fig. 78*F*) instead of the normal 2 (Fig. 78*C*; plate IV, fig. 19, of Sars 1908); the male P3exp-spines C and D sometimes have microserrations as prominent as those on spine E in Fig. 80*B*; and the male P5exp usually has 2 or 3 pairs of spinules, rather than merely 2 single ones as in Fig. 78*E*. There is a rather poorly defined positive correlation between short-tailed females and atypical habitats (flowing, as against still, waters), but the range of variation in all these respects would well repay far more detailed study than can be given it here.

Colour. When alive: at Gordon (see Origin, above) brilliant orange-brown with turquoise-blue-green eggs; at Mulwala (southern New South Wales) on 18.viii.1974, and at several Victorian localities subsequently, pale orange with very pale blue or blue-green eggs; in Summerland Lagoon (Phillip Island, Vic.) in October 1984, glassy clear, with cloudy pale grey viscera. When preserved: dull greyish white in incident light, but pale clear horny brown (like very thin amber or very dilute beer) in transmitted light.

Type locality. Given by Sars (1908) as a swamp at St Arnaud (locality 1 on Map 2), collected on an unspecified date in 1901 by Mr O. A. Sayce, a well-known amateur naturalist of that period with a special interest in Victorian pond life; type specimens no longer in the G. O. Sars Collection in the Oslo Museum (*fide* Dr Marit Christiansen). I was unable to find any swamp when I went to St Arnaud, and therefore have selected neotypes from the abundant (and excellently preserved) Gordon material.

Synonyms. Lang and Henry both relied almost entirely on Sars, whereas Brehm added little of any value (see above, LD and OD). Records without descriptive matter (Shepherd *et al.* 1918; Shiel 1976; Morton and Bayly 1977) are all as *Attheyella australica.*

Range of habitats. By far the most common and widespread lowland species in southern Victoria; almost always in small or large bodies of standing fresh water with plenty of submerged macrophytes, including well-oxygenated lowland swamps. Much less often found in rivers, and never in saline or polluted waters, among moss on waterfalls, in *Sphagnum*, or anywhere in the alpine or subalpine zones.

Geographical distribution. The numerous unpublished and few published records in Appendix 1 are shown on Maps 1, 2, and 5. In Map 1, locality 4 is doubtful because Henry (1922, p. 553) states that all six South Australian species (including *C. australicus* and *C. longiseta*) were found 'in the Botanic Gardens and in the hills near Adelaide' (p. 551), but fails to include South Australia in the distribution of either species (*C. australicus* on p. 567, *C. longiseta* on p. 568).

All the other records I regard as certain (or highly probable, if I have not seen them personally). Of those in Map 1, locality 1 may represent a relict population from a former trans-Australian distribution, or one which was transported by humans or by birds (as is *C. bidens*) from the main eastern population; localities 7 and 8 represent the only finds north-east of the latter, but intermediate collections may yet bridge the gap.

The principal mainland areas of distribution of both this species (Map 2) and of *C. longiseta* (Map 3) lie almost entirely south of an imaginary south-eastern limit (Map 2; also indicated in Maps 1 and 3) drawn from the city of Wagga Wagga (=W in Map 2) to the coasts of South Australia near Kingston, and of New South Wales near Bega, respectively; however, in Map 2 there are already two South Australian finds of *C. australicus* that transgress this limit. The lack of records from the northern half of Victoria is at least partly due to lack of prospecting, apart from the presence of genuinely unsuitable areas such as the Little Desert, or the saline lakes near Kerang; however, the long oval area in the eastern half of Victoria (whose eastern end is conjectural, and therefore shown dashed) in Maps 2–4 and 6 represents (within the Great Dividing Range) a highland area in which *C. australicus* and *C. longiseta* have not been found. The Range itself extends further north and east, to include the areas around Lake Eucumbene and Canberra (LE and C, respectively, in Map 6), but all the records of this genus in that corner of New South Wales refer to

C. australicus or to *C. longiseta*, which is why I have put the dashed eastern limit to the highland area where it is. For the species that have been found in the highland area, see Map 6. The Tasmanian records (Map 5) avoid all waters that are not strictly fresh, and the most mountainous areas, as well as waterfalls and semi-terrestrial habitats.

On Map 2, it is very surprising that Mr Sayce should not have been able to find specimens from somewhere nearer Melbourne than St Arnaud (locality 1), especially since all his other localities in the same paper (Sars 1908) are within a radius of 20 km from the city centre; the Botanic Gardens Lake (where this species was found by Shepherd *et al.* 1918) is in fact only about 2·5 km from the city centre. However, *C. australicus* is the only *primarily* benthonic form (apart from cladocerans and ostracods mentioned on the first page) in Sars' paper, which otherwise deals with species that swim over (or far above) the substrate rather than crawl on or in it; it seems as if Sayce took only planktonic samples, whereas Shepherd *et al.* went for everything they could get. See also the footnote on p. 1097.

Major distinctions from similar Australian species. Only *C. hirsutus*, *C. billwilliamsi*, *C. howardorum*, *C. grandidieri* and all four *Fibulacamptus* spp. have SREs which are completely (or, in *C. grandidieri*, nearly) smooth. None of these have pleats (although, very rarely, a short-tailed *C. australicus* may also lack them, or have pleats that are difficult to see), and none of them has an op and/or FRs that are quite like those of *C. australicus*. Other characters will be found in the keys, in Table 1, and in the respective descriptions and figures.

Major distinctions from the most frequently co-occurring species. Of these, the most frequent co-occurrer (*C. longiseta*) is also the easiest to distinguish because its SREs 1–9 all have very strong teeth and the P5 in each sex (but especially in the female) is much longer and narrower. Members of the *fimbriatus*-group have smaller, but still distinct, teeth on their SREs, and the only ones which also have truly smooth SREs would be *C. hirsutus* and *F. gracilior*.

On subadult specimens. These lacked SRE9 (i.e. Abds 4 and 5 were still united, a standard criterion of subadulthood), and were also the only specimens found in the present survey which agreed with fig. 56 of Brehm (1953) (copied in my Fig. 75*G*) in having the abdomen with transverse microcombs and a curved operculum with a few (maximally 10 or so) slender sinules. My own samples from Brehm's locality (Map 5, CL = Cleveland Lagoon) yielded only adults of this species, but many adults and a few subadults (including that in Fig. 75*F*) were taken in sample TAS 75/18, about 0·5 km east of Big Lake Waterhouse (= BLW in Map 5) in which both Brehm and D. W. Morton have found this species at different times (see also Appendix 1).

Derivation of the specific name. From the Latin *australicus* = Australian.

Canthocamptus billwilliamsi, sp. nov.

Figs 42*J*, 43*E*, 81–84

Female Holotype

Length 0·63 mm (Fig. 81*A*), appearance average, prosome without micropores but with numerous sensillary pores of which those nearest SRE1 are tunnel-pores; Abd thickly covered with transverse combs of long limp microsetules (Fig. 81*B*) save along the ventral surface (Fig. 82*B*). R small (Figs 82*A*, 83*B*), nuchal organ shoe-shaped (Fig. 82*A*), all SREs without pleats, op typical for this group (Figs 82*A*, 82*C*; in the latter the long adanal setules somewhat obscure the opercular outline).

Spinulation (Figs 81*A*, 81*B*, 82*A*, 82*B*) unusual in not being confined to the abdomen, DLs extending very far dorsally on ped5 to Abd3 but less far on Abd4 and ped4. VLs confluent with DLs on Abds 2 and 3 but out of line with them on Abd4; MVs apparently absent from Abd2, but present (and unusually small axially) on Abds 3 and 4, Abd3 with an MVgap. Abd5 has a DL-cum-VLcomb, and an MVcomb, each well developed. Genital region as in Fig. 82*B*.

FRs unique in this paper in being prolonged dorsally into a stout thorn, obliquely truncated in dorsal view (Figs 82*A*, 82*C*) but pointed in side view (Fig. 81*D*), from beneath which setae 5–7 arise as if ventrally offset (*C. grandidieri* has a similar but less extreme form of FR). This appears to be a highly specialized coupling device, permitting the male A1 to be snugly tucked in behind the female's FR when wrapped around her setae 5–7 (Figs 81*A*, 81*B*, 82*D*, 82*E*). In side view (Fig. 81*D*) seta6 has a strongly marked basal dorsal swelling, and seta5 has a very sharply swollen base from which it tapers rapidly and then gradually. Seta2 very short and sharply deflected dorsalwards; setae 1 and 2 arise at about 0·3, whereas setae 3 and 4 are roughly level with one another at about 0·6.

A1 (Fig. 83*B*) unremarkable except for the underside pore (arrowed) on seg2; the front-edge seta of seg1 is stiffly bipinnate. A2 noteworthy in that the proximal abexp seta on the allobasis is surrounded by a group of spinules nearly as long as itself (Figs 81*E*, 83*C*), so that it is easily overlooked, whereas the distal seta is unconcealed as normal; exp (Fig. 83*C*) unusually broad, and WAC (see also Fig. 81*F*) split, both half-WACs with fine spinules. Md (Fig. 83*D*), enp with 1 inner and 4 terminal setae; Mx1 (Fig. 83*E*), PCXA with 1 rear-surface seta, and basis with 5 ramal setae; Mx2 (Fig. 83*F*) proximal endite, proximal seta straight and ending in a tiny fork.

P1 (Fig. 84*A*) has an inner seta on exp1; P2–P4 (Figs 84*B*–84*D*) each have exp-spines A–E all of closely the same thickness on a given leg, and clearly microbipectinate. P2 and P3,enp2 has both edges convex, and has noticeable front-surface combs as well as the more usual outer-edge spinules. None of the outer distal corners of exp1 or exp2 on P2–P4 is ever prolonged into a thorn. The inner seta of P4exp2 is notably long and thick.

P5 (Fig. 83*H*) enp-lobe rather pointed (due to the insertions of the other setae being distinctly stepped proximal to that of seta3); exp with prominent front-surface combs of long needle-like spinules, and of a distinctive shape in that the edges are convex proximally (greatest width at about 0·2–0·3), parallel just above the insertions of setae 1 and 4 (which are level with one another), and parallel again, but closer together, just above the two terminal insertions of setae 2 and 3.

Male Allotype

Length 0·5 mm; general appearance (Fig. 81*A*) very like that of the female. There are DLcombs alone on peds 4 and 5 and Abd1 (Figs 81*A*, 81*C*, 82*F*), and confluent with the VLs and MVs to form gapless hoops on Abds 2–4 (Fig. 83*A*). FRs normal, in other words not modified; setae 5–7 arise direct from the square-cut end of the FR. A1 as usual for this group, but even uncoupled males have their A1s coiled up almost as in precopula (Figs 81*B*, 82*D*, 82*E*); I was unable to obtain an A1 that lay sufficiently extended to be worth drawing by itself.

P2enp2 (Fig. 84*E*) has no outer seta, but has an outer thorn whose distal edge is entirely taken up by a pore; P4 (Fig. 43*E*) with the upper inner seta of exp3 almost as long as the lower one (whereas in the female it is much shorter, Fig. 84*D*); P5 with an extremely long exp-seta2 (Fig. 83*A*), and P6 unlike both the other species in this group in having seta1 as long as seta2, whereas seta3 is much shorter.

Remarks

Deposition. Female J11108, male J11109 (mounted together on a single slide).

Origin of the specimens described. In the type locality on 12.x.1982.

Variation. None noticed.

Colour. Alive, greenish white; dead, whitish grey.

Type locality. Map 6, locality 23.

Synonyms. None.

Range of habitats and geographical distribution. All on Map 6. Very numerous in a mountain stream with *C. mammillifurca* (*q.v.*) at locality 22, but few or singly in localities

19 (no doubt this material has been accidentally washed down from its true habitat in the mountains) and 23, and in moderate numbers at localities 24 and 25. These last three localities are all in *Sphagnum*.

Major distinctions from similar Australian species. The female FR is quite unique, although the male needs careful checking against key 5.

Major distinctions from similar New Zealand species. C. maoricus (Lewis 1972, as *Attheyella (Chappuisiella) maorica*) is remarkably like *billwilliamsi* in the long broad enp2 of P2 and P3, bearing a front-surface, transverse, spinule-comb at about 0·3 or 0·4, as well as in P5 (particularly the exp); but the FR in *maoricus* appears to have a dorsal keel (Lewis's 'flange') and its tip does not overhang the bases of FRsetae 5–7, as it does in her *C. rotoruensis* and in *C. billwilliamsi*. These comparisons apply solely to the females; the males of the New Zealand species are insufficiently described.

Major distinctions from co-occurring species. Apart from the unique female FR, the only other species to have the same combination of a body covered with rows of microsetules, and smooth SREs is *australicus* (and *grandidieri*, if the very minute denticulations of its SREs be ignored for this purpose, and if its Australian range should prove to overlap with that of *australicus* or *billwilliamsi*, which at present I rather doubt).

Derivation of the specific name. I have great pleasure in naming this new species in honour on an old friend who is one of the doyens of post-World War II Australian limnology, Professor W. D. (Bill) Williams, Zoology Department, University of Adelaide, South Australia.

Canthocamptus grandidieri de Guerne & Richard

Figs 74*F*, 74*G*, 85–88

Canthocamptus grandidieri de Guerne & Richard, 1893, p. 234, figs 1–9 (not seen by me, but cited by Lang 1948). (OD)
Elaphoidella grandidieri Lang, 1948, pp. 1136–7, Abb. 452. (LD).

Female

Length 0·52 mm. Prosome smoothly curved in side view (Fig. 85*B*) but very slightly angulate in dorsal view (Fig. 85*A*); nuchal organ of a very characteristic double-headed shape and extending most of the length of the prosome, which is unornamented except for a few widely scattered sensillary pores (not shown). Body widest at the rear of the prosome, thereafter tapering rapidly to Abds 1 and 2 (which are parallel-sided), and again from them to the furca; in dorsal view this gives the effect of a waist at the level of ped5. There are no micropores, but the Abd is covered with combs of microsetules and microspinules, enlarged in Fig. 74*G*; the combs of microsetules are much as in *C. australicus*, but are far fewer and more widely spaced. SREs minutely denticulate (Fig. 74*G*).

Abd spinulation (Figs 85*B*, 86*A*) basically as in *bidens* (Figs 89*B*, 89*C*) except that the spinules are larger and fewer, and that the 2 inner groups of MV3s and the isolated advanced group of MV4s, all found in *bidens* (Fig. 89*C*), are all lacking in *grandidieri* (Fig. 86*A*). Op (Figs 85*A*, 85*B*, magnified in Fig. 88*D*) has a strongly convex edge, closely set with parallel-sided conically pointed teeth which are evenly graded so as to be longest in the middle of the edge; the upper surface of the op is covered with fine striations apparently radiating from an imaginary centre well forward of the op itself. Op slightly overhanging the IRS, IRD less than RBW, FRs slightly converging, and each FR tapers rather irregularly towards the tip, which is square-cut where it carries setae 5–7, but is produced above them into a curiously shaped, thin-walled protuberance (arrowed in Figs 85*A*, 85*B*). FRsetae normal except that seta2 is extremely small and easily overlooked, seta5 has a single row of spinules which are ventral proximally but abaxial distally, and seta7 has a small but plumply rounded adaxial basal swelling (not shown, because of being just out of sight under the arrowed protuberance in Fig. 85*A*). Genital setae (Fig. 86*A*) both very long and strongly bipinnate, as in *bidens* (Fig. 89*C*, 92*C*).

A1 (Fig. 85*C*) definitely with 8 segs and slimmer than in *bidens*; the ventral seta on seg1 and another ventral seta on seg2 are each sparsely bipinnate, all other setae being simple. A2 (Figs 86*B*, 86*C*) like that of *bidens* in having a group of spinules but no setae on the allobasis, and a lengthways-running WAC, but in *grandidieri* the WAC is obviously split so that its halves overlap. Mouthparts all about as in *bidens* except that Mx2 (Figs 86*F*, 86*G*) has an enp-seg which may be even smaller than in Fig. 68*F*; P1 (Fig. 86*J*) exp2 has an inner seta, and the inner seta of enp1 is longer than in *bidens* (Fig. 91*A*); P4 (Fig. 87*C*), inner setae of exp3 not nearly so heavily built as in *bidens*; and P5 (Fig. 86*K*) with exp-setae 4 and 5 (numbered in Fig. 86*L*) unusually small and completely smooth, enp-lobe with an obvious pore just where *bidens* has a doubtful one (see text). Limbs otherwise not significantly different from those of *bidens*.

Male

Length 0·43 mm. Most features of the whole animal very like those of the female, except that the prosomal frons is more square-cut in dorsal view (Fig. 88*A*) and the VLs are confluent with a continuous ventral comb of MVs on Abds 2, 3, and 4 (Fig. 88*C*); there are also a few high-up DLs on Abd1 (Fig. 88*B*), and the MV5comb consists of a single spinule. Op and F as in the female, except that the tip of FR lacks the protuberance arrowed in Figs 85*A* and 85*B*, and FRseta7 does not have a swelling anywhere.

A1 of relatively uncomplicated structure (although a few small lower-surface setae have been omitted from Fig. 88*E*), and unique in this paper in that aes4 arises from just above the base of an enormously long and thick seta (almost like a cucumber!) whose distalmost sixth or so is slender and filiform, like a terminal lash. The terminal part of both A1s in this male are twisted so that the last segment is edge-on to the viewer, but my only other male (from Nardellos Lagoon, Qld, site 8 on Map 7) has a direct terminal segment, about as in Fig. 5*D*. P2 (Fig. 88*F*) as in the female (Fig. 87*A*), except that enp2 lacks the outer seta. P3 (Figs 87*D*, 87*E*) with exp-spine B extremely long, thick, and closely adpressed to exp3; exp-spine A similar but shorter and not quite so thick; enps 2 and 3 each have neither a thorn nor an inner seta, and the prong is short with a stout point. P4 (Fig. 87*F*) with only 3 setae on enp2, instead of 4 as in the female (Fig. 87*C*). P5 (Fig. 88*C*) benp with a short setophore and with no discernible enp-lobe or enp-setae; the exp has 4 setae of which seta4 is unusually small (setae numbered in Fig. 88*G*). P6 apparently totally absent.

Remarks

Deposition. Female J11131, male J11132.

Origin of the specimens described. The subadult female in Fig. 74*F*, and the adult female husk one of whose Mds is shown in Fig. 86*D* came from locality 8, Map 7, and the described adult pair shown in Figs 74*G* and 85–87 (apart from 86*D*) came from locality 15, Map 7 (see also Appendix 3).

Variation. None noticed.

Colour. As for *C. bidens* (*q.v.*).

Type locality. Near Tananarive in Madagascar (de Guerne and Richard 1893, not seen by me but cited on pp. 1136 and 1137 of Lang 1948).

Synonyms. Collated on p. 1136 of Lang (1948) but none are relevant to the present treatment.

Range of habitats. Strikingly similar to those inhabited by *C. bidens*, as evidenced by the records in Appendix 3 (in which they mostly occur together).

Geographical distribution. In Australia it is so far known only from the north-east (Map 7 and Appendix 3), but according to Lang it is very widely distributed in the tropics, from western Africa [Morocco, recorded by Kiefer in Lang (1948); Mali, by Dumont *et al.* (1981), who found no other harpacticoids], throughout most of Africa except in the extreme south, much of south-east Asia from Canton (Gwangdong) to Papua New Guinea, and in the Hawaiian Islands; in fact in all major tropical land masses except Central America. I suspect that it is carried on bird's feet, as has been proved for *C. bidens*, but that in Australia it cannot survive as far south as the latter species.

The very inadequately described '*Elaphoidella capite-radiata*' Brehm, 1951 from near Port Moresby and '*E. grandidieri*' and '*E. sewelli*' of Marmaril and Fernando (1978) from various localities in the Philippines are of no use except to indicate the existence of harpacticoids that need competent drawing and description. If Gurney's form from Ceylon is as constantly different from normal *grandidieri* as Gurney (1916) says it is, then it requires another name, and Ceylon (Sri Lanka) must be excluded from the known range of true *grandidieri*. The figures of this species from other places, copied by Lang, agree well with mine.

Major distinctions from similar Australian species, and co-occurring species. In Australia the only co-occurring species is *C. bidens*, with which it shares (female only) the distinctive P5 and only 2 spines on exp3 of P2–P4, as against all other *Canthocamptus* spp. here. The SREs in *grandidieri* appear smooth except under high power (preferably with anoptral or ordinary phase-contrast), but it is distinguishable from all other Australian species with smooth SREs by its nuchal organ, operculum, and furcal rami.

On subadult specimens. Fig. 74*F* was drawn because the denticulations on the SREs are far more conspicuous in subadult than in adult specimens, although they do occur in the latter.

Derivation of the specific name. Bestowed in honour of Monsieur Grandidier, a prominent worker on the natural history of Madagascar.

Canthocamptus bidens Schmeil

Figs 89–91, 92*A*–92*G*

Canthocamptus bidens Schmeil, 1894, p. 73, plate V, figs 21–4, plate VII, figs 17–21 (not seen by me, but cited by Lang, 1948, p. 1137). (OD)
Canthocamptus bidens Gurney, 1932, pp. 184–91, figs 767–82. (LD)
Elaphoidella bidens Lang, 1948, pp. 1137–41, Abb. 453. (LD)

Female

Length 0·5 mm. General form (Figs 89*A*, 89*B*, 92*A*, 92*B*) average, SREs 5–7 have moderately small teeth in all zones (Figs 89*A*–89*C*) whereas SRE1 has larger teeth across the MDzone, and SREs 2–5 have them mainly in the DLzone, in addition to the above; all these teeth triangular, from equilateral to longer isosceles in form. Nuchal organ elongate, shaped like a keyhole (Fig. 92*A*) or a figure-of-eight (Fig. 89*A*); prosome otherwise densely and evenly covered with a thin fur of microsetules, which tend to be arranged in transverse microcombs along the rear edge of the prosome (just ahead of SRE1), on the dorsal and lateral surfaces of all PLTs behind this, and on all surfaces of all abd somites except the MVzones of Abds 1 and 2. No micropores; each genital complex with 2 very long bipinnate setae.

No abd spinules ahead of the site of SRE6, or behind SRE9; all spinules long except for the MV 3s and 4s, which are shorter. DLs reach highest up the flanks of Abd2 and lowest up those of Abd4; VLs may or may not be confluent with DLs on Abds 2–4 (compare Figs 89*A* and 89*B* with Figs 92*A* and 92*B*), but are truly confluent with the MVs only on Abd4, because MV3s are in a row of staggered combs, slightly out of line with one another because of being curved. Just ahead of the MV4s is a supplementary MVcomb (unique in this paper).

Op (Fig. 89*D*) a smooth shallow curve, upper surface not striated as in *C. grandidieri* (*q.v.*) but instead with a straight transverse row of microsetules; edge-teeth as in *grandidieri* but fewer. IRS almost equal to RBW, FRs parallel or at most slightly divergent, each FR parallel-sided in dorsal or ventral view (Figs 89*A*, 89*C*) but in side view (Fig. 89*B*, magnified in Fig. 92*E*) with a large strongly built and sharply pointed dorsal thorn pointing straight backwards, just behind and adaxial to which is a curved comb of backward-sloping spinules. Ventral to this comb [and just adaxial to the insertion of seta7 (Figs 89*C* and, larger, 92*F*)] is a small conical thorn (visible also in Fig. 92*E*) pointing backwards and downwards; another larger thorn can be seen in Fig. 92*E*, representing the end of the dorsal surface above seta6 and just abaxial to the spinule-comb. All setae normal; seta3 arises just abaxial to the large thorn.

A1 (Fig. 90*A*) 8 or 9 (4,T); the exact segmentation is not easy to determine, because seg9 is separated from seg8 dorsally but united with it ventrally. A2 (Figs 90*B*–90*D*) unusual in that it has a comb of very long abexp spinules (but no abexp setae) on the allobase, and that the single WAC runs lengthways along the edge of the enp before curving sharply around the tip of it. Md (Fig. 90*E*) PCX comb short, with long but not numerous spinules, CXB with an inner terminal seta, and enp with an inner seta and 4 terminal setae (1 of which is slightly out of line with the others). Mx1 (Fig. 90*F*) PCXA with 1 rear-surface seta, basis with 4 ramal setae. Mx2 (Fig. 90*G*) with the enp reduced to a single seta without any trace of a segment, proximal seta of the proximal endite is of the 2-pronged fork type.

P1 (Fig. 91*A*) exp2 has an inner seta. P2 (Fig. 91*B*) and P3 (Fig. 91*C*) alike in that exp1 has a large thorn above the insertion of exp-spine A but no thorn at all below it, whereas exp2 has a rather small thorn above exp-spine B and a distinctly longer and stronger one below it, apart from which both of these limbs have an extremely long pair of terminal setae (with very long pinnules on both sides) on enp2. P4 (Fig. 91*D*) has the thorn above exp-spine A projecting as usual but that above exp-spine B turned backwards, in behind the base of the spine, so as not to be visible from in front; there is no thorn below either of these spines. P4exp3 is unusually slim and distally tapering, with both its inner setae very stoutly built and with very large coarse and distantly spaced toothlike inner-edge spinules; the inner seta of exp2, and both the inner setae of enp2, are similar but shorter and slimmer, and have only moderately coarse spinules. Finally, P2–P4 each have only 2 outer spines on exp3. P5 (Fig. 90*J*) unique in this paper in that exp is long and narrow (widest between 0·3 and 0·7) with 2 combs of spinules on its inner edge, and 2 large spinules together on its outer edge, all proximal to setae 1 and 5 respectively; benp has a long flask-like setophore and a wide but short enp-lobe whose steps are produced into a small thorn adaxial to the insertions of setae 2 and 3. Benp entirely without ornamentation, and a crease-like structure (not shown) just above the insertion of seta3 may or may not represent the folded-over lip of a pore.

Male

Not found in the present survey, and I doubt whether any of those formerly ascribed to the present species (Chappuis—see Lang 1948, pp. 1140–1; Lowndes 1950; Carter and Bradford 1972) really belonged to it, in view of the known ability of this species (Lang, *loc. cit.*) to breed parthenogenetically. In particular, Wilson (1956, p. 294), after pointing out that the males found by Lowndes in precopula with his *C. bidens* females were in fact very much like those assumed by him to be undoubtedly of *C. crassus* because of being found in the same samples in precopula with females of that species, said, ‘In view of the association of the two species in Lowndes’ collection, the possibility of attempted cross-fertilization, or even of the simpler possibility that *crassa* males might temporarily attach to the caudal rami or setae of *bidens* females and thus be collected *in tandem* without actually being *in coition*, must be considered.’ The italics in this passage are Wilson’s own; *C. crassus* (=*Attheyella crassa*) is a British and European species, well described by Gurney (1932). I have never seen heterospecific coupling in any species of harpacticoid from anywhere, nor any male coupled with a female of *C. bidens*; the situation described by Lowndes needs to be reinvestigated using further specimens from his original locality in Berkshire (U.K.). However, the single male collected by Carter furnished all the figures at the top of p. 2 of Carter and Bradford (1972), to judge from which it was very like that which one might expect to find in this species, if the latter ever has a male at all. Their figures are not as detailed as might be desired, and anyway it would be most unsafe to rely on a single male in a species with such a reputation for being able to do without males altogether.

Remarks

Deposition. The female from which Fig. 92 was drawn, J11120; that from which all the other figures except 90*B* were drawn, J11119.

Origin of the specimens described. Fig. 90*B* was drawn from one, and all the other drawings in Figs 89–91 from the other, of two dissected females from the Holbrook, N.S.W., sample (see below); the female from Queensland in Figs 92*A*–92*G* came from sample 17 (see Map 7 and Appendix 3).

Variation. From Lang's key to female *Elaphoidella* (1948, pp. 1129–31), it is possible to construct a derived key to the alleged forms of *bidens*, according to which *bidens* s.str. is alone in having only 2 enp-segs in P1; of the forms with 3 such segs, P4enp1 has an inner seta on *bidens decorata* but lacks it in *bidens coronata*, to which latter subspecies all three of my dissected Australian females belong.

The A2exp in Fig. 90*B* has only 3 setae, but the other A2exp from the same female, and both A2exps from the other female from Holbrook, each have 4 setae (all of which have fallen off), and the dissected female from Queensland also had 4 setae on both exps, one being figured in Fig. 92*G*.

A female from Dandenong Creek, Vic., lacked the otherwise universally present dorsal thorn on each FR, but could nevertheless be determined as *bidens* by the nuchal organ, covering of microsetules, SREs, operculum, exp3 of P2–P4 with only 2 spines, and by the remaining features of the FRs.

Colour. The usual nondescript pale grey in dead specimens; I have not yet seen one alive.

Synonyms. Only as above.

Range of habitats. Most of the Australian finds are either in slow-moving streams, in temporary lakes forming part of a bed of a stream of this kind, or in lakes with a noticeable internal circulation (whether or not driven by a stream); only at the locality of sample 15 in Appendix 3, and at Holbrook (and possibly Lakes Moodemeere and Nagambie) on Map 4, was it found in still waters, which at Gracy Creek and at Holbrook were full of weeds. It was found in compact moss in a small, slowly flowing waterfall at the locality of sample 17 in Appendix 3, but not in similar ones (localities 11 and 13 in Map 6), nor in larger faster-flowing ones with luxuriant hanging growths of moss (localities 6, 12 and 16 in Map 6), in Victoria or Tasmania, perhaps because it cannot compete with the indigenous species in those areas except in other habitats (as in Map 4).

Geographical distribution. For its distribution in northern Australia, see Map 7 and Appendix 3. For its distribution in southern Australia, see crosses in Map 4 (proceeding anticlockwise round the Eastern Highlands)—*New South Wales:* Battery Dam, on the property ('Mount Annan') of Mr and Mrs K. Crawford, 12 km east of Holbrook, 10.iv.1975; Lake Mulwala at Yarrawonga, coll. R. J. Shiel, 21.v.1977. *Victoria:* Lake Moodemeere (off Murray River near Yarrawonga), R. J. Shiel, 7.ix.1978; Murchison, in the river, R. J. Shiel, 29.ix.1976; Nagambie Lake (off the Goulburn River at Nagambie), R. J. Shiel, 15.x.1977; Dandenong Creek (=locality 14 in Map 6); Gippsland Lakes, 18.ix.1979, coll. Fisheries and Wildlife Cruise 8, stn. 3051, per A. D. McKinnon. *South Australia:* Tailem Bend (locality 5 in Map 1), R. J. Shiel, 23.v.1977.

Major distinctions from similar Australian species, and frequently co-occurring species. These may be taken together, since the dorsal thorn on the FR is absolutely distinctive, and in its absence it can be distinguished from other species with moderately strongly toothed

SREs as described above under Variation, as well as by the distinctively shaped P5 (shared only by female *C. grandidieri*).

Derivation of the specific name. From the Latin *bidens* = two-toothed, possibly in allusion to the shape of the FRs in side view (I have not been able to consult Schmeil's original paper, to say whether he justifies his choice of this name).

Canthocamptus longiseta (Henry)

Figs 93–96, 97*A*–97*C*

Moraria longiseta Henry, 1922, p. 567, plate LVI, fig. 3, plate LVII, figs 1–7. (OD)
Moraria longiseta Lang, 1948, pp. 1051–2, Abb. 421 (copied from Henry). (LD)

Female

Length 0·67 mm; body tapering only slightly from R to FRs in dorsal view (Fig. 93*B*); prosome not unusually high in side view (Fig. 93*A*); R small (Fig. 94*B*); nuchal organ small, pear-shaped with the blunt end forward, and unusual in being hard to discern because its outline, although quite sharply defined, is buried under the integument instead of being flush with its surface. Behind, and on either side of, the nuchal organ, a vaguely defined and very flattened raised part of the prosome lies directly ahead of one of the largest teeth of SRE1. Prosome coarsely pitted all over; true pores (many of them sensillary) moderately numerous, but not charted. Microsetules all over the prosome except the frons (but omitted from Figs 93*A* and 93*B* in order not to clutter them up; if shown, the microsetules would be about as in Fig. 98*C*), and in transverse rows from ped3 to Abd4 as in Fig. 93*B*. Dorsal rib of SRE6 smooth except for 2 strong DLteeth on each side, MV and VL teeth on SREs 7–9 in general smaller and more numerous than the MD or DL teeth. MV3s smaller than LV3s or VL3s, as well as not being quite in line with them (Fig. 94*A*), whereas the VL4s and MV4s form a completely continuous comb. It is not clear whether the dorsalmost VL3s or VL4s should in fact be counted as DLs. Op (Figs 93*B*, 94*A*) basically triangular, its edges convex proximally but slightly concave distally so as to give a heart-shaped outline with the apex slightly produced, op substantially overhanging the IRS which is about equal to the RBW. FRs more distinctly convergent than usual in this paper, each FR with a smoothly curved inner edge but an uneven outer edge in dorsal view, and a small dorsal hump in side view bearing seta3 on its apex (at about 0·4). All 7 FRsetae unmodified, seta7 at most as long as the FR itself, and much shorter than setae 1, 4, or 5.

A1 (Fig. 94*B*) 7 (4,7), the terminal segment apparently formed by the fusion of segs 7 and 8; aesT with its setae missing in this specimen. A2 (Fig. 94*C*) exp slender and markedly curved throughout its length; in this specimen the apparent suture across enp-seta C is an artefact (possibly due to injury); WAC split, each half-WAC transverse (so that the halves do not overlap closely, if at all) and made up of fine close-set spinules. Md (Fig. 94*D*) palp set rather further from the axis than in most species in this paper, PCXcomb long and unusually sharply curved besides being very abaxial to the palp-insertion; CXB cylindrical and without setae, enp short and with 4 terminal setae (one of which is slightly out of line with the others) but no lateral setae. Mx1 (Fig. 94*E*) PCXA has 2 rear-face setae and the basis has a total of 5 (?6) ramal setae; Mx2 (Fig. 94*F*), proximal seta of the proximal endite is of the recurved-thumb type, and enp consists of a small seg with 2 setae; Mxp hand (Fig. 94*G*), rear-face spinules arranged in 2 multiseriate patches instead of the usual uniseriate lengthways row.

P1 (Fig. 95*A*) exp2 has an inner seta, and enp3 is fully twice as long as enp2. P1–P4 (Figs 95*A*–95*D*, in that order) each with rather slender and parallel-sided segs in both rami, and with all spines and setae also more or less slender; P2–P4, exp3 has 3 outer spines, coxa and basis small and almost rectangular, the basis with a sharp thorn adaxially, and another 1 abaxially, to the insertion of enp1; exp-spines A and B each have a thorn above and below. P5 (Fig. 95*E*) exp unique in this paper in being very long ($L:B$ almost 5 : 1), narrow, and almost parallel-sided, its outer edge convex but its inner edge concave so that (while lying flat in the plane of the benp) it curves inwards adaxially along its entire length.

Male

Length 0·55 mm (Figs 96*A*, 96*B*); SREs 4–6 each have small MDteeth flanked by large DLteeth, but the MDs are moderately numerous and of middling size on SRE4, numerous and tiny on SRE5, and few (hardly more than broadly rounded low sinuations) on SRE6. Unlike several other species in this paper, FRs and op show no marked sexual dimorphism. A1 (Fig. 96*D*) normal for this group. P2 (Fig. 97*A*) enp2 lacks an outer seta but has a pore, hooded by a thorn, in about the same place; P3 (Fig. 97*B*), enp1 has, but enp2 lacks, an outer distal thorn, prong slender; P4 (Fig. 97*C*) enp2 has both inner setae short. P5 (Figs 96*C*, 96*E*) enp-lobe projecting and terminally parallel-sided, but without spinules except upon the setophore; exp shorter and less spinulose than in the female, and seta2 longer than setae 3 or 4. All features otherwise as in the female.

Remarks

Deposition. Female, J11126; male J11127.

Origin of the specimens described. Among many of this species (but none of any other) collected by Dr B. V. Timms in the Green Lake near Bombala, N.S.W. (= locality 2 on Map 3), on 14.v.1975.

Variation. The op shows a continuous spectrum of variation from Fig. 93*B* to (rarely) Fig. 93*C*, so that by itself it is of no use as a distinction from *C. dumonti*. Fig. 93*C* was drawn from a specimen found with several others, all with normal opercula, in the Jordan River, Tas. (see Appendix 1). Variation in other respects is negligible.

Colour. Alive or dead, a sort of glassy golden-brown, like deeply coloured honey.

Type locality. Holbrook, N.S.W. (= locality 1 on Map 3). With the assistance of Mr Ross, acting under the guidance of his mother (Mrs Neil Ross, who collected the type material; see Henry 1922), I took samples on 9.iv.1975 in the only three ponds, out of a number on the Ross family property north of Holbrook, that had not been poisoned by the rise of saline ground-water in the preceding 60 years or so, reasoning that any harpacticoids found in them, resembling Henry's figures, might have been genetically related to the type material. No harpacticoids of any kind were found, and it was only on visiting the Australian Museum, Sydney, that I was able to confirm the identity of Henry's holotype female (mounted whole on a slide) with my own females in all observable respects, including the very characteristic P5exp. This unsuccessful attempt to obtain unquestioned topotypes was necessitated by Henry's drawings, all of which agree well with *longiseta* as described here except for that of the P5, which I have never been able to reconcile with the adult P5 of any species in this paper, although it may have been young or abnormal. Miss Henry (Mrs A. Cooper, of Brisbane, personal communication) was of course quite unable to throw light on this discrepancy after the lapse of so many years, and I have therefore decided to ignore her figure of the P5 and to base my synonymy on the holotype.

Synonyms. Lang (1948, top of p. 1032, and 'Bemerkung' on p. 1052) provisionally ascribed this species of *Attheyella* or possibly to *Elaphoidella*, going solely by Henry's description. Other synonyms refer solely to records of distribution (see below), without morphological details or figures.

Range of habitats. Virtually identical to that of *C. australicus*, and in fact Morton and Bayly's (1977) table of finds gives an excellent idea of the very considerable ecological overlap between these two species. They found both together in samples 5, 35, 42 and 44; *longiseta* alone in 28 and 40; and *australicus* alone in all the others (8–15, 23, 25–27, 29–32, 34, 36, 39, 41, 43 and 45–52). In my own samples, while *australicus* is undoubtedly much more widespread and in general more numerous, *longiseta* can never be excluded from possible occurrence in a given locality sooner or later, even if it may not be present in a given sample.

Geographical distribution. Again, very much like that of *C. australicus*—compare Map 3 with Map 2, and their respective distributions on Maps 1 and 5. In Map 3 the numbered localities are (1) the type locality, see above; (2) Green Lake, from which the above specimens were described; and (3) the billabong (Shiel 1976) from which Dr Shiel has sent me *C. longiseta* which might thus be identical with either his '*Attheyella ?incerta*' or his '*Elaphoidella* sp.' (names which are too tentative for serious consideration). All known records of this species are listed in Appendix 1.

Major distinctions from allied or similar species. A specimen suspected of belonging to this species should be compared, not only with Table 1, the keys, and the group-diagnoses, but with the notes on this group (see section 7, p. 1044) and with the other members of it (*dumonti* and *mammillifurca*).

Major distinctions from frequently co-occurring species. The one species that is found very often with *longiseta*, namely *australicus*, differs in having no teeth whatever on its SREs (for further details see under that species, p. 1073).

On subadult specimens. Very few subadult specimens seen; it is just possible that one of them furnished the controversial P5 drawn by Henry (see above, under type locality), but no taxonomic confusion need arise because such specimens are quite easy to distinguish from adults on the basis of the imperfectly differentiated abdominal somites and limbs.

Derivation of the specific name. From the Latin *longiseta* = long seta; treated here as a noun in apposition (as distinct from the adjective *longisetosa* whose gender would change so as to match that of the generic name).

Canthocamptus dumonti, sp. nov.

Figs 98–101

Female Holotype

Both in size (length 0·65 mm) and in almost all respects, this species is so like *C. longiseta* that one need mention only the differences between them, by far the most obvious of which is the slab-sided appearance in side view of the FR (Figs 98*C*, 98*D*), with seta3 very far forward upon the apex of the dorsal hump (cf. Fig. 93*D*). Other differences from *longiseta* (apart from those shared with *mammillifurca*, *q.v.*) are: (1) The op (Figs 98*A*, 98*B*, 98*E*) is less prolonged than in most specimens of *longiseta* (Fig. 93*B*), although very occasionally one finds an op of *longiseta* as short as in Fig. 93*C*. In both these species the apex is almost always prolonged, in contrast to its broadly rounded form in Fig. 102*C*. (2) P1, enps 2 and 3 are far more nearly equal in length in Fig. 99*H* than in Fig. 95*A*. In practice, these three species can be distinguished at sight by the form of the female FR in side view; if the FRs are abnormal or missing, other characters must be used which are much less convenient.

Male Allotype

Length originally 0·66 mm (Fig. 101*A*), or much less after being dried out and re-soaked (Fig. 101*C*). This differs from the male of *longiseta* only in having (1) shorter FRsetae 1 and 4, and a much shorter FRseta5, which is less than twice as long as seta7 (Figs 101*B*, 101*D*) instead of being about thrice as long (Fig. 96*C*); and (2) the op apex far more produced (Fig. 101*B*) than in Fig. 96*B*; as well as in the relative lengths of enp2 and enp3 of P1 (as in the female, above), and in the details mentioned under *mammillifurca* (*q.v.*).

Remarks

Deposition. Female J11114, male J11115.

Origin of the specimens described. At the type locality on 17.v.1984.

Variation. None noticed.

Colour. Not seen alive; dead, about as in *C. longiseta* (*q.v.*), but in general paler because the integument is overall not quite so thick.

Type locality. Map 6, locality 15.

Synonyms. None.

Range of habitats and geographical distribution. In flowing water, among living weeds (many at locality 14 and one at locality 19), or without them but with a floor of dead leaves over muddy gravel (a few at locality 15); one accidentally swept out to sea at locality 26.

Major distinctions from similar and/or co-occurring species. This is obviously a member of the *longiseta*-group; when this has been established, compare the accounts of *dumonti* and *mammillifurca* (below) with that of *longiseta* (above), for the appropriate sex.

Derivation of the specific name. I have great pleasure in naming this species in honour of Professor Henri Dumont, University of Ghent, Belgium, who showed me the specimens he had taken at locality 14, which I have subsequently returned to him.

Canthocamptus mammillifurca, sp. nov.

Figs 102–105

Female Holotype

Length 0·56 mm (Figs 102*A*, 102*B*, 103*A*); it differs from both *longiseta* and *dumonti* in the following characters, of which the first six can be seen without dissection:

(1) The sensillary pores on the prosome, and some of the thoracic and abdominal pores (whether sensillary or otherwise), are large and mounted on low thick-walled chitinous cones, resembling sponge oscula or miniature volcanoes (Fig. 102*A*).

(2) SRE6 has a row of large teeth completely across the dorsal surface in this species, but is smooth in each of the others.

(3) The op forms a strong and even curve with a smooth edge (Fig. 102*C*), in contrast to the more or less triangular op with spinulose edges found in both the other species.

(4) Instantly diagnostic of this species in side view is the extraordinary protuberance supporting FRseta3 (Figs 102*D* = holotype, 102*E* = paratype 2); less obvious, but still diagnostic, are the smaller protuberances which support respectively setae 1 and 2, and seta4, in dorsal or ventral view (Figs 102*C*, 103*A*).

(5) In side view, the oblique truncation of the FRtip is much more pronounced in this species than in either of the others, and seta6 is more swollen at the base.

(6) A1 has 8 segs (Fig. 103*E*) instead of only 7 (*longiseta*, Fig. 94*B*; *dumonti*, Fig. 98*F*), but too few specimens are known, either of this species or of *dumonti*, to be sure that this character never varies in either of them (it appears to be constant in a large number of *longiseta*), so I have not used it as a key character. Fig. 103*E* is drawn in outline because all the setae fell off the brittle A1 of the holotype; but I saw nothing to indicate any substantial difference between the setation in this species and that in either of the other two.

(7) See Table 1 for the setal formula, and Fig. 104*A* for the uniquely formed P1enp (with 2 very long thin segs).

C. mammillifurca agrees with *dumonti* but differs from *longiseta* in that:

(8) The nuchal organ has a sharply defined edge flush with the surface (not buried below it, as in *longiseta*); however, its ends are broadly rounded in this species and in *longiseta*, but are square-cut in *dumonti*.

(9) The prosome has its coarse pitting more or less confined to the frons, extending at most a little way on either side of it, in these two species, whereas in *longiseta*

its covers the entire prosome. In *longiseta* the microsetules tend to be arranged in transverse rows and to avoid the frons entirely, whereas in each of the other species they are irregularly arranged and extend up to the very edge of the frons (in *dumonti*, as in Fig. 98*C*) or even across its rearmost quarter in *mammillifurca*.

(10) In dorsal or ventral view, the FRs are divergent (but convergent in *longiseta*); each FR has a much more convex inner edge than in *longiseta*; and seta5 is at most about as long as the FR itself, instead of being (as in *longiseta*) at least twice as long.

(11) Mx1PCXA has 2 rear-surface setae in *longiseta* (Fig. 94*E*), but only 1 such seta in each of the others (Figs 99*D*, 105*A*).

(12) The rear-face spinules of the Mxp hand are unique in being grouped in *longiseta* (Fig. 94*G*), whereas they are set in the usual line in *dumonti* (Figs 99*F*, 99*G*), and *mammillifurca* (Figs 105*B*, 105*C*); the front-face spinules are also in a line, in all three species.

(13) P5exp-setae 1, 3, and 4 are each of moderate length (in *longiseta* they are much longer).

(14) The distribution of *mammillifurca* is even more restricted than that of *dumonti*, whereas *longiseta* is widely distributed.

Male Allotype

Length 0·35 mm (Figs 102*F*, 103*B*). This differs from the males of both *dumonti* and *longiseta* in characters 1, 3, and 7 (with regard only to P1) above, as well as in the much more elongate FR (especially in side view, Fig. 102*G*) than in either of the others (Figs 96*A*, 101*D*); and agrees with *dumonti* as against *longiseta* in characters 8, 9, 11, 12, and 14.

Remarks

Deposition. Female J11116, male J11117.

Origin of the specimens described. In the type (and only) locality; the single ovigerous female was lost just before I started to describe it, a pair in precopula became the type specimens (above), another such pair became paratypes 1 and A, and the last remaining specimen (a female) became paratype 2.

Variation. The lost specimen was fractionally larger than any of the other females.

Colour. Not seen alive; when dead, the integument is deep horny brown as in *longiseta* and *dumonti*, but the soft parts tend more to a deep reddish orange (not confined to the gut, but throughout the body) which is cloudily opaque.

Type locality. Map 6, locality 22, in a small, slowly trickling, ankle-deep and rather muddy stream (full of decaying angiosperm-litter from the surrounding bush), apparently a branch of Snowy Creek, which from there runs westward into the Taggerty River which in turn empties into the Acheron River; the sample was taken on 5.iv.1975 in this stream, about 20 m south of a clearing beside the Upper Taggerty Road, the clearing being about 1 km from the junction with Lake Mountain Road. This is inside the Lake Mountain Alpine Reserve (see Acknowledgments).

Synonyms. None.

Major distinctions from similar and/or co-occurring species. In both sexes, the operculum and the P1; the FRs are absolutely unique in the female, and helpful (even if not nearly so distinctive) in the male.

Derivation of the specific name. From the Latin *mammilla* = a little breast, and *furca*; intended to describe the appearance of the female's FRs in side view (as in Figs 102*D*, 102*E*).

Canthocamptus howardorum, sp. nov.

Figs 97*G*, 106–109

Female Holotype

In side (Fig. 106*A*) or dorsal (Fig. 106*B*) view, the body ahead of SRE4 forms a smoothly curved, elongate and moderately inflated oval, whereas behind SRE4 it forms a cylinder which has very little taper except behind SRE9 and then only in side view; in dorsal view the abd somites form a series of short cylinders progressively decreasing in width. In Fig. 106*B* the holotype may have been dorsoventrally pressed out of shape at its broadest point, due to being pinched by the coverslip in order to prevent it from falling over sideways while being drawn.

R not observed. Nuchal organ keyhole-shaped rather than shoe-shaped, its front end with distinct corners but its rear end rounded in the normal way. Op (Fig. 106*B*, enlarged in Figs 106*D*–106*F*) a smooth curve only just overhanging the most proximal part of the IRS; the op edge carries 5 large spinules, each the shape of an isosceles triangle. FR *L* : *B* about 5 : 3 in dorsal view but nearer 2 : 1 in side view; all FR setae quite normal except that seta6 has a slightly dorsal swelling basally (Fig. 106*E*). The outer distal corner of the FR is slightly produced into a small blunt thorn, between setae 4 and 5 in Fig. 106*D*; note that seta4 is present in Fig. 106*F* but is missing (denoted by a dashed line) in Fig. 106*D*. Genital region as in Fig. 106*C*. Microcombs about as in the male (below) on the Abd, but not recorded ahead of Abd1 before dissection.

A1 lost through injury. A2 (Figs 107*A*, 107*B*) with exp-setae 3 and 4 both terminal, Md (Fig. 107*C*) PCXcomb of few and rather large spinules, Mx2 (Figs 107*E*, 107*F*) not remarkable, Mxp (Figs 107*G*, 107*H*) with a slender and almost parallel-sided hand. P1 (Fig. 108*A*) noteworthy only in that enp2 is about as long as enp3. P2 (Fig. 108*B*), P3 (Fig. 108*C*), and P4 (Fig. 108*D*) unremarkable, setal formula as in Table 1.

P5 (Fig. 106*G*) with a short setophore (OBS missing) but a very long and almost parallel-sided enp-lobe with all 6 setae very much on its extreme end, inserted into small steps, seta3 being the distalmost; only seta6 is subspiniform and closely bipectinate, the others being setiform and more sparsely bipinnate. Exp not reaching the end of the enp-lobe, and of a distally pointed heart shape, exp-seta1 terminal and setae 2–4 above it on the outer edge; inner edge with 4 steps, of which the proximal is in the form of a very small rounded lobe and each of the others has a pointed spinule. The only exp-seta that is perfectly smooth is seta2. The enp-lobe has thickened adaxial and abaxial walls, whereas its terminal wall is quite thin; the exp wall is irregularly thickened all round.

Male Allotype

Length 0·86 mm (Figs 109*A*, 109*B*); its dorsal view appears to be less squashed, and therefore possibly truer to life, than that of the female. SRE6 perfectly plain, like the other SREs. On Abds 2 and 3 the DLs, VLs, and MVs are confluent to form a continuous hoop of same-sized spinules; on Abd4 this hoop has a wide MVgap which is bridged by 2 groups, each of 3 of the very tiny MVs found here in the female. Abd5 has a comb of very small closely set LVs between the MVs and VLs; in Fig. 109*C* the most abaxial MV5s are much smaller than the others, and the LVs are too small to be shown at all (being hardly larger than microserrations). Microcombs (all of microdenticles) strongest on the ventral side of Abd2, moderately strong on both dorsal and ventral surfaces of Abd1, and weak on the dorsal surfaces of Abds 3–5 but entirely lacking on their ventral surfaces and on the dorsal surface of Abd2. FR shorter and more rounded than in the female, without any thorns anywhere. Op as in female, but with only 4 marginal spinules.

A1 (Fig. 97*G*) notable mainly for the blunt thorn on seg4 in front of aes4; above this thorn is a short seta with a very swollen base (shaped rather like a wine bottle, or a carrot standing on its blunt end). AesT lost, A1 of the direct type.

P2 (Fig. 109*D*) enp2 with the outer-edge thorns both very small, and therefore hard to see. P3 (Figs 109*E*–109*G*) notable that enp1 has a projecting inner seta, enp2 has a rather short and thick prong with a tiny simple inner seta on the rear surface of its base

(Fig. 109*G*), and enp3 has an indistinct integumental fold at about 0·75 as well as having its inner terminal seta very heavily pinnate all along the adaxial edge. P4 (Fig. 109*H*) enp1 small and without an inner seta; enp2 has all setae shorter (in proportion to enp2's own length), and less ornamented, than in the female.

P5 (Fig. 108*E*) formula 4 and 2, both rami totally without spinules, the smooth edge of each ramus evenly and heavily thickened except where it bears the setae, setophore and OBS each very short, exp orbicular and about as long as the broadly rounded enp-lobe, the isthmus between right and left benps very narrow. Exp-setae 1 and 3, and both benp-setae, spiniform; the other exp-setae setiform.

P6 (Fig. 109*C*) consists of a pair of plates with a very narrow isthmus between them, each plate with 3 setae of which seta1 is weakly spiniform and minutely bipinnate, the other 2 setae being simple.

Remarks

Deposition. Female, J11110; Male, J11111.

Origin of the specimens described. All the known specimens came from the type locality in the type sample; the single female was chosen as the holotype and one of the five males as the allotype, the others being paratypes A–D.

Variation. None as such; one of the paratypes is somewhat contracted, but its op, FRs, and abd spinulation all agree with those of the other paratypes which are each well extended as in Fig. 109*A*.

Colour. Live specimen not seen; dead, a clear golden horny brown.

Type locality. Locality 8 on Map 6; inside the Australian Paper Mills Reserve, on the western slope of Companion Dam in *Nothofagus* litter with a small admixture of eucalypt litter and moss, on 8 and 9.ii.1975. This is within the Surrey Hills area of Howard (1975); see Acknowledgments.

Synonyms. None.

Major distinctions from similar and/or co-occurring species. Even from other species with smooth SREs, this species can be distinguished at sight by the details of the op, FRs and (less obviously) abd spinulation.

Derivation of the specific name. I have great pleasure in naming this species in honour jointly of Dr Howard and her parents (see Acknowledgments), in grateful appreciation of the help they gave me.

Canthocamptus sublaevis, sp. nov.

Figs 110–111, 112*A*, 112*B*

Female Holotype

Length 0·35 mm; in dorsal (Fig. 110*A*) and in side (Fig. 110*B*) views, this species is rather less slender than *howardorum*. Nuchal organ differing from that of *howardorum* only in having rounded, instead of angulate, frontal corners. Op forms a thin straight edge whose ends are sharply rounded off (Fig. 110*E*), edge totally without thickening or ornament of any kind. None of the FRsetae have any basal or other swellings. FR very much as in *howardorum*, but slightly longer (Figs 110*D*–110*F*) and with the outer distal corner not produced into a thorn. Genital area as in Fig. 110*D*.

A1 (Fig. 111*A*) 8 (4, 8). A2 (Figs 111*B*, 111*C*) with only 1 abexp seta on the allobase; exp, seta3 terminal but seta4 distinctly subterminal. Md (unfavourably rolled over in Fig. 111*D*), the spinules in the PCXcomb much slenderer and more numerous than in *howardorum*. Mx1 (Fig. 111*E*), Mx2 (Fig. 111*F*), Mxp (Figs 110*G*, 111*G*) and P1 (Fig. 111*H*) each about as in *howardorum*, except that the Mxp hand is relatively shorter and with more convex edges, and enp3 of P1 is much longer than enp2. P2 (Fig. 111*J*) and P3 (Fig. 111*K*) each unique in this paper in having an enp of 3 segs, whereas P4 (Fig. 112*A*) has only 2 enp-segs; this makes the setal formula impossible to fit conveniently into Table 1, and it is therefore given here:

P1	P2	P3	P4	P5
0.1.0(4), 1.1.0(3);	0.1.123, 1.1.121;	0.1.223, 1.1.121;	0.1.223, 1.321;	4 and 6

P5 (Fig. 112*B*) basically as in *howardorum* but without spinules anywhere; exp with far less marginal thickening than in *howardorum*, such as there is being confined to the inner and outer margins, proximal to the setal insertions.

Male

Unknown.

Remarks

Deposition. Female J11101.

Origin of the specimen described. The type locality, with paratypes 1 (also dissected) and 2 (left whole), all on 27.iii.1976. No other specimens known.

Variation. None.

Colour. Alive, not seen; dead, a very clear pale brown, with pale grey soft parts.

Type locality. Map 6, locality 24.

Synonyms. None.

Major distinctions from similar and/or co-occurring species. The general appearance, the smooth SREs, the operculum and FRs, and (if laid on its back) the 3-segmented enps of P2 and P3 (2-segmented in all the other species in this paper).

Derivation of the specific name. From the Latin *laevis* = smooth, and *sub* = under, or less than; this species would be completely smooth all over, were it not for the abdominal spinulation, so the name means 'nearly smooth'.

11. Diagnosis of *Fibulacamptus*, gen. nov.

Very like *Canthocamptus* as defined above. Integument covered with scattered hard-to-see micropores (Fig. 127*F*) and sometimes with a few very small microcombs of microserrations on various abd somites, as well as with fairly numerous true pores almost every one of which is sensillary; the sensillary pores near the prosomal edge, or near an SRE, generally have tunnels. R of moderate size, slightly larger in the female than in the male. Nuchal organ shoe-shaped. All SREs perfectly smooth, except for the DLthorns on SRE10 of *tasmanicus*. No spinules anywhere on the body ahead of Abd2 except for the adgenital combs in the female, and no MV4s except in both sexes of *bisetosus*; on the other hand, the MV5s are at least as long and as broad as any other abd spinules, and their comb is strongly arched where it curves around the subanal sinus (usually with an MVgap). DLs, where present, clearly separate from VLs, and each of these combs consists of a very few thin spinules (except in *bisetosus*, *q.v.*). Op smooth-edged and evenly curved, projecting at most only slightly into the IRS. FR without thorns or humps, all 7 setae present but seta2 very small; FR general form conical or rounded with an $L:B$ of not more than 5 : 2.

A2exp of 1 seg with 4 rather short setae; enp with setae A–H and B1, WAC always split into 2 rather small transverse non-overlapping half-WACs. Md palp of 2 equally wide parallel-sided components of which the distal (= enp, with 3 terminal setae, but sometimes

4 in *gracilior*) fits onto the entire free end of the proximal (= CXB, which has a few spinules but no setae). Mx1PCXA always with 2 rear-surface setae, of which the distal is about twice as long as the proximal; basis with a total of 4 or 5 ramal setae (according to which setae are defined as ramal). Mx2 with 2 endites, the proximal seta of the proximal endite always free and never of either of the types (recurved-thumb or tiny 2-pronged fork) mentioned above under *Canthocamptus*, but instead conically tapering with a proximally hooked end, and a large spinule about halfway along the proximal edge. Mx2enp always with 3 setae, of which 1 may be small and therefore easily overlooked. Mxp hand with convex edges, widest at about 0·3–0·4, with a front-surface lengthways comb of rather few and very large spinules almost on the palmar edge, but with no rear-surface spinules (except in *victorianus*); only 1 wrist-seta, the claw at least as long as the entire hand.

P1–P4, each exp of 3 segs; P1, P2, and P4 each have an enp of 2 segs, with enp2 not more than about twice as long as enp1; P1 inner basal seta closely and evenly pinnate along its inner edge only, from 0·3 to between 0·7 and 1·0; P1, enp1 does not reach beyond 0·5 of exp3. P5 with both rami clearly present (except in male *bisetosus*, *q.v.*), each with at least 1 seta; P2enp2 has or lacks an inner seta, and the spines on exp3 of P2 to P4 run 3, 3, and 2 respectively.

Female

R fairly strongly developed for a *Canthocamptus*-like canthocamptid. A1 8 (4, 8), with all segs rather short except the distal ones in *bisetosus*, all setae simple. P1–P4 each with 3 exp and 2 enp segs, none of which are unusually short (as are the enp1s of P2–P4 in many *Canthocamptus*) or sexually modified; P3 basically identical with P2 and P4. Setal formulae in Table 1. Rami of P5 discrete and seldom with pores (see *gracilior* and *bisetosus*), each ramus with smoothly curved edges; exp orbicular, with at most a very few spinules (sometimes none at all) most of which lie exactly on the edge, away from the setal insertions (instead of forming epaulettes over them, as in *Canthocamptus*). Benp without an adexp thorn or any spinules, setophore short, enp-lobe (reaching to between 1·2 and 2·5 of the exp) with slightly convergent straight sides and a broadly rounded distal end whose thin smooth edge overlaps the setal insertions (which are therefore on the front surface, above the rounded distal margin). All P5setae basically alike in being long and in tapering evenly to a smooth filiform tip.

Male

Slightly smaller than the female; A1 always of the direct type, about as in *Canthocamptus* but with seg4 less swollen, and the terminal seg (where known) produced into a sharp point from which aesT and its 2 long setae arise subterminally. In all save *bisetosus* the MV2s and 3s each form a more or less continuous row across the ventral surface, but the VLs are widely separated from both the MVs and the DLs. Spermatophore of the usual bottle-like shape, with a rounded free end and a short neck coiled through about half a turn.

P3enp2 modified according to species, but the prong is always very short and forms part of a fused complex structure; it is never of the long slim kind found in *Canthocamptus* spp. P4exp shorter (in proportion to the exps of P2 and P3) than in *Canthocamptus*, and with the setae of exp3 more or less modified according to species; in all four species, however, the outer terminal seta of exp3 is transformed into a 'grapnel', a sort of pincer-like clip with immoveable claws which is quite unique among the Harpacticoidea as far as I know, and is the basis of the generic name (Latin *fibula* = clip, brooch, grapnel, belt buckle, necklace clasp, and kindred meanings; and *-camptus* from *Canthocamptus*; intended to convey the idea of a *Canthocamptus*-like animal with grapnels) as well as the main justification for this genus, which I propose to erect here in spite of what was said in section 3 about the desirability of putting many subgenera in abeyance under *Canthocamptus* s.lat. until they can be revised. For the distinctions between *Canthocamptus* and *Fibulacamptus*, see Key 1, and for those between the females and males of the species, see Keys 2 and 3. The type-species of *Fibulacamptus* is *F. victorianus*.

12. Descriptions of *Fibulacamptus* spp.

Fibulacamptus victorianus, sp. nov.

Figs 92*H*, 92*J*, 112*C*–112*E*, 113–116

Female Holotype

Length 0·65 mm (Figs 113*A*, 113*B*); the divisions inside the nuchal organ represent imperfectly preserved soft parts. Genital region as in Fig. 113*C*, op as in Fig. 113*A*. The abd spinulation consists mostly of short combs with a few, more or less long, spinules (DL3s–5s, MV2s, and prominent VL4s), apart from which Abd3 has (on each side of the MVgap) 2 confluent groups of MVs as far as the sensillary tunnel-pore, and a group of either LVs or outer MVs abaxial to that; on either side of the small MV5gap, there is a long and strongly arched MV5comb of stout spinules. FR $L : B$ hardly exceeds 1 : 1 even in ventral view, and is of course somewhat less than this from any other aspect.

A1 (Fig. 113*D*) fairly short. Other limbs not remarkable, except that:

(1) The MdPCXcomb shown in Fig. 114*A* may be unusual in having so few spinules.
(2) As indicated by the middle of the three reverse-side arrows in Fig. 114*D*, the rear surface of the Mxp hand has a short comb (in this species only) of small and very adpressed spinules, in addition to the usual front-surface comb of large spinules.
(3) The ICP of P1 has a median thorn as in Fig. 92*H*.
(4) P3 (Fig. 115*B*) has its 2 inner setae so close together on enp2, that Fig. 112*C* shows the other enp2 with its setae (as well as the rear-surface tube-pore adjacent to the 2 inner setae); these 2 setae are shown at high power, those in Fig. 112*D* from Fig. 112*C*, and those in Fig. 112*E* from Fig. 115*B*, to show how they are placed on the inner edge of enp2.
(5) The characteristic shape and proportions of P5 (formula 4 and 4) are as in Fig. 114*F*.

Male Allotype

Length 0·66 mm (Figs 116*A*, 116*B*); in other words, as long as the female but distinctly slimmer. MV2s and 3s form continuous combs of spinules all of about the same size, the VLs widely separated from both the DLs and the MVs on Abds 2–4. Op, and spinules on Abd5, about as in the female, but FRs distinctly shorter.

A1 (Fig. 116*D*) seg9 ends in a sharply pointed tip, aesT with its 2 long setae inserted subterminally. P1 has a slightly different ICP (Fig. 92*J*) from that of the female. P2 (Fig. 114*G*) basis has a large rounded thorn on the distal edge, with a much smaller thorn immediately adaxial to it. P3 (Fig. 116*E*), exp3 lower inner seta thick, with a few coarse pinnules along each edge, and ending in an obliquely cut tip bearing a row of fine setules; enp1 long and cylindrical without any projections, enp2 modified as shown. P4 (Fig. 115*D*) shorter than P2 or P3, exp modified in the way typical of the genus (Figs 115*E*, 115*F*), enp formula 1.221, outer terminal seta long and sparsely bipinnate but each of the others short and simply setiform. P5 (formula 4 and 1) and P6 as in Figs 116*C*, 116*F*.

Remarks

Deposition. Female, J11142; male, J11143.

Origin of the specimens described. The type locality.

Variation. None.

Colour. When alive (locality 27 only), semitransparent; dead (locality 27, after preservation, and in all other localities when first found) a very dark brownish grey.

Type locality. Map 6, locality 21.

Synonyms. None.

Range of habitats. Leaf-litter or moss, or both together.

Geographical distribution. Map 6, localities 11, 21, 27, and in moss on a steep wall beside the road, about 4 km west of locality 23 towards Tanjil Bren, Vic.

Major distinctions from similar and/or co-occurring species. The abd spinulation, op, FRs, and P1enp, singly or in combination, distinguish this species from all Australian *Canthocamptus* spp. with smooth SREs, while it may be distinguished from its congeners as in Keys 2 and 3.

Derivation of the specific name. Latin *victorianus* = Victorian, to denote (in this instance) an animal living in the Australian State of Victoria.

Note on habits. This is one of the very few species that I have seen alive; in a Petri dish of water it swims strongly but clumsily, turning over and over (like a rifle bullet, or *Paramecium*) and wobbling about as it goes, while it is stronger than any other harpacticoid that I have seen at crawling across a microscope slide either in air (having broken out of a drop of water) or when slightly pinched under a coverslip in water.

Fibulacamptus tasmanicus, sp. nov.

Figs 92*K*, 92*L*, 117–120

Female Holotype

Length 0·69 mm, general appearance (Figs 117*A*, 117*B*) very like that of *victorianus*. Genital region as in Fig. 117*C*, op as in Fig. 117*D*. Spinulation differs from that of *victorianus* only in that (1) Abd2 has no spinules at all, (2) the VL4s and DL4s are almost but not quite confluent, and (3) there are no DL5s, whose place on SRE10 is taken by an overlapping pair of triangular teeth (arrowed in Figs 117*A*, 117*B*, and 117*D*) just where the well-known British and West-European species *Canthocamptus staphylinus* (cited by Gurney 1932, p. 83, as the type-species of *Canthocamptus*) also has a projecting thorn, although I have no reason to think that these two species are at all closely related. FRs of *tasmanicus* about as in *victorianus*.

A1 (Fig. 117*E*) of medium build. Other limbs hardly different from those of *victorianus*, except that the MdPCXcomb has more spinules in it (Fig. 117*G*), the Mxp hand has only the front-surface comb of large spinules (Figs 118*D*, 118*E*), P1 has a shorter enp1 (Fig. 118*F*), P2 to P4 (Figs 118*G*–118*J*) differ in very minor ways, and the basically similar P5 (Figs 120*D*, 120*E*) shows differences in ramal proportions, wall-thickenings, and setation. P3enp2 has a division (shown by a straight transverse line in Fig. 118*H*, and by twin dashed lines in Fig. 120*F*) across its rear face, so that the enp appears to have 3 segs with a formula of 1.1.221 in rear view, or 2 segs with a formula of 1.321 in front view. Also in Fig. 120*F*, the arrows denote spinules (all the other appendices along the inner edge are setae), and 'enp3' has a tube-pore on its far (= rear) surface, similar to those shown on the near sides of Figs 120*H*, 120*K*.

Male Holotype

Length 0·56 mm, appearance (Figs 119*A*, 119*B*) much as in the female except that the Abd is slimmer (relative to the prosome) in dorsal view. MV2s and 3s each consists of a series of slightly oblique short combs not quite confluent with one another (i.e. about as the female MV3s in Fig. 113*C*). There are no DL2s; the DLs are widely separated from the VLs on Abd3 but confluent with them on Abd4; VL4s long, MV5s all rather small but definitely forming the usual arched comb. Op and FRs differ from those of *victorianus* only in that FRseta4 is much longer in relation to seta2 (Figs 119*A*–119*C*; compare Figs 116*B*, 116*C*).

Remarks

Deposition. Female, J11144; male, J11145. The paratypes are in the Tasmanian Museum, Hobart, registration no. G2888.

Origin of the specimens described. The type locality.

Variation. In Fig. 120*E* the P5enp has 3 setae on one side and (abnormally) 4 on the other.

Colour. Not seen alive; dead, pale straw-yellow with a greyish cloudiness inside.

Type locality. Nicholls Range and Hardwood Hill, transects 2R.860 and 12R.850, coll. C. Howard and others. This is somewhat inside locality 1 of Map 6, as is locality 7R.670 from which Figs 92*K* and 92*L* were drawn.

Synonyms. None.

Range of habitats. Leaf-litter of *Nothofagus* and/or eucalypts, and possibly (though not certainly) in the topsoil just underneath, especially in hot or dry weather.

Geographical distribution. Map 6; in practically every sample in localities 1 and 2 on various dates (now in the Tasmanian Museum), and a single male with *C. howardorum* (*q.v.*) in locality 8.

Fibulacamptus gracilior, sp. nov.

Figs 121–124

Female Holotype

Length 0·66 mm, distinctly slenderer (Figs 121*A*, 121*B*) than any of the other three species. Nuchal organ broadest at about 0·1 to 0·2. Genital region as in Fig. 121*D*. No MVs anywhere except for the arched comb on Abd5, Abds 3–5 each with a small isolated VLcomb, Abds 4 and 5 each with an even smaller isolated DLcomb. With an *L* : *B* of 5 : 3 in ventral view (Fig. 121*G*), although naturally somewhat less in dorsal (Fig. 121*E*) or side (Fig. 121*F*) views, the FR in this species is slimmer than in any other species of this genus; taking the length of the FR in side view as extending from 0·0 to 1·0 (as in Fig. 45*D*), FRseta5 has a crest-like lengthwise dorsal thickening from 1·2 to about 1·7.

Limbs hardly different from those of *tasmanicus* except that:

(1) The distal half-WAC of A2enp is composed of a larger number of spinules.
(2) The Md enp has lost its tip, with all its setae, in the single available Md of the holotype, and has 3 setae on the single available Md of the allotype; but paratypes 1 (female, Fig. 121*J*) and A (male) each have both their Mds, and all 4 of these Mds have 4 enp setae each. Each of the other species has 3 setae in either sex.
(3) The inner edge of P1enp2 has 2 long spinules close together about halfway down (Fig. 122*G*) instead of a few spaced out along the edge (Fig. 118*F*).
(4) P2enp1 is unique in this genus in lacking an inner seta; moreover, the holotype has 021 on one enp2 (Fig. 124*A*) and 121 on the other (Fig. 122*J*), but these might easily be misread as 111 (or 120) and 220 respectively, because of the placement of the spiniform outer seta at the very bottom of the outer edge, without a small piece of thickened wall between it and the outer terminal seta.
(5) P3enp2 (Fig. 122*H*) has no trace of subdivision, and is closer in this respect to Fig. 115*B* than to Figs 118*H* and 120*F*, although there are other differences between the first two figures.
(6) The exp of P5 (Fig. 124*C*) has a very different setation from that of any of the other species.

Male Allotype

Length 0·58 mm (Figs 123*A*, 123*B*); Abd2 with a long comb of MVs, Abd3 with a shorter comb of similar MVs and Abd5 with the usual arched combs of MVs, but none on Abd4. VLs and DLs form isolated combs, of very few spinules each, on Abds 3 and 4 alone. FRs parallel-sided, rather than tapering (Fig. 123*C*), most of the setae lost.

A1 as in Fig. 123*D*. P2 (Fig. 124*D*; basis magnified in Fig. 123*E*, whose OBS is shown from both sides) produced distally into a rounded knob with a very much smaller pointed thorn (arrowed in Fig. 123*E*) adaxial to it. P3 (Fig. 124*E*) enp1 very short and without any processes, enp2 modified as shown in Fig. 123*J*; P4 (Fig. 124*F*), exp3 modified as in Fig. 123*K*; P5 (Fig. 124*G*) rather small, and P6 (Fig. 123*C*) with 2 setae.

Remarks

Deposition. Female, J11146; male, J11147.

Origin of the specimens described. The type locality, on 24.v.1984, coll. A. Boulton and R. Hamond.

Variation. None.

Colour. Not seen alive; dead, a dark grey, with or without a yellowish tinge, and with the soft parts usually broken up into hundreds of little globules.

Type locality. Map 6, locality 15, on several occasions by A. J. Boulton with or without H. J. Dumont or R. Hamond, but never in numbers.

Synonyms. None.

Range of habitats. Slow-moving brooks, among dirt and living or dead plant material.

Geographical distribution. Map 6, localities 13 and 15.

Major distinctions from similar and/or co-occurring species. As given above for *F. victorianus*; *F. gracilior* is by far the most slender species of this genus, and has much the longest FRs.

Derivation of the specific name. Latin *gracilior* = more slender than; this species is distinctly more slender than any of its congeners.

Fibulacamptus bisetosus, sp. nov.

Figs 125–128

Female Holotype

Length 0·55 mm, and in general appearance more like *tasmanicus* than any other species, but FRs slightly longer in proportion to Abd5 than in any species save *gracilior*. Abd spinulation quite unique in this genus, in that it consists of long combs of unusually small spinules, the combs confluent except for being separated by sensillary tunnel-pores. Abds 2–4 have VLs confluent with DLs, which on Abds 2 and 3 are themselves confluent with an extra high comb of DLs, and on Abd4 with a continuous MVcomb; Abd5 with the normal MVcomb (Fig. 125*F*), less sharply arched, and consisting of shorter spinules, than in any of the other species. Genital area as in Fig. 125*C*, op and FRs as in Fig. 125*D*. SRE10 lacks the DLteeth found in *tasmanicus*.

The limbs differ from those of *tasmanicus* as follows:

(1) A1 (Fig. 126*A*) with segs 5–8 distinctly longer, in proportion to segs 1–4, than in Fig. 113*D*.
(2) A2enp (Figs 126*B*, 126*C*) with a much longer B1seta than in Fig. 113*F*.
(3) Mxp (Fig. 126*G*) agrees with both the other species, in lacking the rear-surface palmar comb shown (with a reverse-side arrow) in Fig. 114*D*.
(4) P1enp2 (Fig. 126*H*) has a longer inner terminal seta than in Fig. 114*E*.
(5) P3enp2 has 1 inner seta (Fig. 128*A*) instead of 2 (Fig. 115*B*).
(6) P4enp is unique in this genus in being very small and in having fewer setae (Figs 128*B*–128*D*) than in any of the other species.
(7) P5 has an equally long (in relation to the exp, and to the benp as a whole) but much less wide enp-lobe, bearing only 2 setae (Fig. 126*K*) instead of 4 (Fig. 114*F*); the exp-setae are also slightly different.

Male Allotype

Length 0·50 mm (see below), general appearance (Figs 127*A*, 127*B*) very much as in the female. The allotype being little more than a husk, the prosome and the thoracic pedigers may have pulled apart from one another in Fig. 127*A* (equivalent to a length of just over

0·5 mm) a little more than they might have done normally (Fig. 127*B*, equivalent to a length of just under 0·5 mm, certainly appears more natural); and, in the same way, the abd somites telescoped into one another to such an extent on being mounted that, after being drawn in this condition in Fig. 127*C*, they were redrawn as in Fig. 127*D* as if at, or near, full extension, so as to facilitate the reading of the abd spinulation. The dashed rectangle in Fig. 127*D* is much enlarged in Fig. 127*F*, to show the sparse micropores (very hard to see without Nomarski or, at a pinch, phase-contrast), combs of microdenticles, a few spinules from the VL2comb, and the sensillary tunnel-pore STP which is taken here as the boundary between the VL2s and MV2s. Abds 2–4 each with a continuous hoop of DLs, VLs, and MVs, which on Abd4 is confluent with a comb of similar MDs to completely encircle the body. Abd5, FRs, and op, all as in the female.

A1 (*in situ* in Fig. 127*B*) unfortunately lost during mounting, and thus not available for drawing separately. P2 (Fig. 128*E*) with a strong divergent pair of large bluntly triangular spinules on the distal projection of the basis. P3 (Fig. 128*F*) with an enormous abaxial thorn on enp1, enp2 modified as in the other species although different in detail (the other side of P3enp is shown in Fig. 128*G*). P4 (Fig. 128*H*) with the enp even more reduced than in the female (Figs 128*B*–128*D*) and bearing only a single, long and sparsely bipinnate, terminal seta; exp3 (enlarged from both sides in Figs 128*J* = front view and 128*K* = rear view) basically as in each of the other species. P5 (Fig. 127*E*) with its rami fused into a single plate with 4 setae; P6 with 3 setae (Fig. 127*C*).

Remarks

Deposition. Female, J11148; male, J11149.

Origin of the specimens described. The type locality.

Variation. None.

Colour. Not seen alive; dead, pale grey.

Type (and only known) locality. Locality 2 in Map 1 (= locality 4 in table 2 of Bayly 1982) at different times; a small pond with *Isoetes* and *Campylopus.*

Synonyms. None.

Major distinctions from similar Australian species. The abdominal spinulation is unique in this genus; otherwise, proceed as under this heading for *F. victorianus.*

Major distinctions from co-occurring species. None, because no other species were found with it.

On subadult specimens. None.

Derivation of the specific name. Latin *bisetosus* = with 2 setae, referring to the benp of the female P5.

13. Zoogeography

Of the species in this paper, only seven could be reconciled with previously named species, namely two immigrant species (*C. bidens* and *C. grandidieri*) and five others (*C. australicus*, *C. fimbriatus*, *C. hirsutus*, *C. longiseta*, and *C. tasmaniae*) which, together with the 19 described here for the first time, appear to be endemic to Australia, and all to the area shown in Map 6 except for *F. bisetosus* (*q.v.*) from south-western Western Australia. The maps of still or flowing waters in Tasmania and Victoria given by Williams (1964 – see also fig. 2:1 in Weatherly 1967) and by Bayly and Williams (1973, fig. 10:2) offer a useful background to Maps 2–6 of the present paper.

Of the two migrants, *C. bidens* is known to be air-lifted on the feet of waterbirds such as rails, waterhens and coots (Lang 1948, p. 1141), and this may also be true of *C. grandidieri.* Both appear to have entered northern Queensland from adjacent tropical areas in which their distribution, although still very incompletely known, has already been established. The virtual absence of records of any non-marine harpacticoid between Townsville and Canberra makes it impossible to say whether there is any link between the *C. bidens* in Map 4 and those on Map 7, but no morphological difference could be found between them.

By far the commonest species, *C. australicus* and *C. longiseta*, require maps to themselves (Maps 2 and 3) in Victoria, with a few more distant mainland finds in Map 1 (see also p. 1075, on the geographical distribution of *C. australicus*).* Why *C. henryae* should have much the same sort of distribution as these two species in Tasmania (Map 5), but an entirely separate (or at any rate different) one on the mainland, cannot be explained at present.

The remaining species (all those on Map 6, and *F. bisetosus* in Map 1) have in most cases extremely restricted distributions, which at the moment I tend to regard as the shrunken and fragmented remains of distributions which were far more extensive when south-eastern Australia was cooler and wetter than now. In this connection, the long-oval area in eastern Victoria on Maps 2, 3, 4 and 6 represent the 'highland island' (for a far more detailed map see fig. 16.1, on p. 362, of Costin 1981) covering only the southern extremity of the Great Dividing Range (which otherwise extends up the whole eastern side of Australia, through Map 7 and north of it). This island is postulated here because several species occur either entirely within it (although *C. timmsi* also occurs at localities 8 and 10–12), or mostly within it and less often outside it (including stray specimens that are accidentally swept down-river), while on the other hand some species (Maps 2–4) equally occur only outside it. The postulated but unconfirmed eastern end of the island is shown dashed because the distributions of *C. australicus* and *C. longiseta* appear to extend round it in Maps 2 and 3; however, only the Melbourne end of the island can be regarded as at all well known up to now, and far more collecting is needed over the whole of the rest of it and further north-east, embracing the whole of the area around Lake Eucumbene and extending as far as Canberra (LE and C in Map 6).

Localities 5, 6 and 7 in Map 6 form a group of Tasmanian localities having some species in common with the highland island as well as a few endemics (of which by far the most widely distributed is *F. tasmanicus*, all over areas 1 and 2, but not yet looked for elsewhere). Nearly all records in central and eastern Tasmania, as well as some of those in the north and north-west (Maps 5 and 6), are of species that also occur on the mainland; as shown by figures of *C. timmsi* and *C. hirsutus*, I could detect no appreciable differences between mainland and Tasmanian forms of any of these species. Of species which appear to form pairs, both *C. caecosetosus* and its near relative *C. clavifurcatus* occur at locality 6, but only the former also occurs on the mainland (at locality 16) and only the latter also lives semi-terrestrially (at locality 7); both *F. victorianus* and *F. tasmanicus* live more nearly terrestrially than any other species in their respective States, whereas the other Victorian species (*F. gracilior*) lives in rivers. By far the most likely places in which to find rare species are leaf-litter, moss on waterfalls (or at any rate wherever kept continuously wet or very moist), or in (or under) *Sphagnum* (itself confined almost entirely to the highland island). Nobody has yet discovered how any of the species in this paper cope with the drying-out of their habitats that regularly occur every summer, for instance by encysting as described for the European *C. staphylinus* (see Lang 1948, p. 1598 and Abb. 610).

The samples listed in Appendices 1–3 represent only a minority of the samples taken in recent years, at least in the area of Map 6, by the workers mentioned in this paper, all of whom have kindly turned over their harpacticoids to me; even allowing for the fact that their sampling techniques were far less specifically directed to this group than were my own, the stage has long ago been reached at which new samples contain only species that I already

---

**Note added in proof.* The following two samples from Queensland, collected by Dr W. F. Ponder and Mr P. H. Colman, constitute a significant northward extension of the known northward range of *C. australicus*: Map 1, locality 9, large swampy spring, west of Injune and just north of Mount Hutton Horst, 2.x.1984, 1 female without eggs; Map 1, locality 10, spring north-east of Lake Huffer (itself north-east of Muttaburra), 25.ix.1984, 2 females (both with eggs) and 2 males.

know, and therefore I regard the coverage of this paper as reasonably complete, at least in Tasmania and much of Victoria. As far as taxonomy and zoogeography are concerned, the next steps should be:

1. To search the rest of the highland island, as already mentioned.
2. To find the missing other sexes of some of the present species.
3. To search all potential habitats in promising but unexplored areas, particularly the Kimberleys and south-western Western Australia.
4. To sample widely and thoroughly in all kinds of ephemeral and/or subterranean waters, all over the continent.
5. To discover a means of making *all* the harpacticoids in a sample (and not just certain species, or only some of each species) come out of the debris of their own accord, clean enough for immediate examination, thus eliminating the time-consuming labour of sorting the filtrate under a stereobinocular.

If one matches the total invertebrate fauna of the 23 samples on Map 7 against the fauna of an ecologically comparable set of samples from a similar area of Victoria or Tasmania, allowing for the fact that animals other than harpacticoids were identified only to groups, the most striking impression is that these other animals are just as abundant in a Queensland sample as in a Victorian or Tasmanian one, and show (very approximately) similar relative abundances in each State, whereas harpacticoids are rarely as numerous in even the richest Queensland samples as they may be in quite a moderately rich Victorian or Tasmanian one, and are often absent from an outwardly suitable Queensland locality. These impressions refer only to total abundances in a no more than roughly quantitative sample, but even so they appear to support the established differences between tropical and temperate collections of pond-life in other parts of the world, in that North Queensland resembles the Philippines (Marmaril and Fernando 1978) or West Africa (Dumont *et al.* 1981) in having the pantropical *C. grandidieri* and at most one other species of harpacticoid, whereas Map 6 might be compared to the British Isles (Gurney 1932). In such general terms, a cool climate obviously goes with a varied fauna of harpacticoids, some of which may be very numerous at times.

Against this general background, however, collectors in any country should be constantly on the lookout for rare species living in isolated 'pockets' like some of those on Map 6, such pockets being more likely to be found in mountainous or hilly areas (unless utterly arid) than in flatter or low-lying areas, unless the latter present a great diversity of localized biotopes, every one of which should be sampled. Obviously far more searching of this kind remains to be done in Australia, as indeed elsewhere; it is hoped that the present paper will be suitably helpful to all who wish to use it.

14. Acknowledgments

I would like to express my warmest thanks to the following:

Professor G. D. Campbell and Dr M. J. Littlejohn (successive Chairmen) for facilities in the Zoology Department, University of Melbourne; and to them, and all my former colleagues there, for their interest and encouragment.

Dr I. A. E. Bayly and Mr D. W. Morton, both of the Zoology Department, Monash University, for many helpful discussions; Mr A. J. Boulton, of the same Department, for guiding me to his collecting-places; to these three, and many others mentioned in the text, for sending me Australian specimens; and to Dr P. DeDeckker for the material in Appendix 4.

Dr D. H. Ashton, Botany Department, University of Melbourne, for drawing my attention to the terrestrial harpacticoids found by Howard (1975), to Dr Howard for guidance, and to her parents (Mr and Mrs M. Howard) for taking me to her Surrey Hills locality.

The late Mr Paul Genery, of Melbourne, for taking me to Gordon, Vic.

The late Mrs M. Cooper (née Henry), the late Mrs Neil Ross, and Mr Ross Jr, for helping in my attempt to collect topotypes of *C. longiseta*.

Dr A. G. Nicholls for directions on how to get to the Guide River Falls, Tasmania.

Professor W. D. Williams, Zoology Department, University of Adelaide, and Dr Bayly for consistently supporting my grant applications, and the Australian Biological Resources Study for funding.

The Curators of Crustacea in the following State museums, who willingly lent whatever relevant material they had: Mr W. Zeidler and Mrs P. J. M. Greenslade, South Australian Museum, Adelaide; Miss A. Green, Tasmanian Museum, Hobart; Dr J. K. Lowry, Australian Museum, Sydney.

The Forests Commission of Victoria, and the National Parks and Wildlife Services of Victoria and Queensland, for permission to collect in their respective Reserves.

Messrs W. Arthur, U. R. M. Bates, G. Liedtke, D. Powell, J. Rastoll, M. P. Sinclair, N. Stallard, and the late D. E. Wentworth, for making, modifying, or repairing apparatus (mostly accessories for microscopes).

15. References

Bayly, I. A. E. (1982). Invertebrate fauna and ecology of temporary pools on granite outcrops in southern Western Australia. *Australian Journal of Marine and Freshwater Research* **33**, 599–606.

Bayly, I. A. E., Bishop, J. A., and Hiscock, I. D. (1967). 'An Illustrated Key to the Genera of the Crustacea of Australian Inland Waters.' (Australian Limnological Society: Melbourne.)

Bayly, I. A. E., and Williams, W. D. (1973). 'Inland Waters and their Ecology.' (Longmans: Australia.)

Bodin, P. (1979). 'Catalogue des Nouveaux Harpacticoides Marins.' (Nouvelle Edition.) (Université de Bretagne Occidentale, Laboratoire d'Océanographie Biologique, 29283 Cédex, Brest, France.)

Borutzky, E. V. (1964). 'Fauna of U.S.S.R., Crustacea. Vol. 3. No. 4: Freshwater Harpacticoida.' (Israel Program for Scientific Translations Cat. No. 1119.)

Bowman, T. E., Prins, R., and Morris, B. F. (1968). Notes on the harpacticoid copeods *Attheyella pilosa* and *A. carolinensis*, associates of crayfishes in the eastern United States. *Proceedings of the Biological Society of Washington* **81**, 571–85.

Brehm, V. (1950). Neue Entomostraken aus Tasmanien. *Anzeiger des Österreichisches Akademie der Wissenschaften* **87**, 250–3.

Brehm, V. (1951). Sobre la microfauna de las aguas dulces de diversos paises extraeuropeos. *Publnes. Inst. Biol. Aplicada (Barcelona)* **5**, 83–100.

Brehm, V. (1953). Contributions to the freshwater microfauna of Tasmania. Pt 1. Copepods. *Papers and Proceedings of the Royal Society of Tasmania* **87**, 33–62.

Canu, E. (1892). Les Copépodes du Boulonnais; morphologie, embryologie, taxonomie. *Travaux du Laboratoire de Zoologie Maritime de Wimereux-Ambleteuse (Pas-de-Calais)* **6**, 1–294, plates 1–30.

Carter, M. E., and Bradford, J. M. (1972). Postembryonic development of three species of freshwater harpacticoid Copepoda. *Smithsonian Contributions to Zoology* **119**, 1–26.

Chapman, M. A., and Lewis, M. H. (1976). 'An Introduction to the Freshwater Crustacea of New Zealand.' [William Collins (New Zealand) Ltd: Wellington, N.Z.]

Chappuis, P. A. (1951). Copépodes de Tasmanie. *Archives de Zoologie Expérimentale et Générale* **87** (Notes et Revue 3), 104–15.

Costin, A. B. (1981). Alpine and sub-alpine vegetation. In 'Australian Vegetation'. (Ed. R. H. Groves.) pp. 361–76. (Cambridge University Press.)

Dumont, H. J., Pensaert, J., and Van de Velde, I. (1981). The crustacean zooplankton of Mali (West Africa). *Hydrobiologia* **80**, 161–87.

Forbes, S. J., Walsh, N. G., and Gullan, P. K. (1982). Vegetation of East Gippsland. *Muelleria* **5**(1), 53–113.

Guerne, J. de, and Richard, J. (1893). *Canthocamptus grandidieri*, *Alona cambouei*, nouveaux Entomostacés d'eau douce de Madagascar. *Mémoires de la Société zoologique de France* **6**, 214–24. [Not seen.]

Gurney, R. (1916). On some freshwater Entomostraca from Ceylon. *Proceedings of the Zoological Society of London for 1916*, pp. 333–43, plates 1–3.

Gurney, R. (1920). A description of the copepod *Cylindropsyllus brevicornis*, van Douwe, and of a new species of *D'Arcythompsonia*, Scott. *Annals and Magazine of Natural History* (9)**5**, 134–40, plates 5–7.

Gurney, R. (1932). 'British Freshwater Copepoda.' Vol 2. pp. 1–336. (Ray Society: London.)

Hamond, R. (1969). Methods of studying the copepods. *Microscopy (Journal of the Quekett Microscopical Club)* **31**, 137–49.

Hamond, R. (1971). The Australian species of *Mesochra* (Crustacea : Harpacticoida), with a comprehensive key to the genus. *Australian Journal of Zoology*, Supplement No. 7. pp. 1–32.

Hamond, R. (1973*a*). A review of *Cletodes* (Crustacea : Harpacticoida), with the description of a new species from Queensland. *Memoirs of the Queensland Museum* **16**(3), 471–83.

Hamond, R. (1973*b*). The harpacticoid copepods (Crustacea) of the saline lakes in southeast Australia, with special reference to the Laophontidae. *Records of the Australian Museum* **28**(17), 393–420.

Hamond, R. (1973*c*). The Australian species *Robertsonia* (Crustacea, Harpacticoida), with a revised key to the genus. *Records of the Australian Museum* **28**(18), 421–35.

Harding, J. P. (1958). *Bryocamptus stouti* and *Goniocyclops silvestris*, two new species of copepod crustacean from forest litter in New Zealand. *Annals and Magazine of Natural History* (13)**1**, 309–14.

Henry, M. (1922). A monograph of the freshwater Entomostraca of New South Wales. Pt II. Copepoda. *Proceedings of the Linnean Society of New South Wales* **47**, 551–70, plates 55–58.

Howard, T. M. (1975). Litter fauna in *Nothofagus cunninghamii* forests. *Proceedings of the Royal Society of Victoria* **87**(1 and 2), 207–13.

Ito, T., and Takashio, T. (1980). *Canthocamptus mirabilis* Sterba (Copepoda, Harpacticoida) from Hokkaido, northern Japan. *Annotationes Zoologicae Japonenses* **53**(3), 210–19.

Kabata, Z. (1979). 'Parasitic Copepoda of British Fishes.' (Ray Society: London.)

Lang, K. (1948). 'Monographie der Harpacticiden.' Vols 1 and 2. pp. 1–1682. (Hakan Ohlssons Boktryckeri: Lund.)

Lang, K. (1965). Copepoda Harpacticoidea from the Californian Pacific coast. *Kungliga Svenska VetenskapsAkademiens Handlingar* (4)**10**(2), 1–560.

Lewis, M. H. (1972). Freshwater harpacticoid copepods of New Zealand. I. *Attheyella* and *Elaphoidella* (Canthocamptidae). *New Zealand Journal of Marine and Freshwater Research* **6**(1 and 2), 23–47.

Lowndes, A. G. (1950). The male of *Canthocamptus bidens* Schmeil. *Proceedings of the Zoological Society of London* **120**, 395–403.

Luxton, M. (1982). Some new species of mites from New Zealand peat soils. *New Zealand Journal of Zoology* **9**, 325–32.

Marmaril, A. C. Sr., and Fernando, C. H. (1978). Freshwater zooplankton of the Philippines (Rotifera, Cladocera, and Copepoda). *Natural and Applied Science Bulletin* **30**(4), 105–221.

Moore, C. G. (1976). The form and significance of the hyaline frill in harpacticoid copepod taxonomy. *Journal of Natural History* **10**, 451–6.

Morton, D. W., and Bayly, I. A. E. (1977). Studies on the ecology of some temporary freshwater pools in Victoria with special reference to microcrustaceans. *Australian Journal of Marine and Freshwater Research* **28**, 439–54.

Sars, G. O. (1908). Freshwater Copepoda from Victoria, southern Australia. *Archiv for Mathematik og Naturvidenskab* (B)**29**(7), 3–24, plates 1–4.

Sars, G. O. (1911). 'An Account of the Crustacea of Norway, with Short Descriptions and Figures of all the Species. Vol. 5. Copepoda, Harpacticoida.' (Albert Cammermeyer's Forlag: Bergen.)

Schmeil, O. (1894). Deutschlands freilebende Süsswasser-Copepoden. II. Harpacticidae. *Bibliotheca Zoologica (Stuttgart)* **5** (15, No. 2), 1–100. [Not seen.]

Schminke, H. K. (1971). Evolution, naturlishes System, und Verbreitungsgeschichte der Bathynellacea (Crustacea, Malacostraca). Ph.D. Thesis, Kiel University.

Shepherd, J., Searle, J., and Stickland, J. (1918). One years' collecting microfauna, Botanic Gardens Lake, Melbourne. *Victorian Naturalist* **35**, 79–84.

Shiel, R. J. (1976). Associations of Entomostraca with weedbed habitats in a billabong of the Goulburn River, Victoria. *Australian Journal of Marine and Freshwater Research* **27**, 533–49.

Weatherly, A. H. Ed. (1967). 'Australian Inland Waters and their Fauna: Eleven Studies.' (Australian National Univerrsity Press: Canberra.)

Wells, J. B. J. (1980). A revision of the genus *Longipedia* Claus (Crustacea : Copepoda : Harpacticoida). *Zoological Journal of the Linnean Society* **70**, 103–89.

Williams, W. D. (1964). Some chemical features of Tasmanian inland waters. *Australian Journal of Marine and Freshwater Research* **15**, 107–22.

Williams, W. D. (1974). Freshwater Crustacea. IV. In 'Biogeography and Ecology in Tasmania'. (Ed. W. D. Williams.) Chapter IV. (Dr W. Junk: The Hague.)

Williams, W. D. (1980). 'Australian Freshwater Life; the Invertebrates of Australian Inland Waters.' (MacMillan Company of Australia Pty Ltd: Melbourne.)

Wilson, M. S. (1956). North American harpacticoid copepods. I. Comments on the known fresh-water species of the Canthocamptidae; 2. *Canthocamptus oregonensis* n.sp. from Oregon and California. *Transactions of the American Microscopical Society* **75**(3), 290–307.

Wilson, M. S. (1958). North American harpacticoid copepods. 5. The status of *Attheyella americana* (Herrick) and the correct name for the subgenus *Brehmiella*. *Proceedings of the Biological Society of Washington* **71**, 49–52.

Appendix 1: Detailed Records of the Commoner Species of *Canthocamptus*

(*a*) C. australicus

Western Australia: Locality in Map 1 = locality 17, sample 1, of Mr J. R. Terni (W.A. Institute of Technology), Swampy Paddock, Sevenoaks St between Cecil Av. and Bent St, Cannington (in the south-eastern suburbs of Perth), 28.vi.1979. **South Australia:** Locality 4 in Map 1 = a doubtful record from Adelaide (on p. 553, but not on p. 567, of Henry 1922). In Map 2, from north to south: Shallow temporary pool 39 km south of Bordertown, 23.viii.1974, D. W. Morton. Temporary pool (max. depth 10 cm) on Exmoor, *c.* 30 km north of Naracoorte, 23.v.1974, coll. D. W. Morton. Flooded roadside ditch 7 km north of Beachport, 12.ii.1974, coll. D. W. Morton. Browne's Lake, Mount Gambier, 12.vii.1974, coll. D. W. Morton. Caroline Sink Hole, Pond Flat in Caroline Forest (S.A. Mus. TC 2807), coll. W. Zeidler and A. Gackle, 20.iv.1979. Note that the first two of these localities in Map 2 lie north of my arbitrary 'south-eastern limit'. **Victoria** (all localities in Map 2, from west to east): Pine Forest Lagoon near Nelson, 17.xi.1970, coll. B. V. Timms. Sheepwash Lagoon next to Lake Bong Bong (near the coast west of Portland) on 12.viii.1972, coll. B. V. Timms. Showler's Swamp, Karnak (nearer Edenhope than Horsham, and just north of the main road between them), 22.v.1974, coll. D. W. Morton. Cavendish (about 20 km north of Hamilton), as in fig. 1 and tables 1 and 2 of Morton and Bayly (1977). Locality 1 in Map 2 is the type locality, an undated collection by O. A. Sayce in a swamp at St Arnaud (Sars 1908). Among submerged grasses in a stream flowing at about 1 m/s under the road between St Arnaud and Donald, near the milestone saying 'Melbourne 259 km', and just north-east of the type locality, 16.iv.1975, coll. R. Hamond. In a temporary pool 4 miles (about 7 km) north of Beaufort, 24.v.1976, coll. D. W. Morton. Shallow temporary pool about 3 km east of Mortlake, 21.v.1974, coll. D. W. Morton. Lake Purrumbete (locality 5 in Map 2), undated, coll. B. V. Timms (Lewis 1972, p. 44). Just south-east of locality 5, Quarrell's Swamp (= locality 12 on Map 6); a few coll. D. W. Morton on 20.v.1974, and many coll. R. Hamond on 1, 2, and 15.x.1981. Temporary pool about 20 miles (32 km) north-east of Camperdown, beside road to Foxhow, 20.v.1974, coll. D. W. Morton. Locality 2 in Map 2 (see species description under the heading 'Origin of the specimens described'); and a few about 20 min later and 0·3 km further north in the stream running through Mr Genery's property. Localities 14 and 15 on Map 6, on several occasions, both normal and short-tailed forms. Locality 3 in Map 2, the lake in the Melbourne Botanic Gardens (Shepherd *et al.* 1918). Locality 4 in Map 2, the billabong investigated by Shiel (1976, pp. 538, 539). The remaining localities (between 3 and 4 in Map 2, to the north and east of Westernport, and in a row through central Gippsland) are mainly in Morton and Bayly (1977, fig. 1 and table 2) with the addition of a few samples collected by D. W. Morton. However, the Phillip Island records were from Summerland on 14.viii.1966, coll. J. Bradbery and in Oct. 1984, coll. A. J. Boulton; and that from Lake Wellington was from Fisheries and Wildlife cruise 8, station 3051, on 18.ix.1979 (by courtesy of A. D. McKinnon). **New South Wales** (from west to east): In a roadside swamp with small sedges about 100 m north-east of the State Electricity Commission substation at Mulwala, 18.viii.1974, coll. R. Hamond. Holbrook area, no details (Henry 1922, p. 567). Mount Kosciusko area, no details (Henry 1922, p. 567). In an unnamed lake at Bungarby (south-east of Lake Eucumbene), coll. B. V. Timms on 13.v.1975. In an unnamed lake west of Cathcart (north-east of Bombala), and in an unnamed swamp south of Cathcart, both coll. B. V. Timms on 14.v.1975. Redhead Lagoon (locality 7 in Map 1), just south of Newcastle, 16.xi.1975, coll. B. V. Timms. Llangothlin Lagoon, north of Armidale (locality 8 in Map 1), 17.viii.1967, coll. B. V. Timms. **Tasmania:** Map 5, from west to east, in shallow temporary pool 12 km east of Marrawah, 18.viii. 1974, coll. D. W. Morton. Small permanent pond in paddock 35 km west of Smithton, 17.viii.1874, coll. D. W. Morton. Localities 8 and 9 on Map 6, small green weeds in the shallow margin of Lake St Clair, about 50 m from the dam at the southern extremity of the lake, 11.ii.1975, coll. R. Hamond. Temporary pond near Lake Echo (exact location not available), 20.viii.1974, coll. D. W. Morton. In a swamp only about 30 m from the sea at Hawley Beach (near Port Sorell, which is roughly north-west of Launceston), 27.viii.1974, coll. D. W. Morton. Lagoon of Islands, both among weeds at the waters' edge and in the outflowing culvert *c.* 100 m away, 15.iv.1975, coll. R. Hamond. Locality 6 on Map 6, shallow water densely packed with *Elodea*-like weed in the northern end of Lake Crescent next to the road, 15.iv.1975, coll. R. Hamond. Shallow pond covered by ice less than 1 cm thick, 20 km north-west of Oatlands, 22.viii.1974, coll. D. W. Morton. Cleveland Lagoon (= CL in Map 5), knee-deep water nearest to the track running 0·4 km from the post-office on the main road, 19.iii.1975, coll. R. Hamond. Big Lake Waterhouse (= BLW in Map 5), 26.viii.1974, coll. D. W. Morton (doubtfully there by Brehm 1953, pp. 54–5). Swampy pond thick with algae and reeds, about 0·5 km from the nearest part of Big Lake Waterhouse and 1·8 km from where the track joins Homestead Road (4·4 km from which the track joins the main road); 26.viii.1974, coll. D. W. Morton, and 19.iii.1975, coll. R. Hamond (sample TAS75/18, see Map 5). Pools in bed of Jordan River under a private driveway which enters the main road exactly 6·0 km towards Bothwell from the Melton Mowbray Hotel, 7.ii.1976, coll. R. Hamond.

(*b*) C. longiseta

Western Australia: Mullet Lake (locality 3 in Map 1), 9 km east of Esperance, 7.x.1981, coll. R. J. Shiel; a single very damaged male, which probably did not live in this rather saline lake. **South Australia:** In Map 3, from west to east, in flooded roadside ditch 7 km north of Beachport (see *C. australicus*). In Browne's Lake at Mount Gambier (see *C. australicus*). Doubtfully in the Adelaide area (locality 4 in Map 1; see *C. australicus*). Not on p. 568 of Henry (1922). **Victoria** (also in Map 3, from west to east): Pine Forest Lagoon (see *C. australicus*). Swamp in paddock about 3 km east of Nelson, 12.vii.1974, coll. D. W. Morton. Quarrell's Swamp (on all dates given under *C. australicus*). In stream between St Arnaud and Donald (see *C. australicus*). In deep pool covered by willow trees and going under road 3·3 km down Maryborough road from junction with Sunraysia Highway where signpost says Avoca 32 km, St Arnaud 32 km, coll. R. Hamond, 16.iv.1975. In a billabong at Trawool (south-east of Seymour), coll. D. W. Morton on 27.x.1980. In another billabong (= locality 3 in Map 3) just east of the preceding, in various samples from 1974 to 1977, coll. R. J. Shiel (for a description of this billabong, and a definition of the term billabong, see Shiel 1976). In the lake in the Jock Marshall Reserve at Monash University, 20.ix.1974. Map 6, localities 14, 15 (see *C. australicus*), and 18, various places north-east or south-east of Melbourne and in Gippsland (= coastal Victoria south of the mountains and east of Melbourne) given by Morton and Bayly (1977) as *Attheyella*, sp. nov. Snowden's Lagoon near Bandiana (just south of Albury), 11.viii.1976 and in July 1978, both coll. R. J. Shiel. **New South Wales** (in Map 3 unless otherwise stated): Mulwala (see *C. australicus*). Locality 1 in Map 3, on the Ross property just north of Holbrook (see text 'Type locality', and Henry 1922, p. 568). Cootalantra Pond (just south-west of Cootalantra Lake, which lies west of Cooma, north-east of Berriedale, and south-east of Lake Eucumbene), 12.v.1975, coll. B. V. Timms. Locality 2 in Map 3, Green Lake (between Cathcart and Bibbenluke, north-east of Bombala) 14.v.1975, coll. B. V. Timms. Unnamed swamp south of Cathcart (see *C. australicus*). Locality 8 in Map 1, Llangothlin Lagoon (see *C. australicus*). **Tasmania** (Map 5, from north to south): Big Lake Waterhouse, coll. R. Hamond, 5.ii.1976. Weeds at and below water-level on mud bank of North Esk River, right opposite where Hart St (on signpost, but Hart Crescent on map) enters Bridget Road (which runs along the river bank at this point in the eastern suburbs of Launceston) and 0·25 km west of railway crossing, coll. R. Hamond, 4.ii.1976. In a long shallow pool on the west side of the road, 4·4 km towars Poatina from junction with the Cressy-to-Campbelltown road, coll. R. Hamond, 19.iii.1975. Lagoon of Islands (see *C. australicus*). Locality 6, Map 6 (see *C. australicus*). In ice-covered pool near Oatlands (see *C. australicus*). Amid thick weeds (?*Lemna*, ?*Spirogyra*) under a small plank bridge in the south-east corner of Lake Tiberias, 7.ii.1976, coll. R. Hamond. Jordon River, 1976 (see *C. australicus*). Also, Dr R. J. Shiel found a very dilapidated and fragmented husk in the Great Lake (= locality 4 on Map 6) on 8.v.1980; this may not be a natural habitat.

(*c*) C. henryae

South Australia: Shallow saltpan (= locality 6 in Map 1) just south of Meningee, 13.vii.1974, coll. D. W. Morton. **Victoria** (Map 4, from west to east): Pine Forest Lagoon (see *C. australicus*). Lake Bong Bong (near coast, about two-thirds of the way from Portland to the border with South Australia), in shallow water near the edge, coll. B. V. Timms on 17.xi.1970. Sheepwash Lagoon (see *C. australicus*). Shore of Main Bridgewater Lake (next to Tarragul, due west of Portland) coll. B. V. Timms, 18.viii.1972. **Tasmania** (from west to east in Map 5): Lagoon of Islands (see *C. australicus*). Lake Crescent (see *C. australicus*). Launceston, a single husk (see *C. longiseta*). Big Lake Waterhouse and the swamp 0·5 km east of it; both sampled by D. W. Morton on 26.viii.1974 and by R. Hamond on 19.iii.1975, but only the Lake sampled by R. Hamond on 5.ii.1976 (for both Lake and swamp, see *C. australicus*). See also localities 3, 5 and 6 on Map 6.

Appendix 2. Records of *Fibulacamptus* spp. and rarer *Canthocamptus* spp.

Localities 1–10 are in Tasmania, localities 11–28 are on the mainland

Locality	Details
1 and 2	The areas from which all the *F. tasmanicus* in Tasmanian Museum, Hobart, came.
3	Two of the three tarns marked 'Wombat' on the map of Mount Field National Park; *C. henryae*, *C. echinopyge*.
4	Shallow mud-bottomed farm pond with very green water, 200 m to right of main road, about 8 km out of Ouse towards Hobart; *C. mortoni*.
5	Lake Leake, mostly among weeds on the shore of Boat Hole but about one-fifth of the sample in shallow water on the stony and sandy shore of Bellevue Island; *C. australicus*, *C. clavifurcatus*, *C. henryae*, *C. longifurca*.
6	Small roadside rockpool with a bottom of very soft mud, beside the road from Steppes to Oatlands, 7·7 km east of the turn-off to the Lagoon of Islands; *C. australicus*, *C. longifurca*, *C. longiseta*.
7	Great Lake; *C. clavifurcatus* (*q.v.*), *C. longiseta* (see Appendix 1).
8	Australian Paper Manufacturers' Forestry Reserve, including Companion Dam; *C. howardorum* (*q.v.* for details), *C. mortoni*, *C. fimbriatus*, *C. obtusus*, *C. timmsi*, *C. lacinulatus*, *C. clavifurcatus*, and *F. tasmanicus*.
9	Roadside swampy pool near Parrawe; *C. mortoni*.
10	Wet moss all down rock face of Guide River Falls; *Canthocamptus* sp. 1, *C. hirsutus*, *C. tasmaniae*, *C. globulisetosus*, *C. clavifurcatus*, *C. caecosetosus*.
11	Wet moss and leaf-litter in scrub, beside Turton's Track about 5 km west of Haines' Junction in the Otway Ranges; *C. lacinulatus*, *C. globulisetosus*, *F. victorianus*.
12	Quarrell's Swamp, beside the road from Stoneyford to Cobden but much nearer the former; *C. longifurca*.
13	Werribee River under the bridge at Ballan; *F. gracilior*.
14	Werribee River *c.* 15 km north-north-west of Ballan, near the road from Spargo to Blakesville; *C. dumonti*, *C. timmsi*, *C. globulisetosus*, *C. longifurca*.
15	In muddy gravel and among dead leaves, about 200 m downstream of Sailors' Falls; *C. dumonti*, *C. longifurca*, *C. globulisetosus*, *F. gracilior*.
16	Thick tufts of moss (*Tridontium tasmanicum*) at the foot of Trentham Falls; *C. timmsi*.
17	Small cushions of bright green moss on rock faces in Sherbrooke Falls (Sherbrooke Forest); *C. hirsutus*.
18	Dandenong Creek; *C. longifurca*, *C. longiseta*, *C. bidens*.
19	Acheron River south of Taggerty; *C. caecosetosus*, *C. billwilliamsi*, *C. dumonti*.
20	Wet moss all down face of Cora Lyn Falls; *C. hirsutus*, *C. caecosetosus*.
21	Roadside leaf-litter in mountainous forest area (Ben Cairn); *F. victorianus*.
22	Small stream; *C. mammillifurca* (*q.v.* for details), *C. billwilliamsi*, *C. dedeckkeri*, *C. caecosetosus*, *C. globulisetosus*.
23	*Sphagnum*-cushions in marshy pools, *c.* 50 m south of the Ski Assembly Area just east of Mount Baw Baw Village; *C. billwilliamsi*, *C. dedeckkeri*, *C. longifurca*, *C. lacinulatus*.
24	Mount Baw Baw, high-altitude *Sphagnum c.* 2–5 km east of No. 22; *C. billwilliamsi*, *C. dedeckkeri*, *C. timmsi*, *C. sublaevis*.
25	Mount Buffalo area, *Sphagnum* in Bunyip Bog; *C. timmsi*, *C. globulisetosus*, *C. billwilliamsi*, *C. hirsutus*, *C. longipes*, *C. lacinulatus*.
26	Corner Inlet, accidentally swept into the marine plankton; *C. dumonti*.
27	Eucalypt leaf-litter in a cluster of localities on the Errinundra Plateau (the nearest place in Forbes *et al.* 1982 is Cann River); *F. victorianus*.
28	Green Lake (= locality 2 on Map 3); *C. longiseta* (see Appendix 1 for details).

Appendix 3. Samples taken in North Queensland (Map 7) in June 1981

All samples taken in freshwater save samples 18 and 22

Date	Sample No.	Details
4.vi.1981 (p.m.)	1	Among waterweeds (?*Posidonia*) growing on soft mud sloping rapidly into a very deep part of the Daintree River, next to the boat-ramp below the former butter factory at the eastern end of Daintree town. Many of a calanoid, some small prawns, several insect larvae, a few mites and cyclopses, but no harpacticoids.
5.vi.1981	2	Squelchy pond full of sedges, beside main road and next to Devil Devil Creek; many insect larvae and cyclopses, some ostracods, three or four *Hydra*, one legless husk of *C. grandidieri*, and 2, 0, 0, 1, *C. bidens*.
	3	Weeds in the ford, about 1 km along McDougall's Road from the main road; two prawns, a few mites, insect larvae, and cyclopses, but no harpacticoids.
	4	In the weedy and squelchy edge of McDougall's Lagoon (about 1 km east of locality 3); lots of insects, cyclopses, *Daphnia*, and a few of an ostracod, but no harpacticoids.
	5	Ptiloris Swamp; many of an oligochaete, many statoblasts and some small colony fragments of *Plumatella* sp., a few insect larvae and *Daphnia*, several cyclopses, but no harpacticoids.
6.vi.1981	6	A few metres north of Spear's Creek (itself 0·5 km north of Mount Molloy village), a small boggy pond on the east side of the road to Julattan; many insect larvae, two *Lymnaea*-like snails, many cyclopses, ostracods, cladocerans, a few calanoids, but no harpacticoids.
	7	About 6 or 7 km south of Mount Molloy village, a long shallow grassy roadside pool; many mosquito larvae, some other insect larvae, many cyclopses, many of an ostracod, a few tadpoles, but no harpacticoids.
	8	In thick submerged grass with tough stems, along the north side of Nardellos Lagoon, which is full of reeds and waterlilies; numerous *Volvox*, many insects (larvae and adults) and cyclopses, several sorts of ostracods, a few 'rat-tailed' oligochaetes, some calanoids, two *Hydra*; many adults and a few subadults of *C. grandidieri*.
	9	Lake Barrine, on east side of launching jetty and into the muddy swamp beside it (under trees resembling mangroves); many cyclopses, some cladocerans, one ostracod, but no harpacticoids.
7.vi.1981	10	In a large tuft of weed in the stream bed, about 20 m downstream of Millaa Millaa Falls (themselves inaccessible, and with some ferns but no moss); mostly insect larvae, a very few mites and cyclopses, but no harpacticoids.
	11	Elinjaa Falls, inaccessible and with bare rock; pools in stream just above falls had (among weed) several small prawns, many insect larvae, some cladocerans and ostracods, few cyclopses, several *Hydra*, and one quite well-preserved husk of *C. bidens*.
8.vi.1981	12	Little Millstream Falls, reeds and weeds in shallow bed of river flowing slowly over flat rock (water no more than 10 or 15 cm deep) just upstream of the roadbridge about 1 km west of Ravenshoe (i.e. about 0·5 km upstream of the Falls themselves, which were of inaccessible bare rock). Many cyclopses, a few cladocerans and insect larvae, also 12, 0, 0, 1, *C. bidens* and 2, 1, 0, 0, *C. grandidieri*.
	13	Small rocky pool at edge of lake at end of forest track supposedly leading to Tully Falls (not visited); fluffy green weed with some cyclopses, a few each of mites, cladocerans, and protozoans (?*Actinosphaerium*), but no harpacticoids.
	14	Marshy stream under main road from Ravenshow to Millaa Millaa (0·25 km past Glendinning Road); mostly insect larvae and cyclopses, mites, ostracods, and cladocerans (few of each), two *Hydra*, but no harpacticoids.

Date	Sample No.	Details
	15	Just south of Innisfail, about 50 m south of where Gracy Creek cuts the main road to South Johnstone; many *Hydra* and globular protozoans (?*Difflugia*), few each of insect-larvae, cyclopses, cladocerans, ostracods, mites, and oligochaetes; 15, 1, 3, 4 (including 1, 0, 0, 0, husk) of *C. grandidieri*.
9.vi.1981	16	Eubenangee Swamp, *c.* 200 m from the stockpens on Dinner Creek Road; an oxbow lake with extremely slowly flowing shallow water and weeds; many of a furry dark ostracod; some each of *Daphnia*, a small globular cladoceran, cyclopses, and insect larvae; a few ?*Limnadia*; but no harpacticoids.
	17	Small firm cushions of pale green moss on a low waterfall (about 1·5 m high) under Goldsborough Road; a few *C. bidens* and several *C. grandidieri*.
10.vi.1981	18	Stones, weed, and mud beside pilings of small deserted pier on the shore of a mangrove-lined estuary at the end of Greenbank Road north of Cairns airport. A few amphipods, very few isopods and tanaids, but no copepods.
11.vi.1981	19	Weed bed in the Daintree River, about 2 km upstream from the ferry by which travellers from Mossman to Cape Tribulation cross the river; many of a prawn (zoea to small adult stages), many of a calanoid, a few each of insect larvae and oligochaetes, one tiny nereid, one cyclops, one amphipod, one anthurid isopod; four females of a new genus and species of Ameiridae (harpacticoid).
	20	In flooded wheel-ruts (made by a heavy vehicle, such as a tractor) full of weed, beside the Port Douglas to Mossman road, 200 m south of the turnoff to the ferry in 19 above; large numbers of desmids (?*Closterium* sp.), some cladocerans and ostracods, very few cyclopses, insect larvae, and oligochaetes, no harpacticoids.
12.vi.1981	21	Cairns Botanic Gardens, Centennial Lake area, freshwater lake with pond lilies and *Salvinia* (bottom mud smelt strongly of H_2S); many cyclopses, few of anything else, and no harpacticoids.
	22	Same area, salt-water lagoon next to 21 above; three loxosomatids, many cyclopses and small cladocerans, three small nereids, one tiny prawn, several insect larvae; many harpacticoids, mostly *Metis* sp. but a few each of *Stenhelia* sp. and laophontids.
	23	Cairns Botanic Gardens, filtrate of about 30 bromeliads in the Plant House; one *Metis* (no doubt brought in by accident), and some slender canthocamptids in the form of dilapidated husks that were indeterminable because of having lost all their legs.
14.vi.1981	24	Up Noosa River to reedy swampy edge of Lake Cooloola; a few small prawns but nothing else.
15.vi.1981	25	Gympie, weedy edge of Alfred Lake in Museum Park; some tiny prawns, many insect larvae, cyclopses, and *Daphnia*, a very few mites, but no harpacticoids.
16.vi.1981	26	Purlingbrook Falls, in the Gwongorella National Park just off the Springbrook Road a little north of Springbrook (20 km due west of Coolangatta); various insect larvae and a few cyclopses, but no harpacticoids.
	27	On main road from Beenleigh to Beaudesert, 20 m along turnoff to Jimboomba, a large lake on the north side of the latter road ends in a muddy lily pond near a culvert; many *Hydra*, some cyclopses, few cladocerans, very few ostracods, but no harpacticoids.

Appendix 4. A New *Canthocamptus* of the *australicus*-group from New Caledonia

Canthocamptus ablatifurcatus, sp. nov.

Figs 129–134

Female Holotype

Length 0·53 mm, general appearance (Figs 129*A*, 130*A*) normal for the smaller members of this genus (see Discussion, below). Nuchal organ shoe-shaped. Micropores plentiful all over the body (although not so numerous as to be almost touching), almost invisible on the prosome, but much easier to see on the abdomen even though overlain there by the dense transverse fringes of microsetules (as in Fig. 130*B*; the situation in the male, Fig. 134*B*, is very similar) which cover the whole body from the rearmost part of the prosome to Abd5. I have indicated only those sensillary pores that I could see for certain; no doubt some were missed, although probably not very many. SREs 1–3 very minutely denticulate, and SREs 7–9 rather more strongly (but still minutely) so.

Spinulation consists of a high-up DLcomb on ped5 and another on Abd1, the DLs ascending progressively less and less dorsalwards on Abds 2–4, on all 3 of which they are confluent with the VLs, which are in turn confluent with the MVs. The MV2s consist of no more than a few spinules in the LVzone (in other words, there is a very wide MVgap), the MV3s run right across Abd3, the MV4s run right across Abd4 except for being abnormally small midventrally (as if there were an incipient MVgap), and the MV5s form the usual pair of arched combs around the outer corners of the subanal sinus. There is a short comb of very small VL5s, and another (exceptional among Australian *Canthocamptus* spp.) of small DL5s. Genital area as in Figs 129*C*, 129*E*.

Op (Fig. 130*B*) deceptive in that it has a very thin, shallowly curved, edge fringed with slender close-set short spinules all pointing directly tailwards, whereas just under it (and very liable to be mistaken for it) there is a thickened curved edge which is completely smooth. The true arrangement in the present species could not be made out from the holotype and allotype in water, but was eventually clarified when they had been dissected and mounted in a variant of Berlese's medium (similar to Hoyer's medium), using Nomarski optics. FRs almost square in dorsal (Fig. 130*B*) or ventral (Fig. 129*D*) view; their shape, with seta4 located alone on a protuberance a long way abaxial to setae 5–7, has no parallel, that I can find, in any member of this genus. Seta2 is tiny, and directed rearward and dorsalward along the flank of the FR so as to cross under seta1 and be invisible in ventral view; seta3 arises slightly adaxial to the FRmidline at about 0·45–0·5; seta5 has 2 small adaxial basal swellings between which there is an abaxial basal swelling; seta6 is by far the largest (as usual), with its base slightly overhung by the rounded and somewhat thickened FRtip (Fig. 129*B*); and seta7 has a slightly kinked and irregularly swollen base. Setae 1, 3, 4, and 7 are each about 1·5 (for slightly less) times the length of the FR itself.

A1 moderately long (Fig. 130*A*) and fairly slender (Fig. 129*F*), segmentation 8 (4, 8) as in almost all the Australian species. A2 (Figs 131*A*, 131*B*) allobasis with both setae, and with a short exop-side comb of long spinules between the proximal seta and the rather slender exp; enp has seta B1, and a long single WAC of rather short and fine spinules. Md (Figs 131*C*, 131*D*) unusual only in that the PCXcomb consists of no more than a few extremely long and rather stout spinules, and also in that the CXB ends in a bluntly rounded thick-walled tip with no seta (all allied Australian species have a seta here); the enp has a small inner seta, and 4 terminal setae of which the outermost is slightly subterminal on the rear surface. Mx1 (Fig. 131*E*) PCXA has one rear-surface seta (whose distal part could not be seen) and a possible tube-pore just proximal to it, while the basis has 4 ramal setae. Mx2 (Fig. 131*F*) proximal endite has its proximal seta fused to it, thick-walled, stiff, and ending in a tiny 2-pronged fork (enlarged in Fig. 131*G*) as in a minority of Australian species; enp with 2 setae. Mxp (Fig. 131*H*) normal; rear-surface lengthways comb shorter, and of smaller spinules, than the front-surface lengthways comb; rear-surface flanking seta much shorter than the claw itself; abpalmar spinules on the distal part of the forearm, and on the proximal part of the hand, extremely long.

P1–P5 agree in setal formula (Table 1) and in general appearance (P1, Fig. 131*J*; P2, Fig. 132*A*; P3, Fig. 132*B*; P4, Fig. 132*C*) with those of the other species in the *australicus*-group (see below); P5 (Fig. 132*D*) very much like that of *australicus* (Fig. 78*D*).

Male Allotype

Length 0·6 mm (Figs 133*A*, 133*B*), and thus slightly longer than the female but slimmer overall, prosome more angulate in front, nuchal organ more slender and set slightly further back; SRE1 mid-dorsally and dorsolaterally with extremely minute denticulations (like those on SRE2 in Fig. 134*A*, magnified in Fig. 134*C*, and on SREs 3–5), whereas those on SREs 6–9 are somewhat coarser, about as in the female; SRE1 smooth laterally, as is the ventral prosomal edge which curves uninterruptedly into SRE1. Integument covered with transverse rows of microsetules (Fig. 134*B*, cf. the female in Fig. 130*B*). The oval double line in Fig. 134*A* denotes the lateral organ (with a slight injury-tear in its leading edge) on PLT2; this organ is also found in this position in certain Australian species (e.g. *australicus*), but in the present species it is quite impossible to see on a specimen mounted whole in water, and is difficult to detect even when the dissected PLT2, mounted in a gum-arabic-based medium, is observed (as here) with high-power Nomarski optics. FRs short and conically tapering (Figs 133*C*–133*E*), not at all like those of the female. MVs, VLs, and DLs completely confluent and all of the same size on Abds 2–4; spinulation otherwise as in the female, as is the op (whose relationship to the thick smooth curved edge under it is shown better in Fig. 133*C* than in Fig. 130*B*).

A1 (Figs 133*A*, 133*B*), enlarged in Figs 134*D*, 134*E*) of the direct type, modified as in other species of the *australicus*-group. P2 (Fig. 134*F*) enp2 has no outer seta, but instead that outer edge bears a blunt knuckle-like thorn at about 0·8, and the ICP has a large blunt spinule with a smaller pointed one immediately adaxial to it. P3 (Figs 134*G*, 134*J*) has exp-spines A and B, especially B, unusually large in proportion to their respective exp-segments, to each of which they are closely adpressed; enp2 (and presumably enp1, although this was lost) without any setae, the prong of enp2 long, slender, and slightly bent about halfway along, all very much as in related forms. P4 (Fig. 134*H*) likewise as in *australicus* and *hirsutus*, in resembling P4 of the conspecific female except that the outer terminal seta of exp3 has 4 large barb-like spinules along its outer edge. P5 5 and 2, the exps detached so that one of them had been drawn by itself, both overall (Fig. 133*G*) and in close-up (Fig. 133*H*), before the benp could be located and drawn (Fig. 134*K*) with an exp fitted conjecturally to it. P6 (Fig. 133*F*) with seta2 much longer than either seta1 or seta3. Spermatophore shown dotted in Fig. 133*B*. All other features so like those of the holotype that I have no doubt of this being the conspecific male of the female described above, in spite of the fact that the two sexes have not yet been found together.

Remarks

Deposition. Female holotype J11807, male allotype J11808.

Origin of the specimens described. The holotype was one of two non-ovigerous females at NC7 (166°50′37″E.,22°12′57″S., on 31.vii.1981)—the other female being retained in my own collection as paratype 1—and the allotype was the only specimen found at NC15 166°53′10″E.,22°16′23″S., on 2.viii.1981); these numbers refer to samples taken by Dr Patrick De Deckker during a hitherto unpublished survey of lentic waterbodies in New Caledonia.

Variation and colour. In life, not noted.

Type locality. As above.

Synonyms. None.

Range of habitats. No information available.

Geographical distribution. New Caledonia.

Major distinctions from similar Australian species. In the body of this monograph, the present species is clearly a member of the *australicus*-group (see section 7), into which it fits exactly except for characters 1, 3 and 6 of the following respects; in character 6 it further disagrees with every Australian *Canthocamptus* save *bidens* and *grandidieri*. The female *ablatifurcatus* leads in Key 4 to a mixture of *hirsutus* and *australicus*, and the male leads in Key 5 to *hirsutus* alone; the following are the salient differences between *ablatifurcatus* and *hirsutus* (characters 1–3 apply to both sexes, 4–6 to females only, and 7–9 to males only):

(1) SREs 2–4, 7–9, and (in the male alone) 6, are minutely denticulate in *ablatifurcatus*, but SRE5 is smooth, as are all SREs of *hirsutus*.
(2) The multiseriate spinule-comb, found along the adoral edge of the prosome in *hirsutus*, is totally lacking in *ablatifurcatus*.
(3) MdCXB has a seta in *hirsutus* but not in *ablatifurcatus*.
(4) Abnormally small MVs are absent from Abd3, but there are a few axial ones on Abd4, in *ablatifurcatus*, whereas they extend across most of the MVzone on both Abd3 and Abd4 of *hirsutus*.
(5) The FRs of *ablatifurcatus* are quite unique in this genus; those of *hirsutus* are of a simple conically tapering form with slightly convex sides. Should the FRs be missing from the female whose identification is required, recourse must be had to differences 1–4 and 6.
(6) P4enp1 has an inner seta in *hirsutus*, but none in *ablatifurcatus*.
(7) In dorsal or ventral view the FRs are distinctly longer in *ablatifurcatus* than in *hirsutus*.
(8) P4enp2 has 2 inner setae in *hirsutus* but only 1 in *ablatifurcatus*.
(9) P5exp is longer, in proportion to its width, in *ablatifurcatus* than in *hirsutus*.

Major distinctions from co-occurring species. No other harpacticoids were found in any of the samples containing this species, although species of *Cletocamptus* and *Phyllognathopus* occurred in some of Dr De Deckker's other samples, and will be described with their Australian congeners at a later date.

On subadult specimens. One such specimen, from NC10 (166°05′26″E.,21°54′41″S., on 1.viii.1981), closely resembled the equivalent stages of similar Australian species, and is provisionally assigned to the 4th copepodite stage (taking the adult to be the 6th stage) because SRE9 was wholly lacking and SRE8 was only very faintly indicated. However, the minute denticulations of its existing SREs agree well with the present species, which is in any case the only *Canthocamptus* known from the relevant area, and the presence of 8 large spinules on the opercular edge (instead of the adult's fringe of numerous fine spinules) exactly parallels the ontogenetic changes recorded on p. 1076 for *C. australicus*.

Derivation of the specific name. From the Latin *ab* (= away from) and *latus* (= wide or broad), together *ablatus* (= widened away from, in the sense of being expanded outward); and *furcatus* (= forked, or in this case pertaining to the FRs); thus, intended to convey the idea of the female furcal rami, each of which is expanded disproportionately on the abaxial side in dorsal or ventral view.

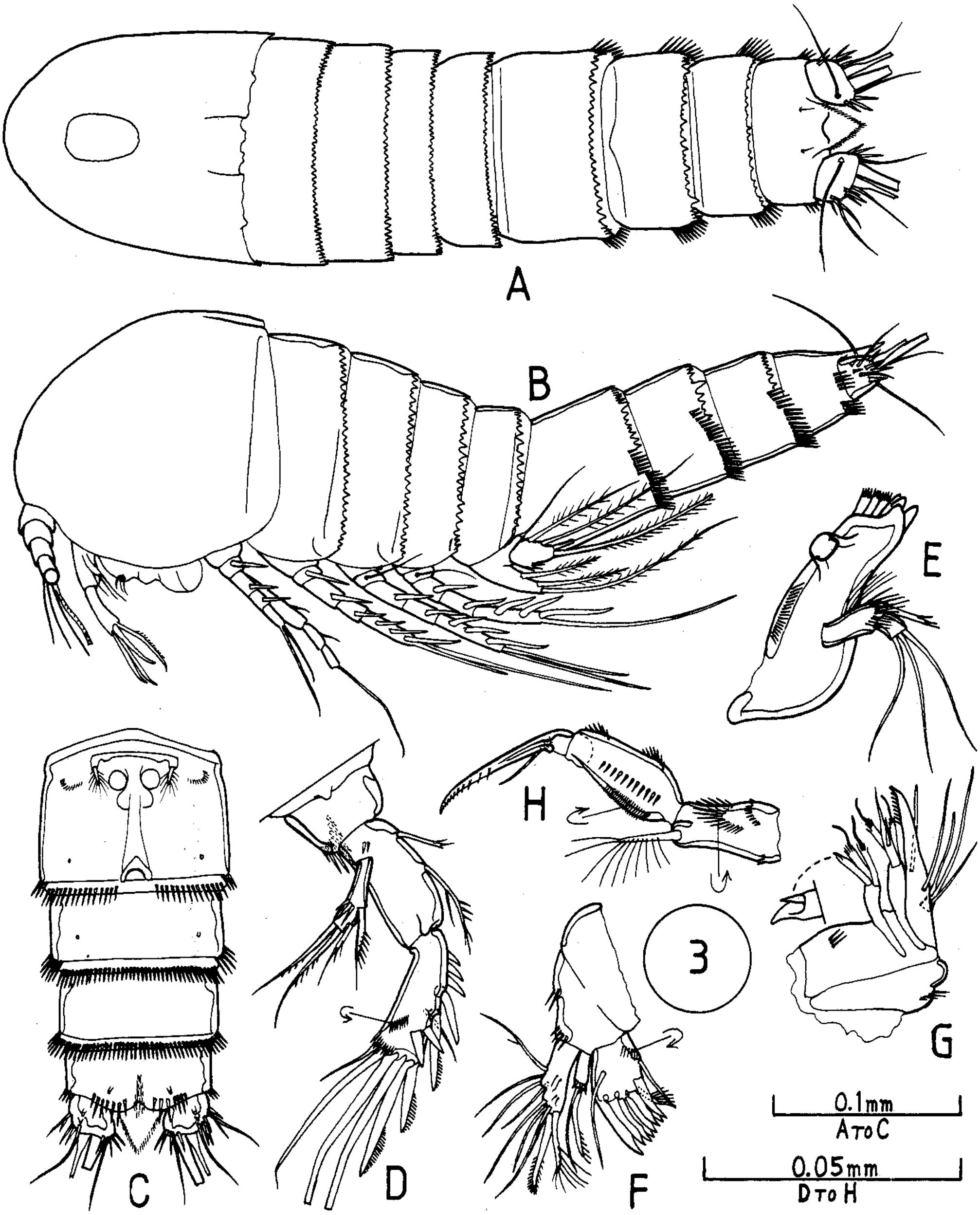


Fig. 3. *C. fimbriatus*, female; *E* and *F* from neoparatype 1, the others from the neoholotype. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D*, exop view of A2; *E*, Md; *F*, Mx1; *G*, Mx2; *H*, Mxp; *E* and *G* in front view, *F* and *H* in rear view.

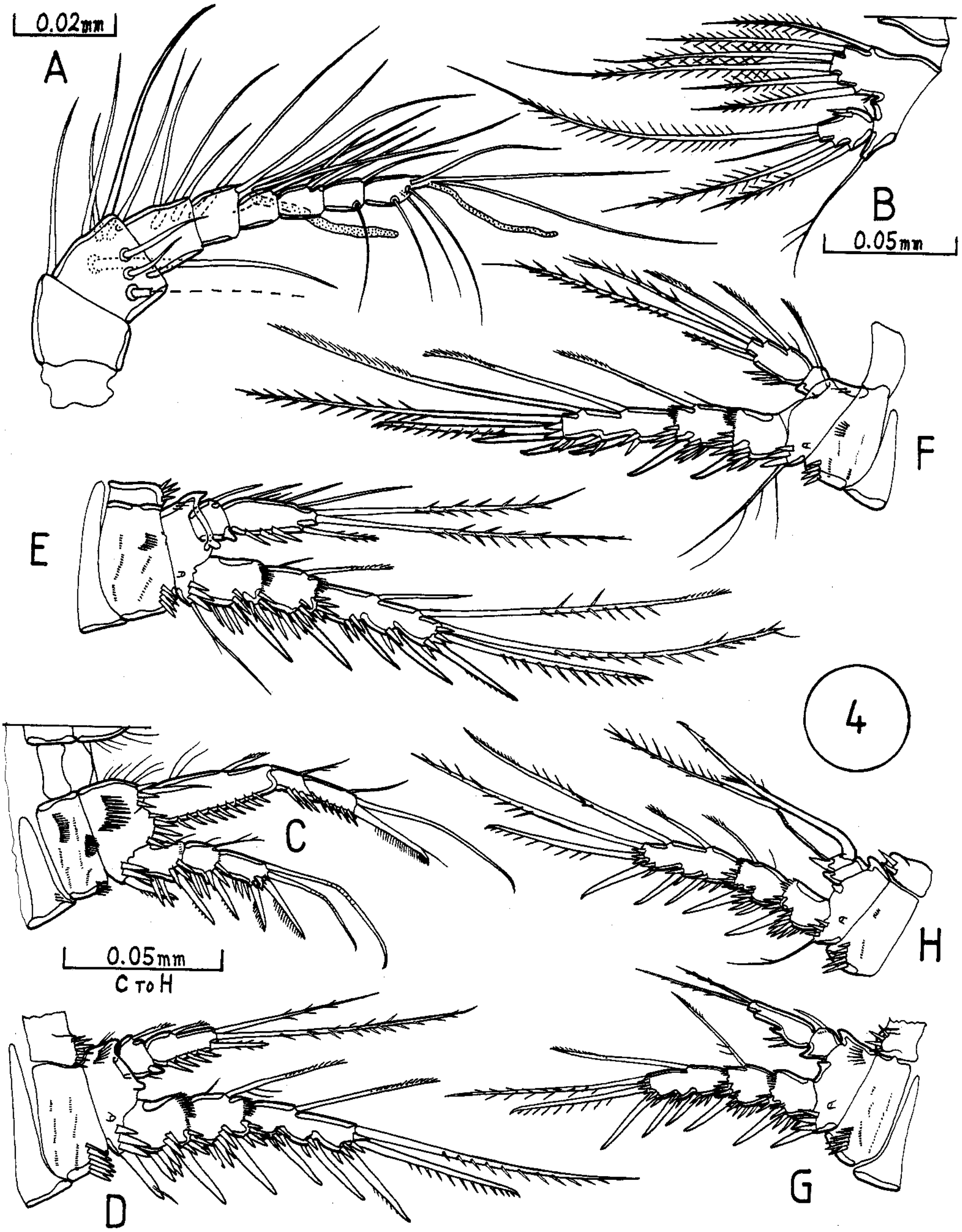


Fig. 4. *C. fimbriatus*; *G* and *H* from male neoallotype, the rest from female neoholotype. *A*, A1; *B*, P5; *C*, P1; *D* and *G*, P2; *E* and *H*, P3; *F*, P4. *A* and *B* have own scales.

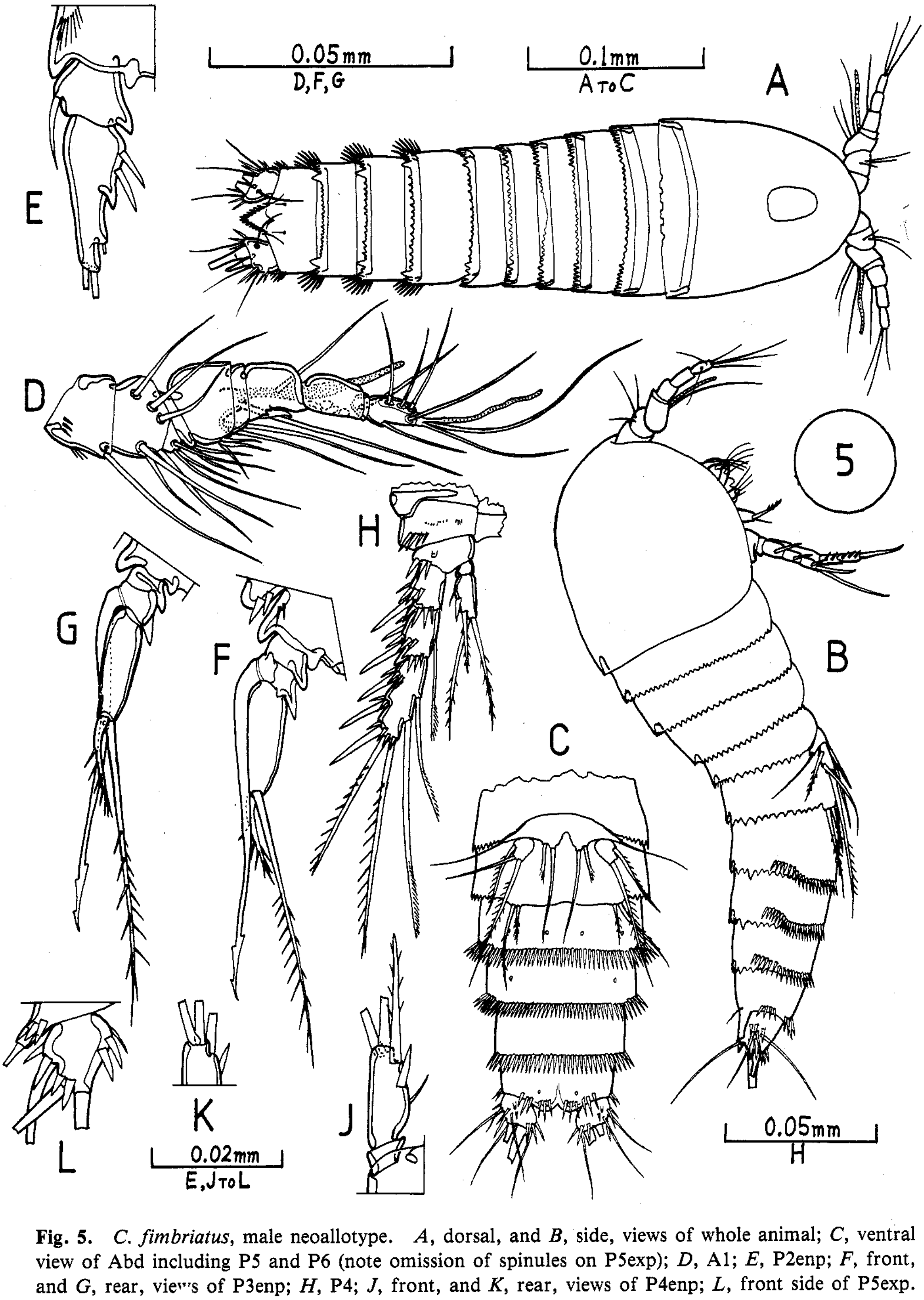


Fig. 5. *C. fimbriatus*, male neoallotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd including P5 and P6 (note omission of spinules on P5exp); *D*, A1; *E*, P2enp; *F*, front, and *G*, rear, vie''s of P3enp; *H*, P4; *J*, front, and *K*, rear, views of P4enp; *L*, front side of P5exp.

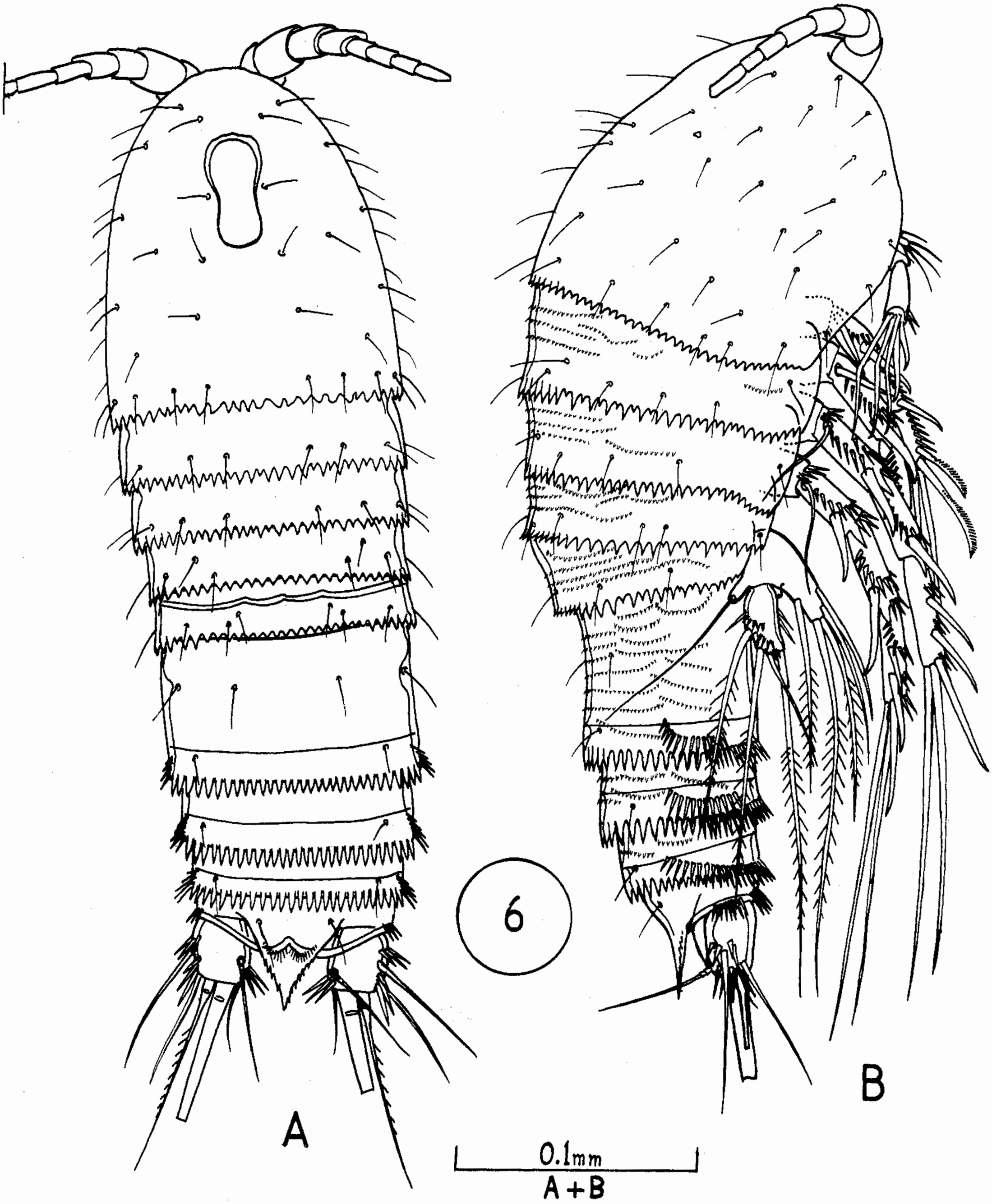


Fig. 6. *C. henryae*, female holotype. *A*, dorsal, and *B*, side, views of entire animal.

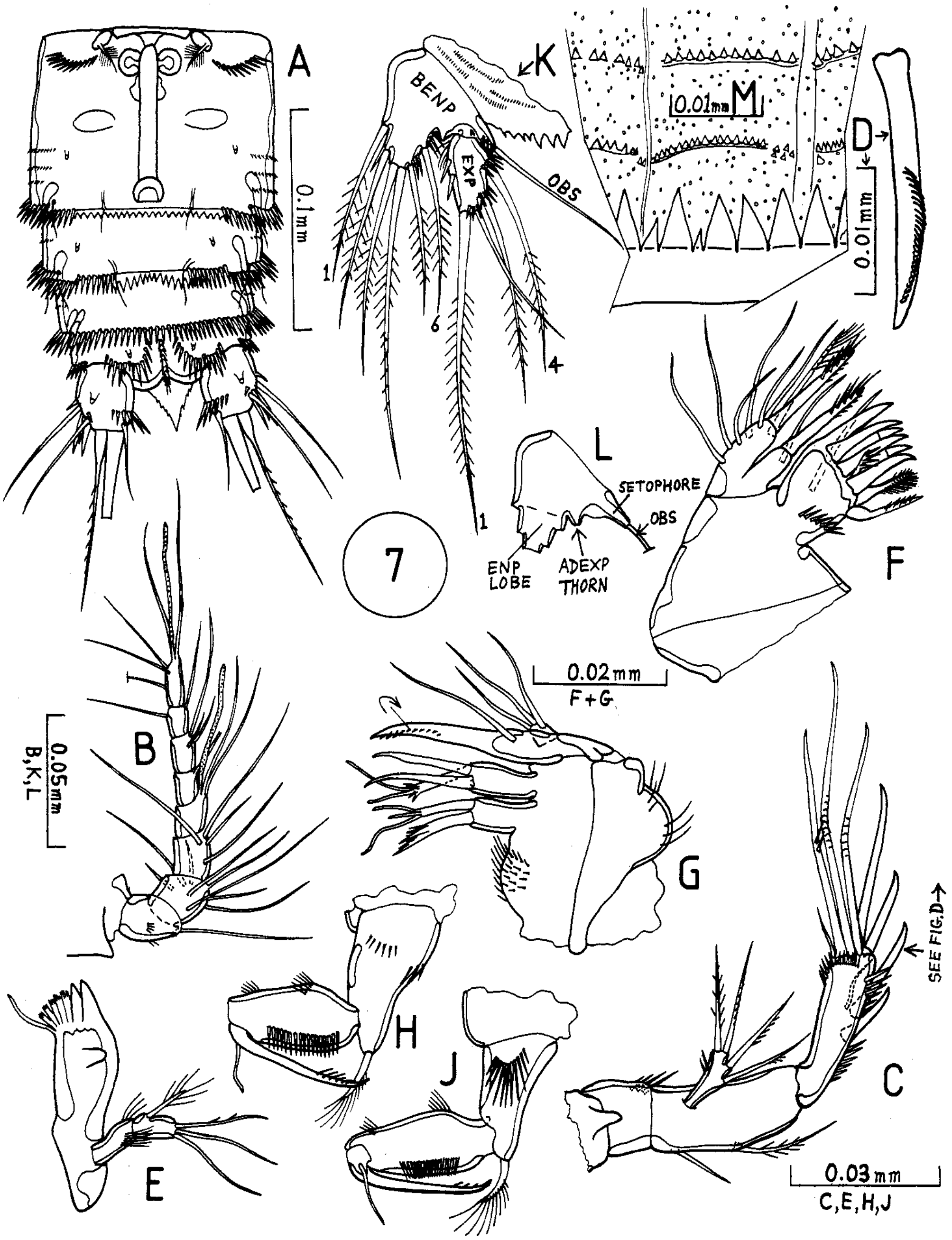


Fig. 7. *C. henryae*, female; *F* from paratype 1, *M* from paratype 3, and the others from the holotype. *A*, ventral view of Abd; *B*, R+A1; *C*, exop view of A2; *D*, abexp view of A2enpB (arrowed in *C*), enlarged to show serrations; *E*, Md; *F*, Mx1; *G*, Mx2; *H* and *J*, Mxp; *K*, P5 (see also Figs 65*C*–65*E*); *L*, benp from *K* redrawn without spinules, to show adexp thorn with pore, enp-lobe, setophore, and outer basal seta (OBS); *M*, dorsal surface of Abd3, the large teeth being those of SRE7, to show scattered micropores and transverse combs of microdenticles. *E*–*L* in front view, except *J* which is in rear view.

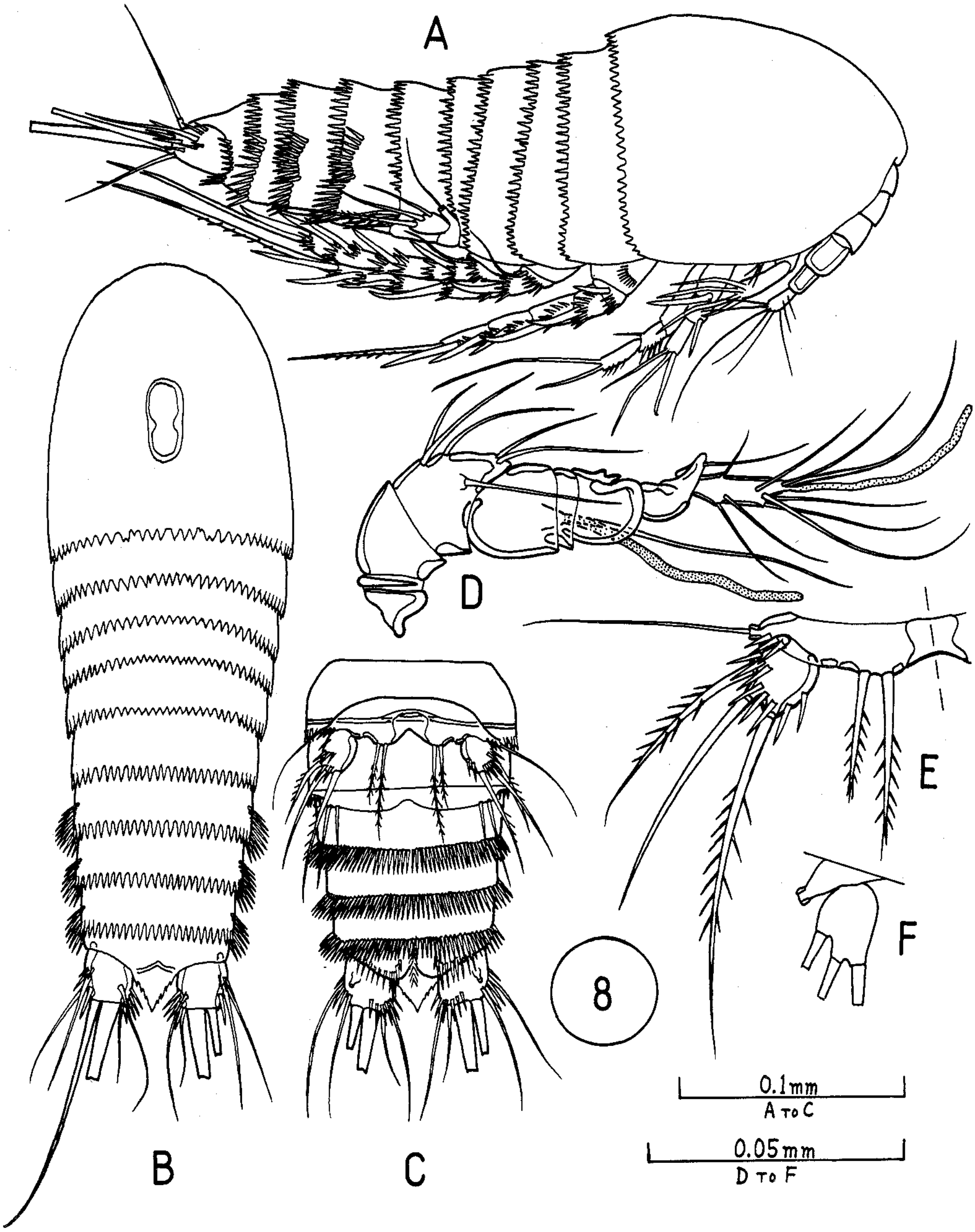


Fig. 8. *C. henryae*, male allotype. *A*, side, and *B*, dorsal views of entire animal; *C*, ventral view of Abd including P5; *D*, dorsal view of A1; *E*, P5; *F*, P5exp as in *E*, but without spinules so as to show outline.

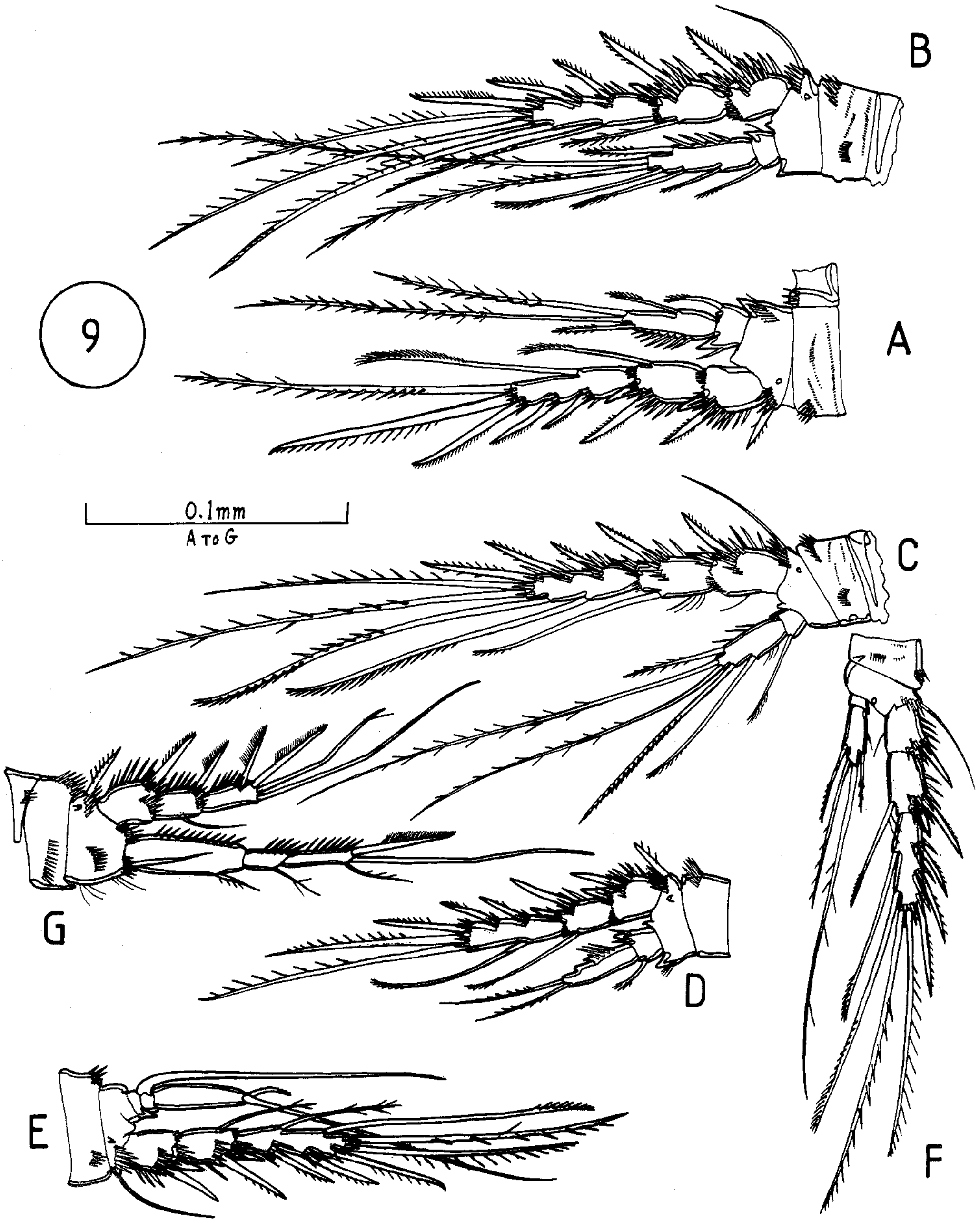


Fig. 9. *C. henryae*; *D–F* male, the others female; *G* from paratype 3, the others from the holotype and allotype. *A* and *D*, P2; *B* and *E*, P3; *C* and *F*, P4; *G*, P1; see Figs 65*F*–65*H* for FRseta5.

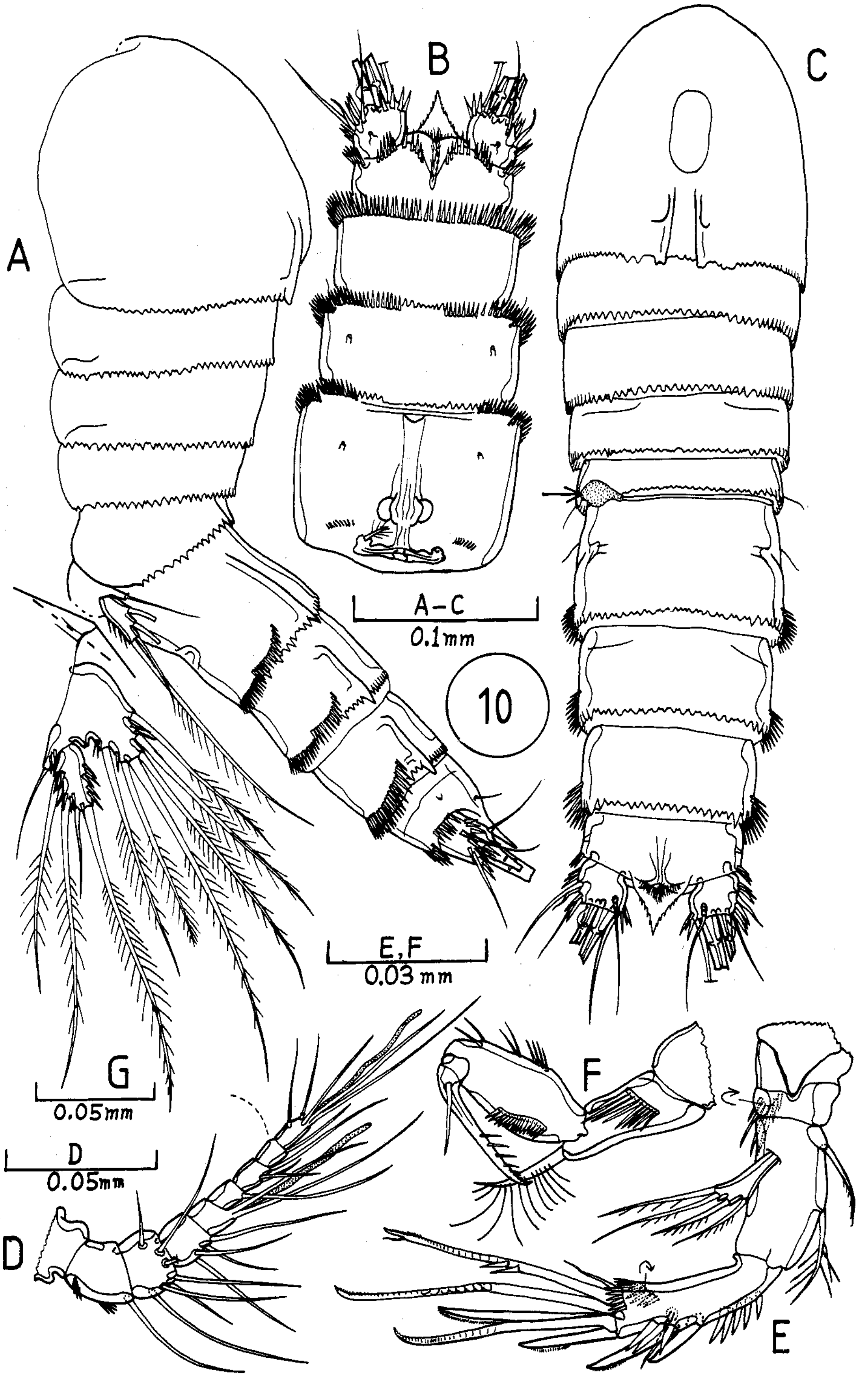


Fig. 10. *C. lacinulatus*, female holotype. *A*, side, and *C*, dorsal, views of entire animal; *B*, ventral view of Abd; *D*, dorsal view of A1; *E*, exop viewof A2; *F*, front view of Mxp; *G*, P5.

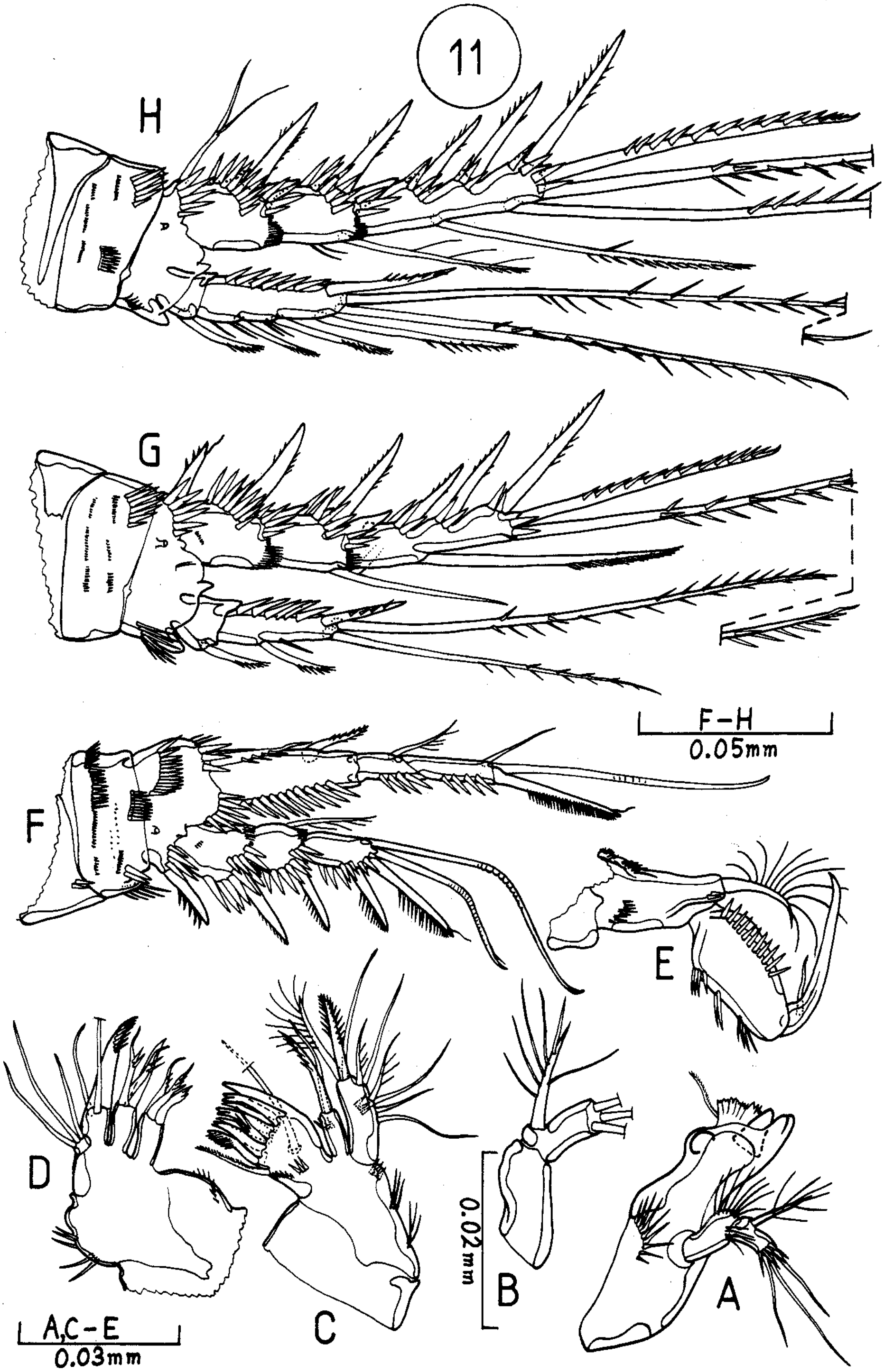


Fig. 11. *C. lacinulatus*, female; *C* and *D* from paratype 2, the others from the holotype. *A*, Md; *B*, Md palp; *C*, Mx1; *D*, Mx2; *E*, Mxp; *F*, P1; *G*, P2; *H*, P3. *A* and *D* in rear view, the others in front view.

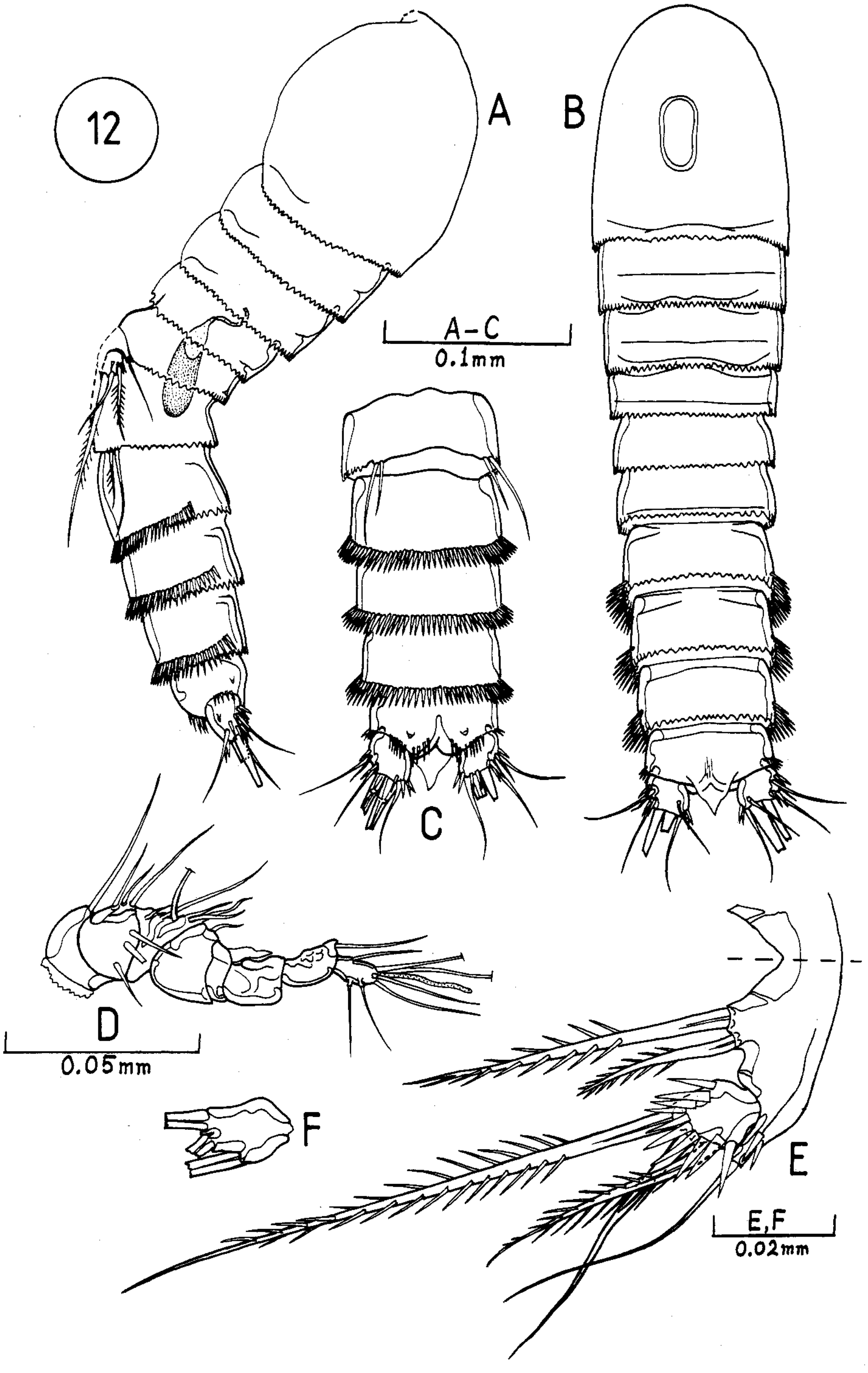


Fig. 12. *C. lacinulatus*, allotype male. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, dorsal view of A1; *E*, P5; *F*, exp of P5 with the bases of its 3 setae but without spinules, to show shape.

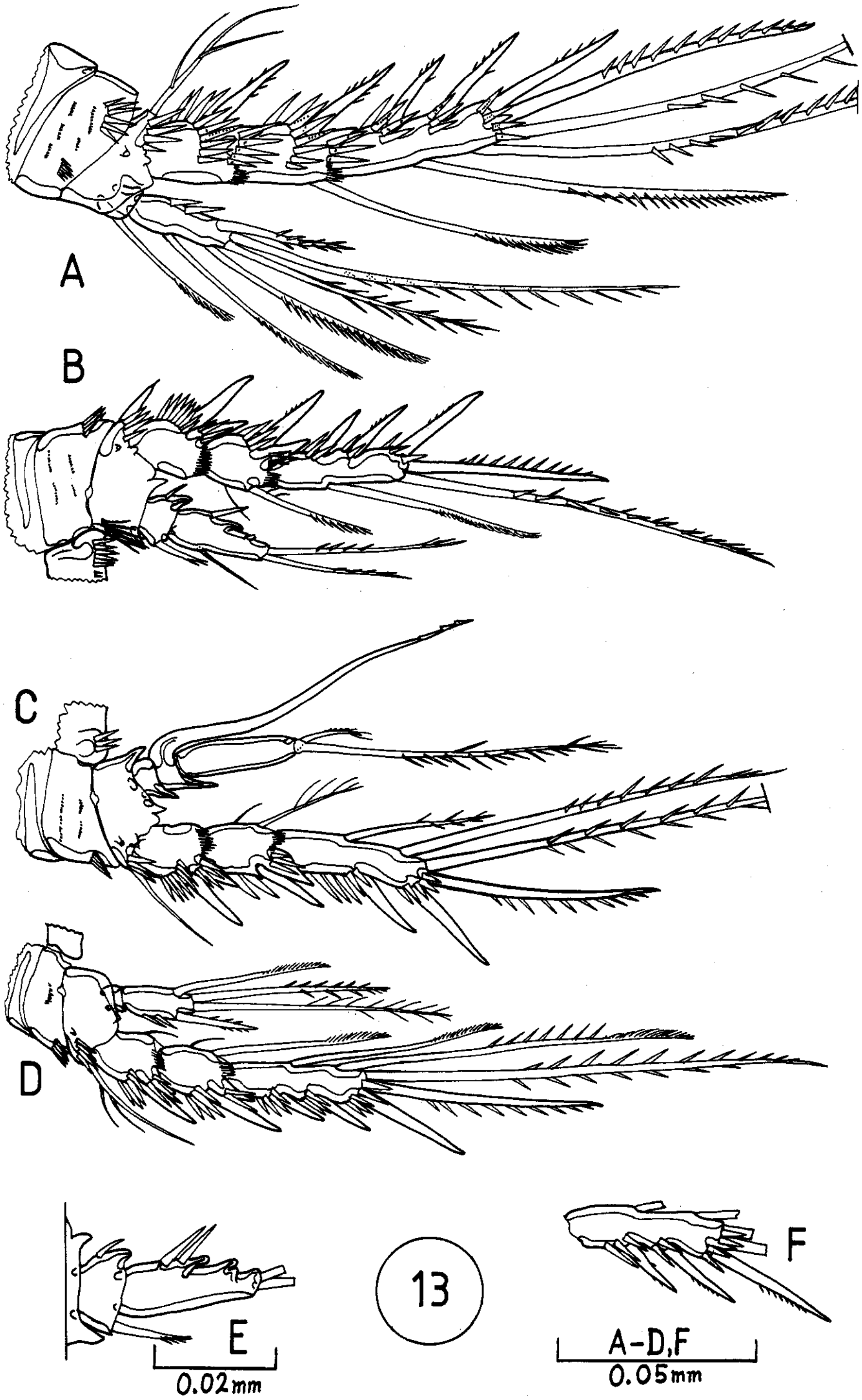


Fig. 13. *C. lacinulatus*; *A* from holotype female, the rest from the allotype male. *A* and *D*, P4; *B*, P2; *C*, P3; *E*, enp of other P2; *F*, exp3 of other P3 (exp3 in *C* being abnormal in having only 2 outer spines).

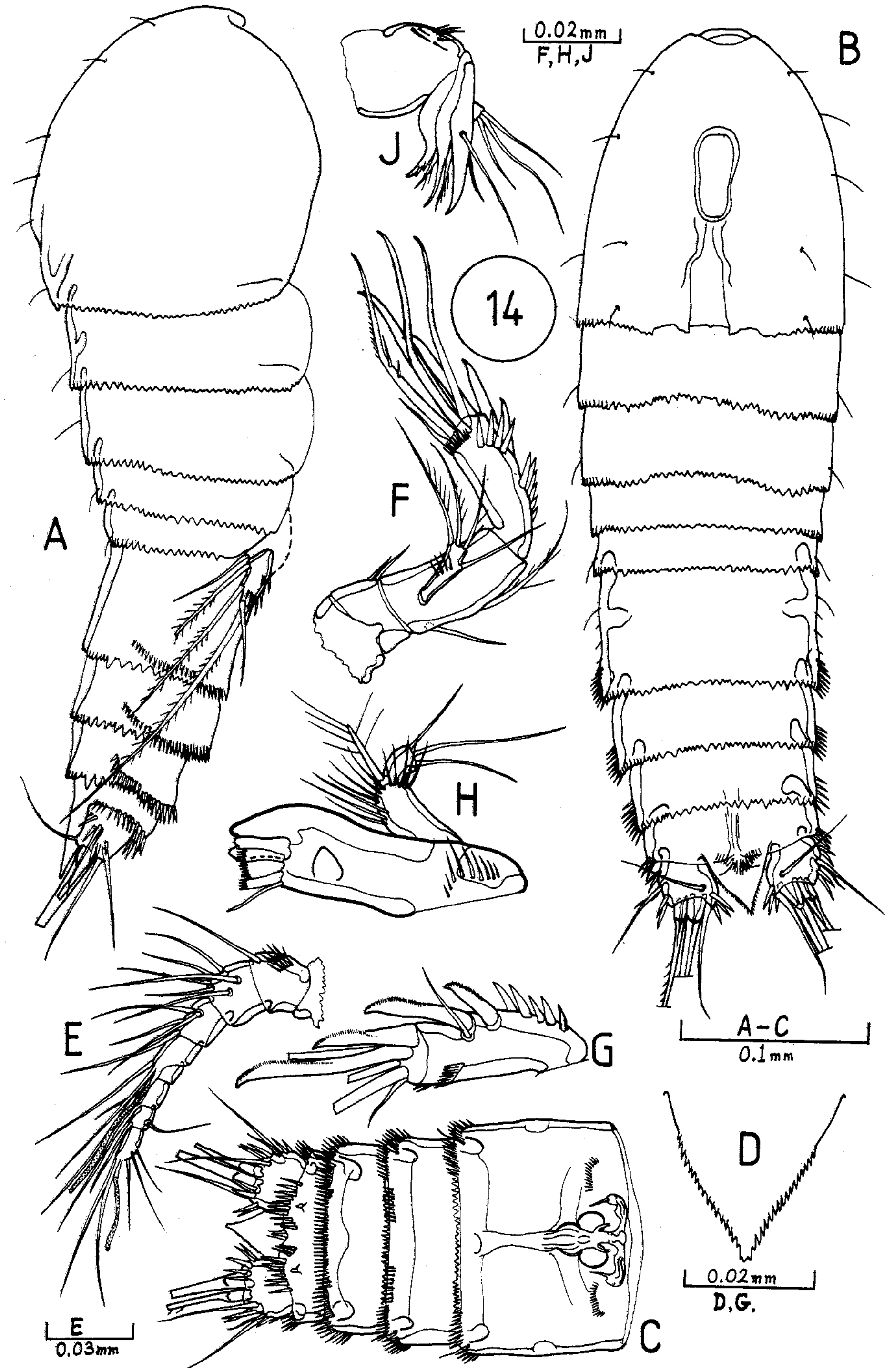


Fig. 14. *C. lacinulatus*, female from locality 11 on Map 6. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, op (as *B* but enlarged); *E*, A1; *F*, A2; *G*, exop view of A2enp; *H*, rear view of Md; *J*, front view of Mx2.

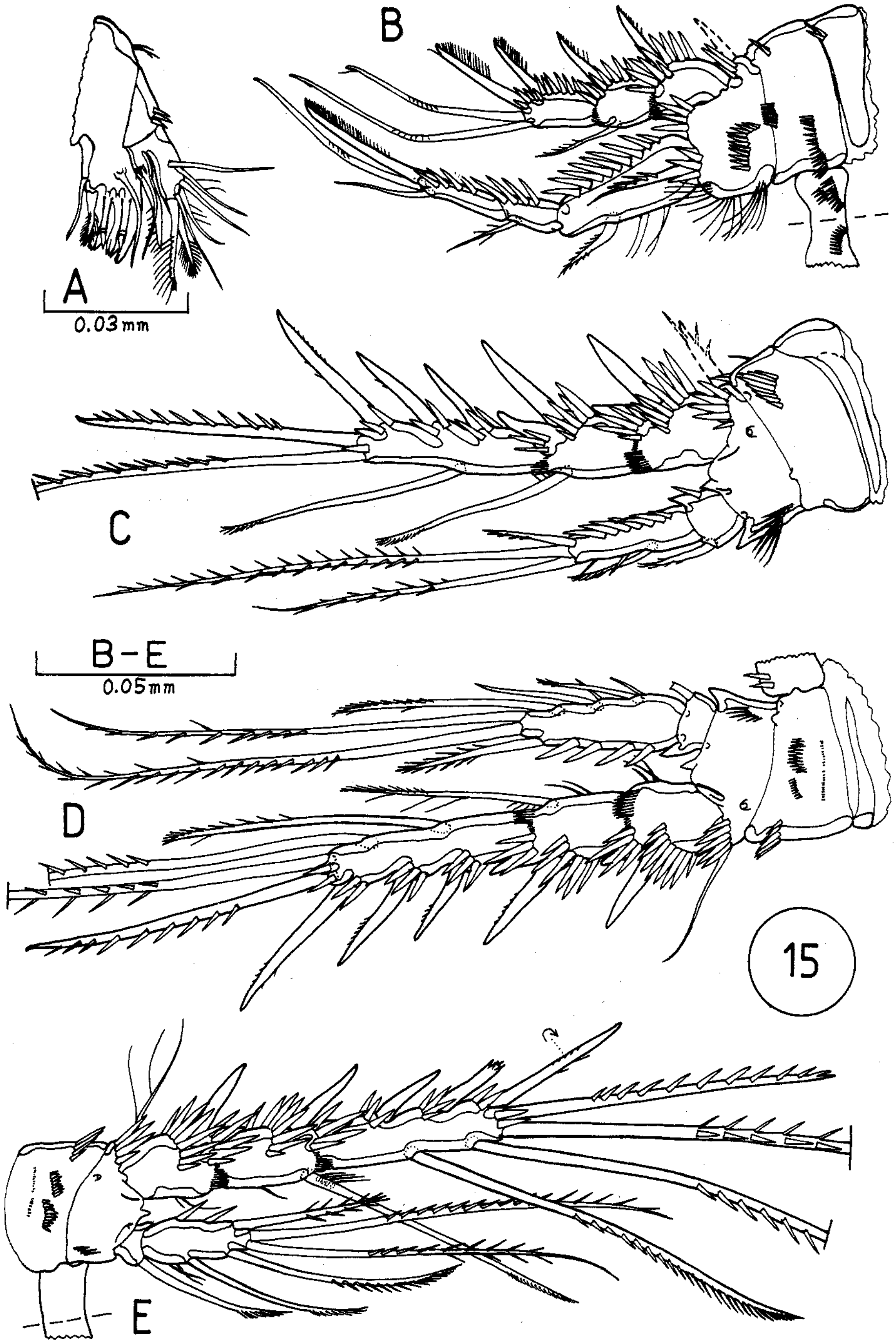


Fig. 15. *C. lacinulatus*, as for Fig. 14. *A*, rear view of Mx1; *B*, P1; *C*, P2; *D*, P3; *E*, P4.

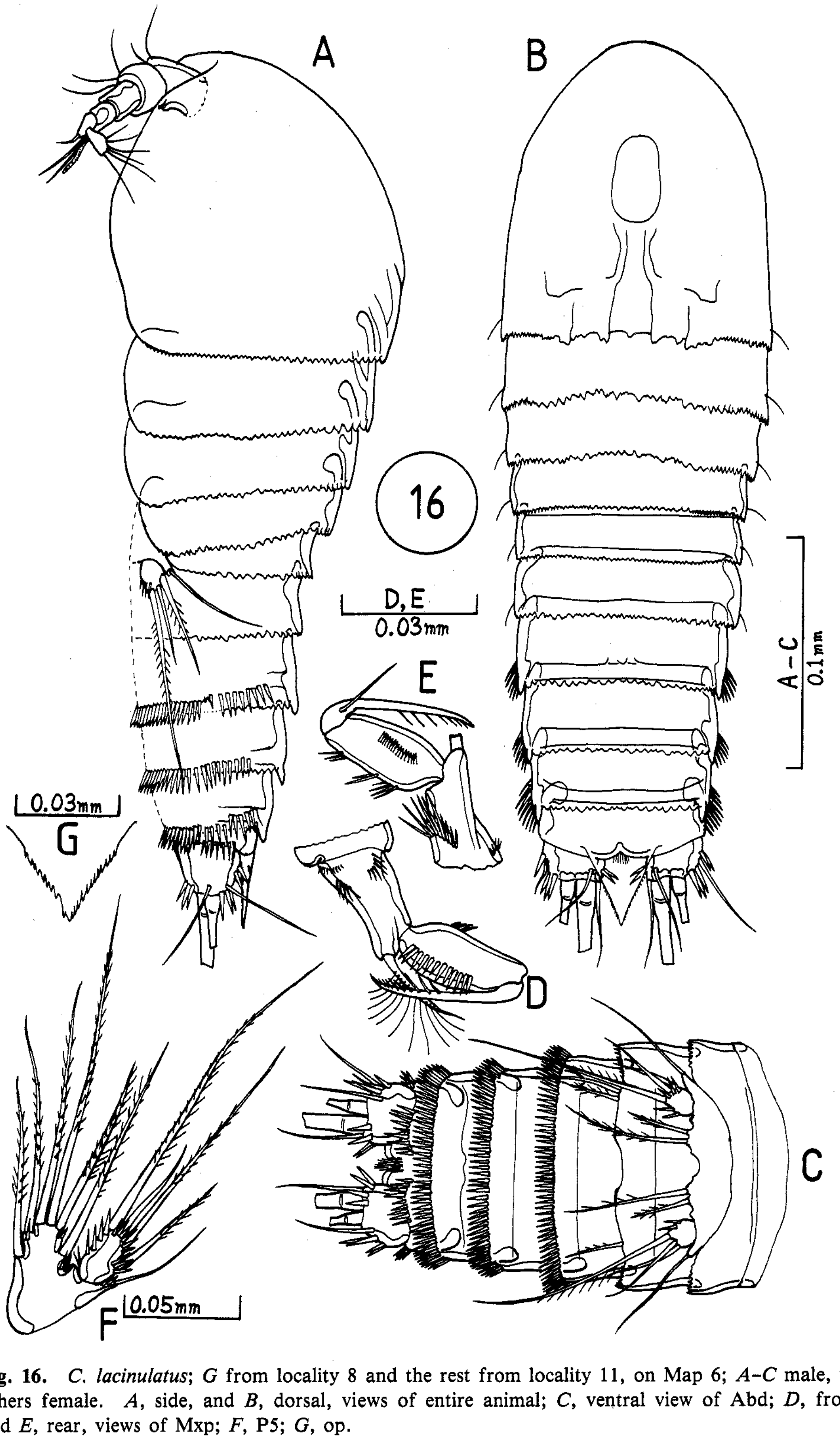


Fig. 16. *C. lacinulatus*; *G* from locality 8 and the rest from locality 11, on Map 6; *A–C* male, the others female. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, front, and *E*, rear, views of Mxp; *F*, P5; *G*, op.

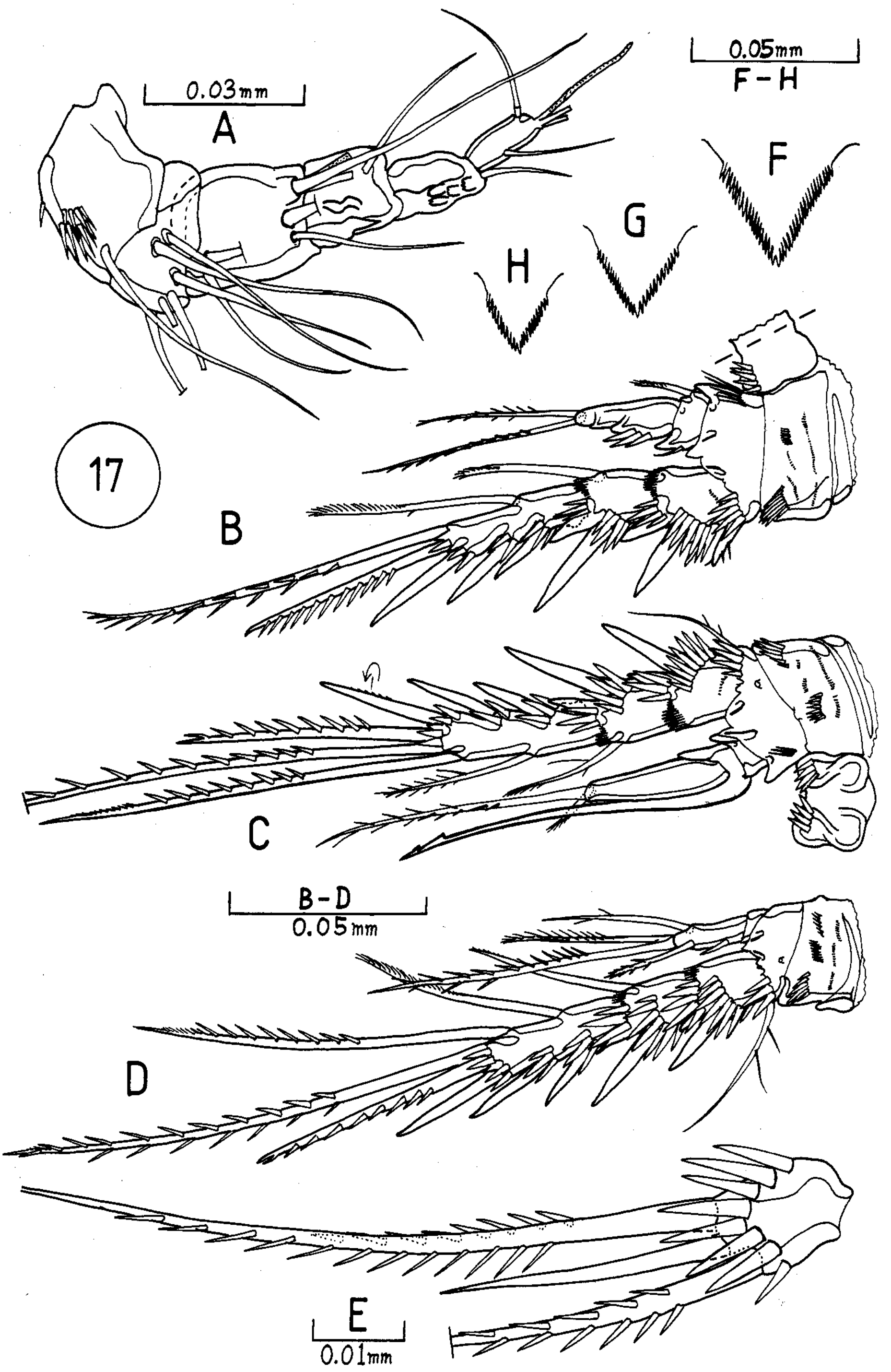


Fig. 17. *A–E*, *C. lacinulatus*, male from locality 11 on Map 6; *F–H*, *C. fimbriatus* from locality 8 on Map 6. *A*, A1; *B*, P2; *C*, P3; *D*, P4; *E*, P5exp; *F–H*, ops (*F*, neoparatype 1; *G*, neoholotype; *H*, neoallotype; *F* and *G* female, *H* male).

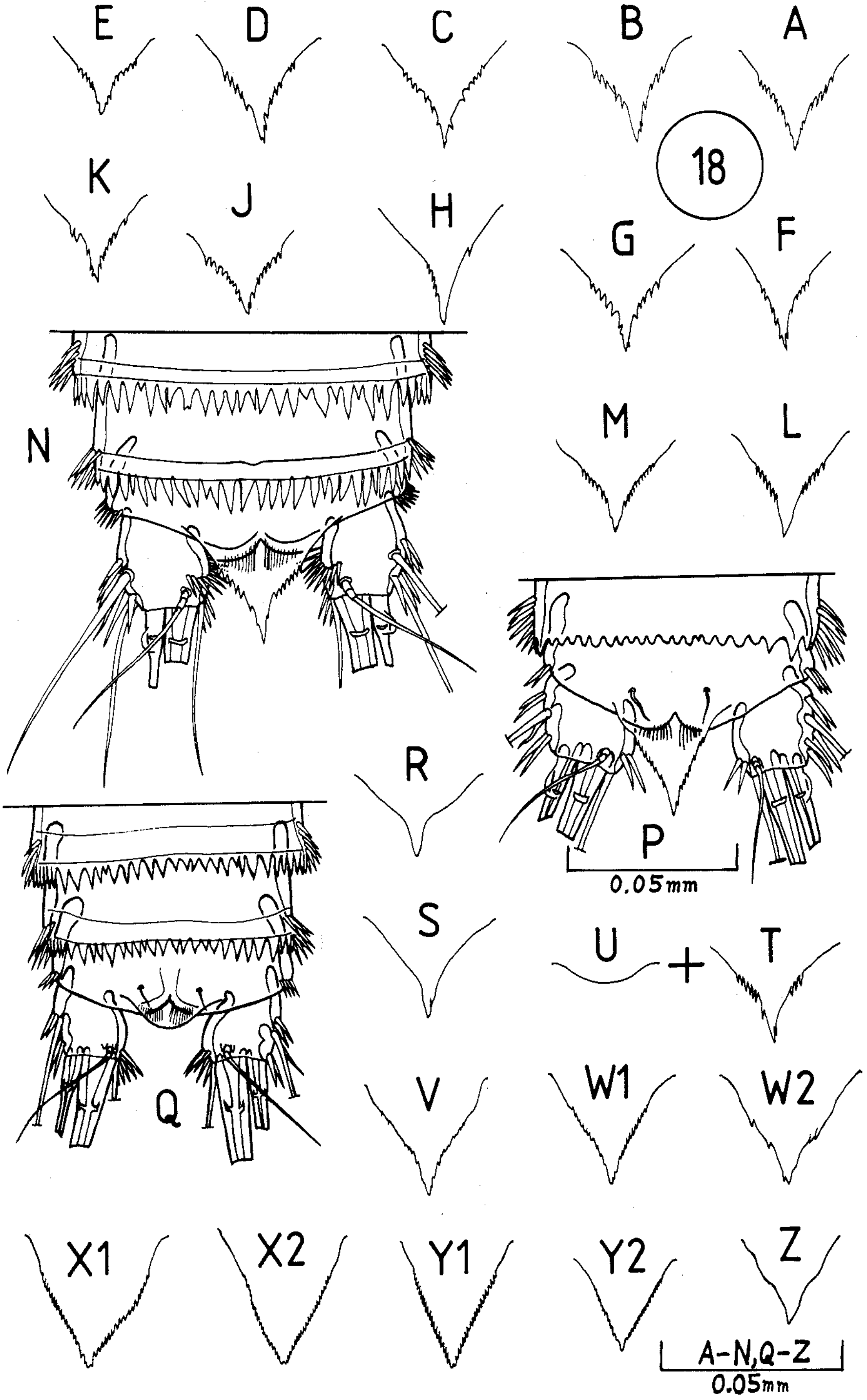


Fig. 18. *A–U* (except *P*) *C. henryae*, the others *C. lacinulatus*. *E*, *F*, *Q*, *U*, *Y1*, *Y2*, and *Z* are all males, the rest females; *A* and *V*, holotypes; *B–D*, paratypes 1–3; *E* and *Z*, allotypes; *F* and *Y*, paratype As. The plus sign indicates that *U* was clinging to *T* in precopula. *A–F* from Lake Bong Bong and *G–K* from Pine Forest Lagoon (both near Portland, Vic., see Map 4), and the remainder from the following localities on Map 6; *L–U* (except *P*) from locality 3; *P*, *W1*, and *W2*, from locality 23; *V*, *Y2*, and *Z*, from locality 25; *X1*, *X2*, and *Y1*, from locality 11.

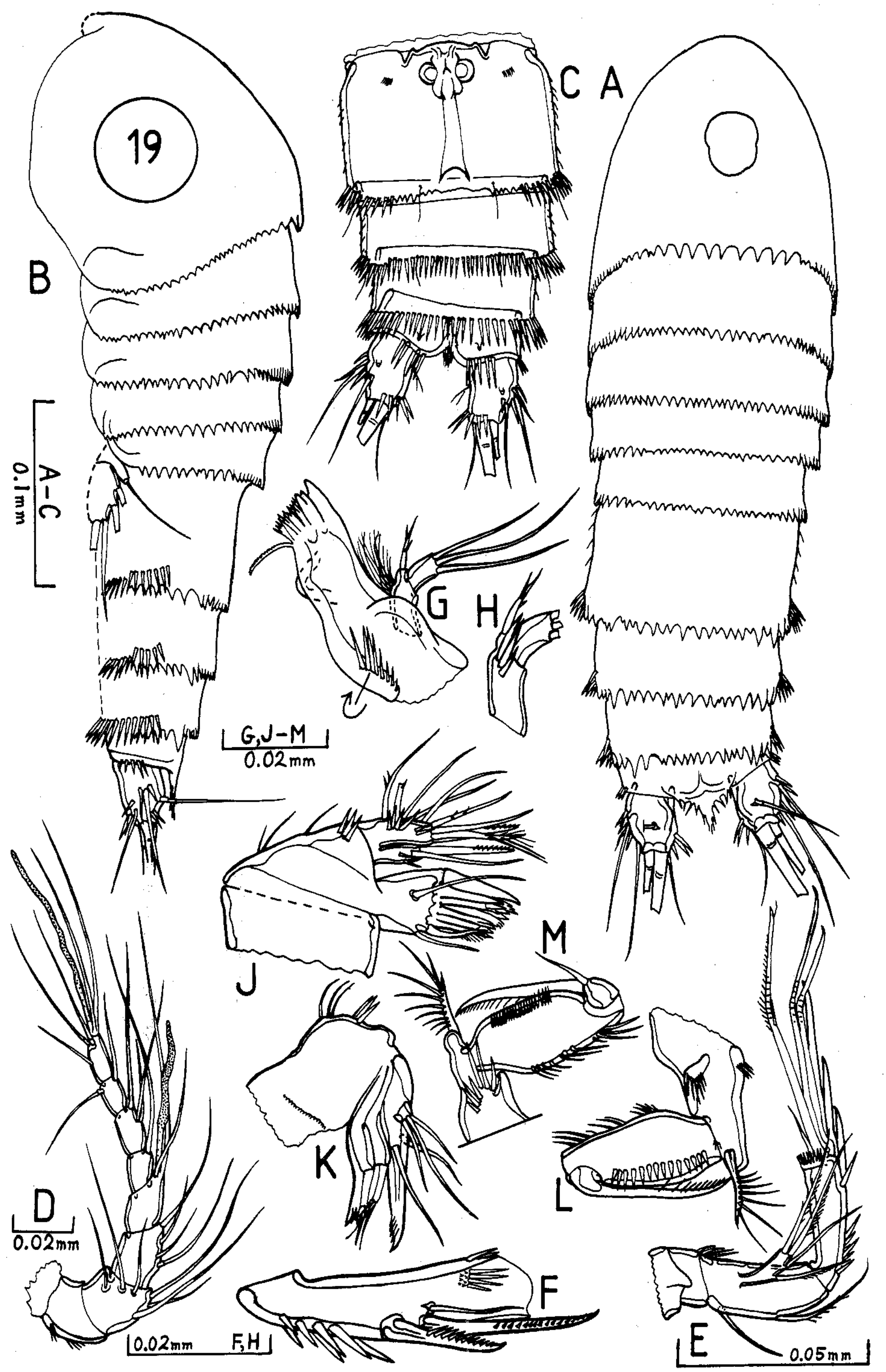


Fig. 19. *C. echinopyge*, female holotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, A1; *E*, A2; *F*, abexp view of A2enp; *G*, Md; *H*, Md palp; *J*, Mx1; *K*, Mx2; *L* and *M*, Mxp. *H* and *L* in front view; *G*, *J*, *K*, and *M* in rear view.

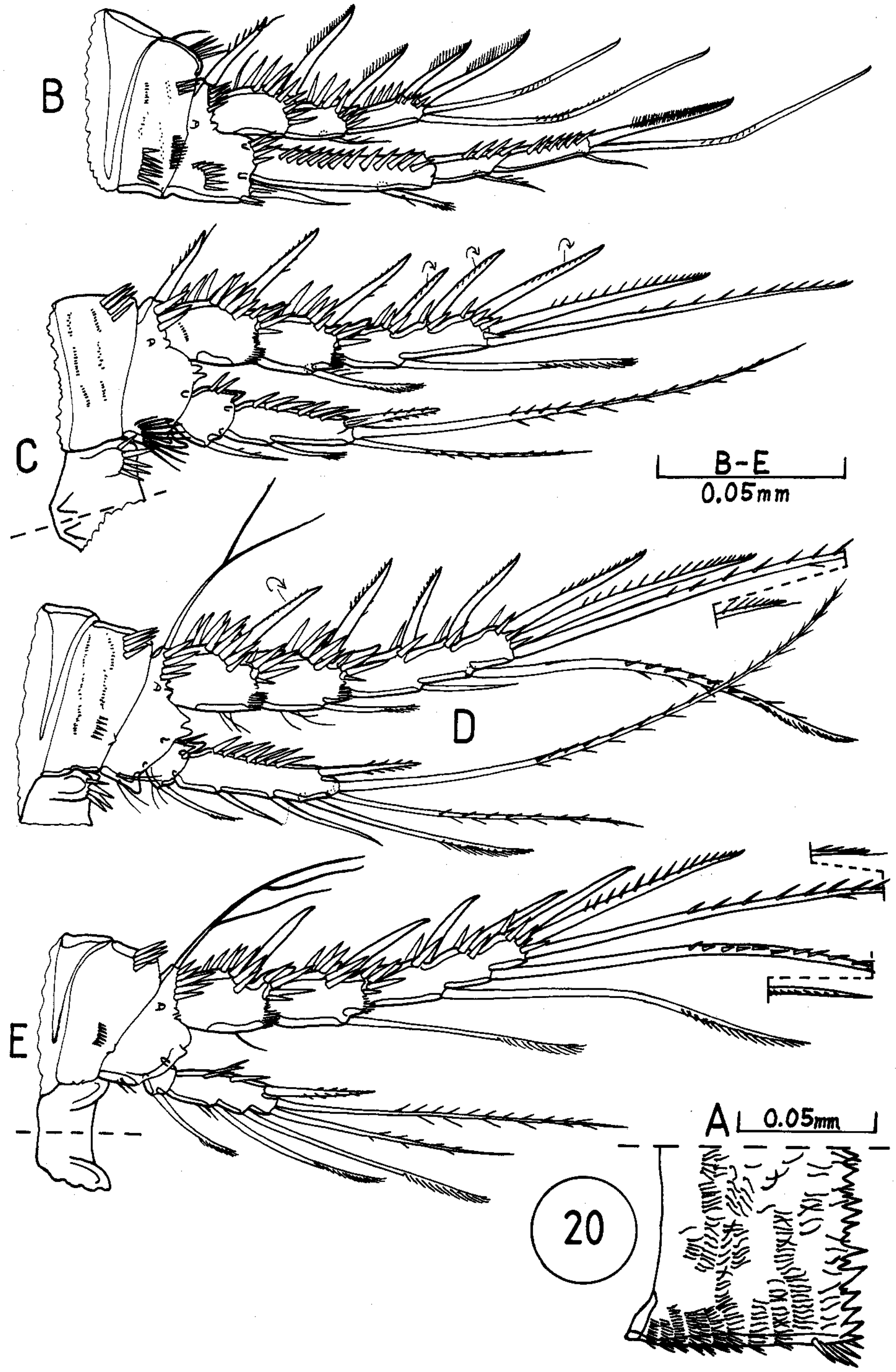


Fig. 20. *C. echinopyge*, female holotype. *A*, dorsal view of part of an abd somite to show microcombs of microsetules; *B*, P1; *C*, P2; *D*, P3; *E*, P4.

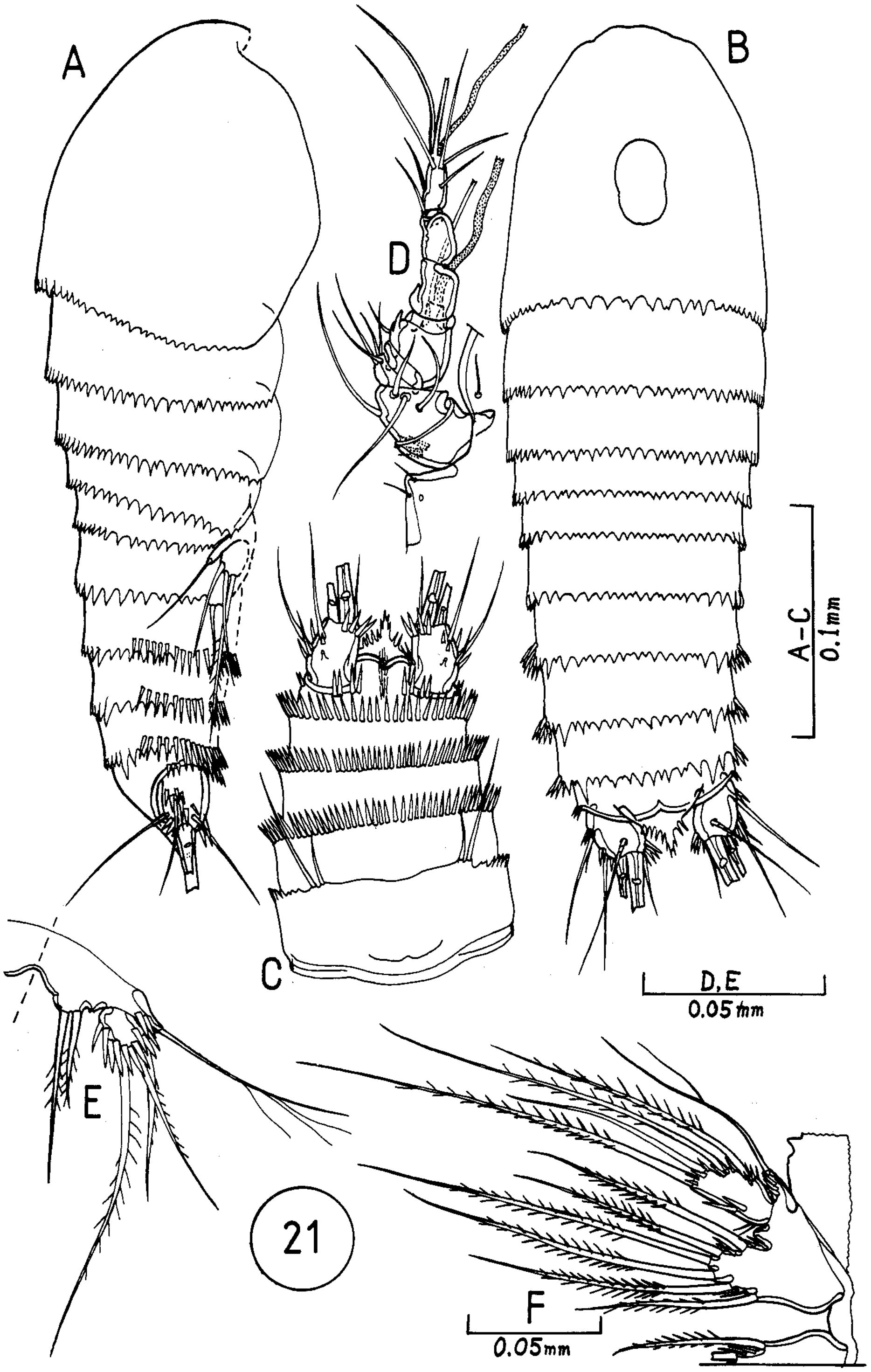


Fig. 21. *C. echinopyge*; *A–E*, male allotype; *F*, female holotype. *A*, side, and *B*, dorsal, view of whole animal; *C*, ventral view of Abd; *D*, A1; *E* and *F*, P5s.

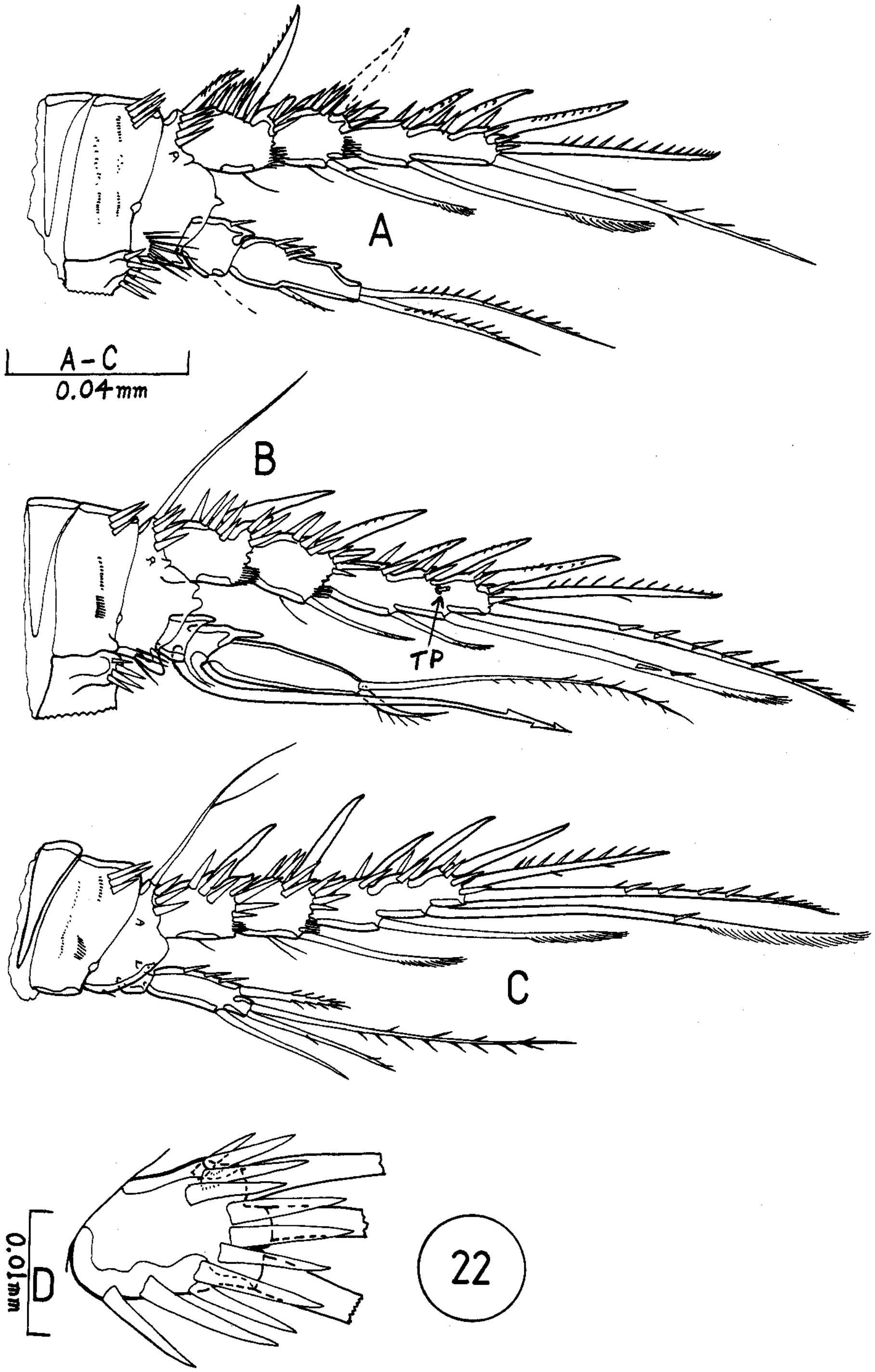


Fig. 22. *C. echinopyge*, male allotype. *A*, P2; *B*, P3 (TP, tube-pore); *C*, P4; *D*, P5exp, much enlarged.

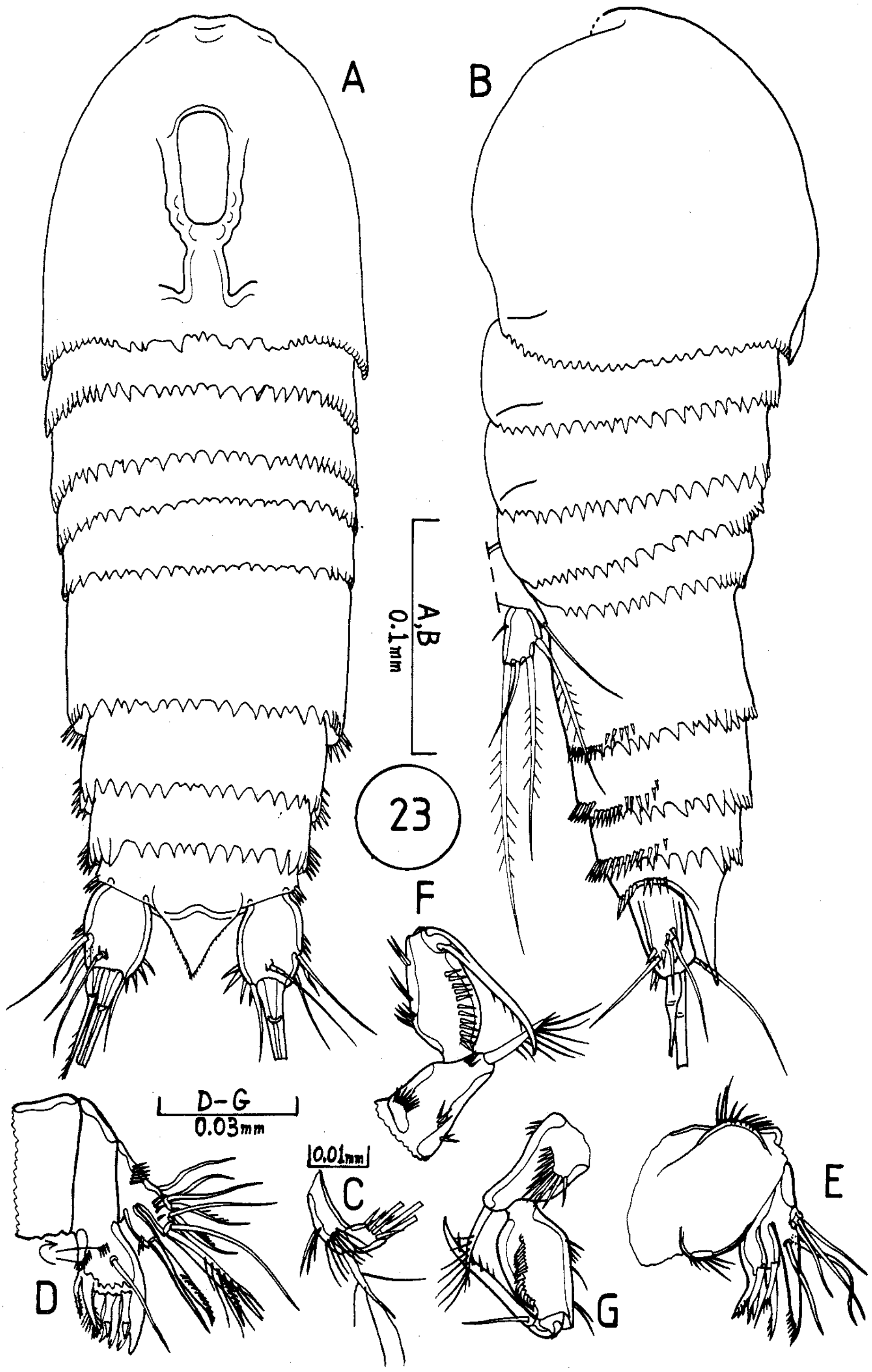


Fig. 23. *C. longifurca*, holotype female. *A*, dorsal, and *B*, side, views of entire animal; *C*, Md palp; *D*, Mx1; *E*, Mx2; *F* and *G*, Mxp. *C* and *F* in front view; *D*, *E*, and *G* in rear view.

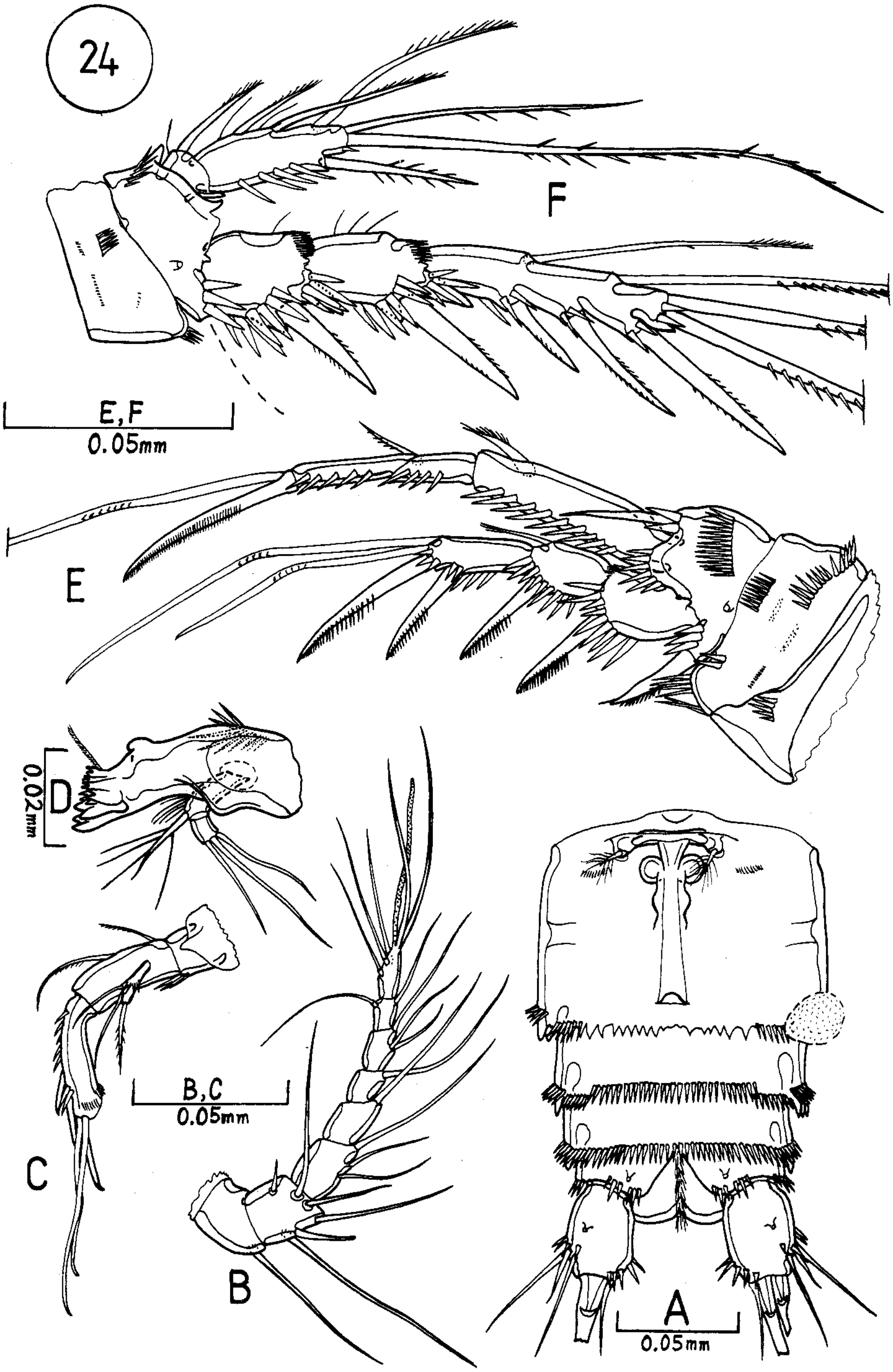


Fig. 24. *C. longifurca*, holotype female. *A*, ventral view of Abd; *B*, A1; *C*, exop view of A2; *D*, rear view of Md; *E*, P1; *F*, P3. In *A* the op has been omitted to minimise confusion.

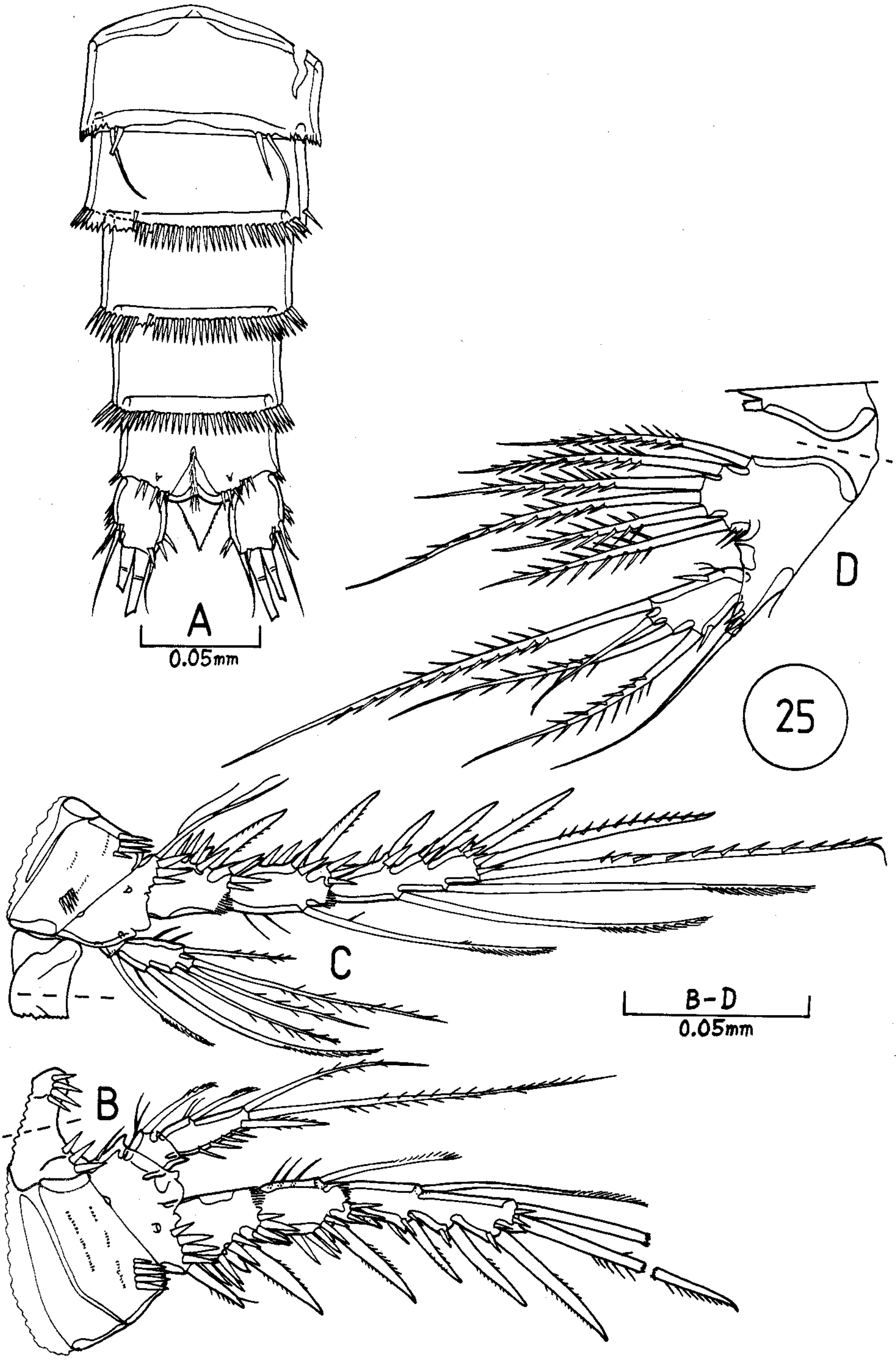


Fig. 25. *C. longifurca*; *A* allotype male, the others from the holotype female. *A*, ventral view of Abd; *B*, P2; *C*, P4; *D*, P5.

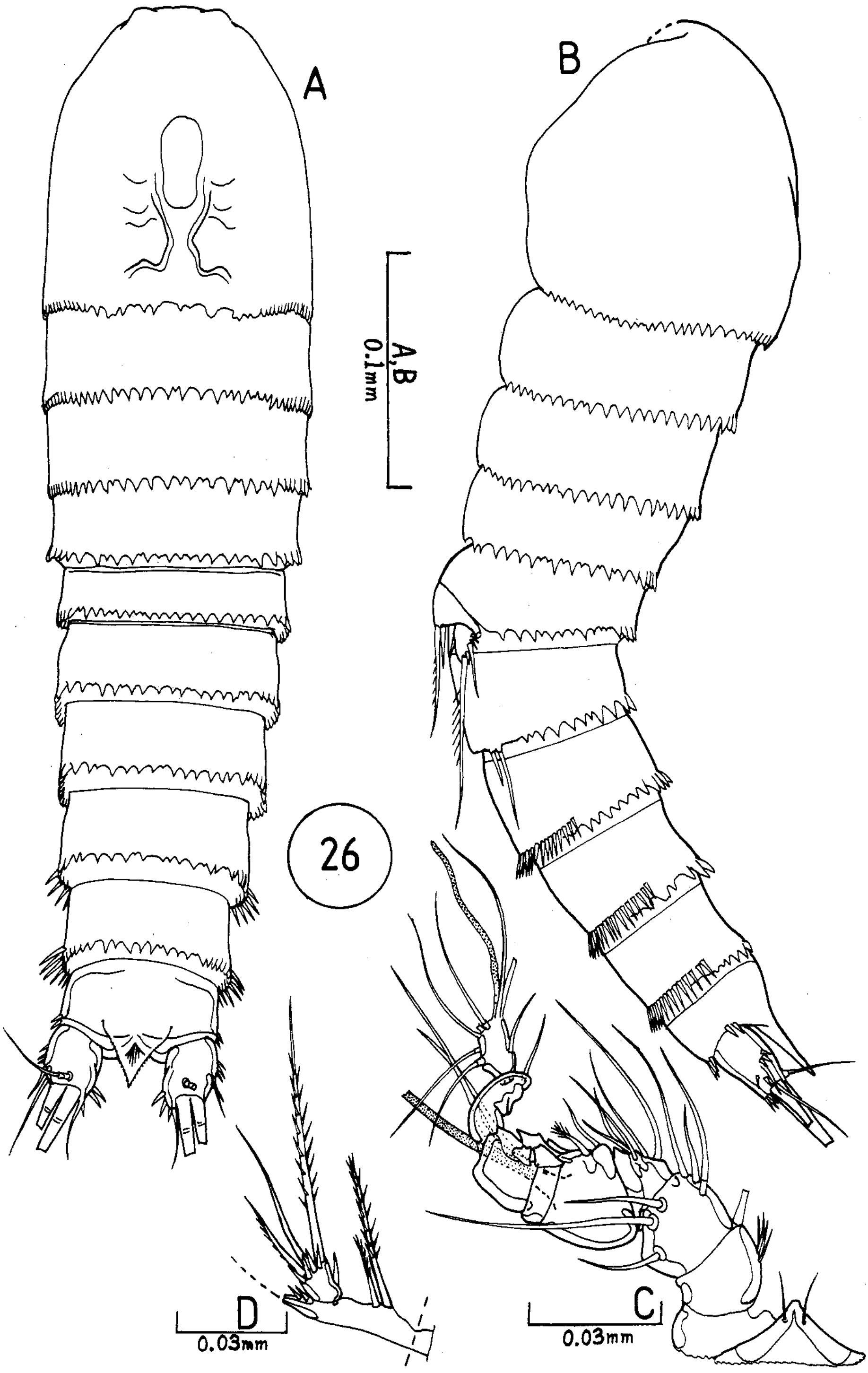


Fig. 26. *C. longifurca*, allotype male. *A*, dorsal, and *B*, side, views of whole animal; *C*, R + A1; *D*, P5.

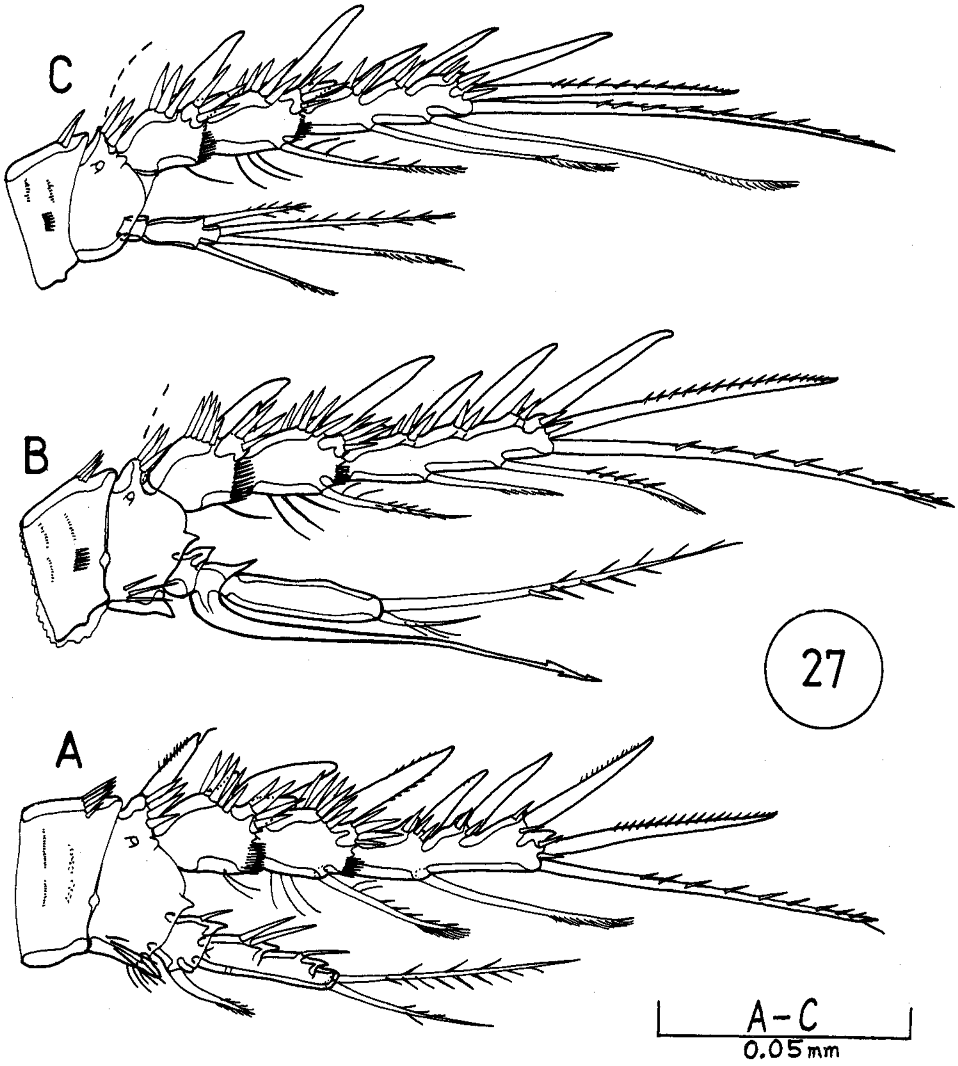


Fig. 27. *C. longifurca*, allotype male. *A*, P2; *B*, P3; *C*, P4.

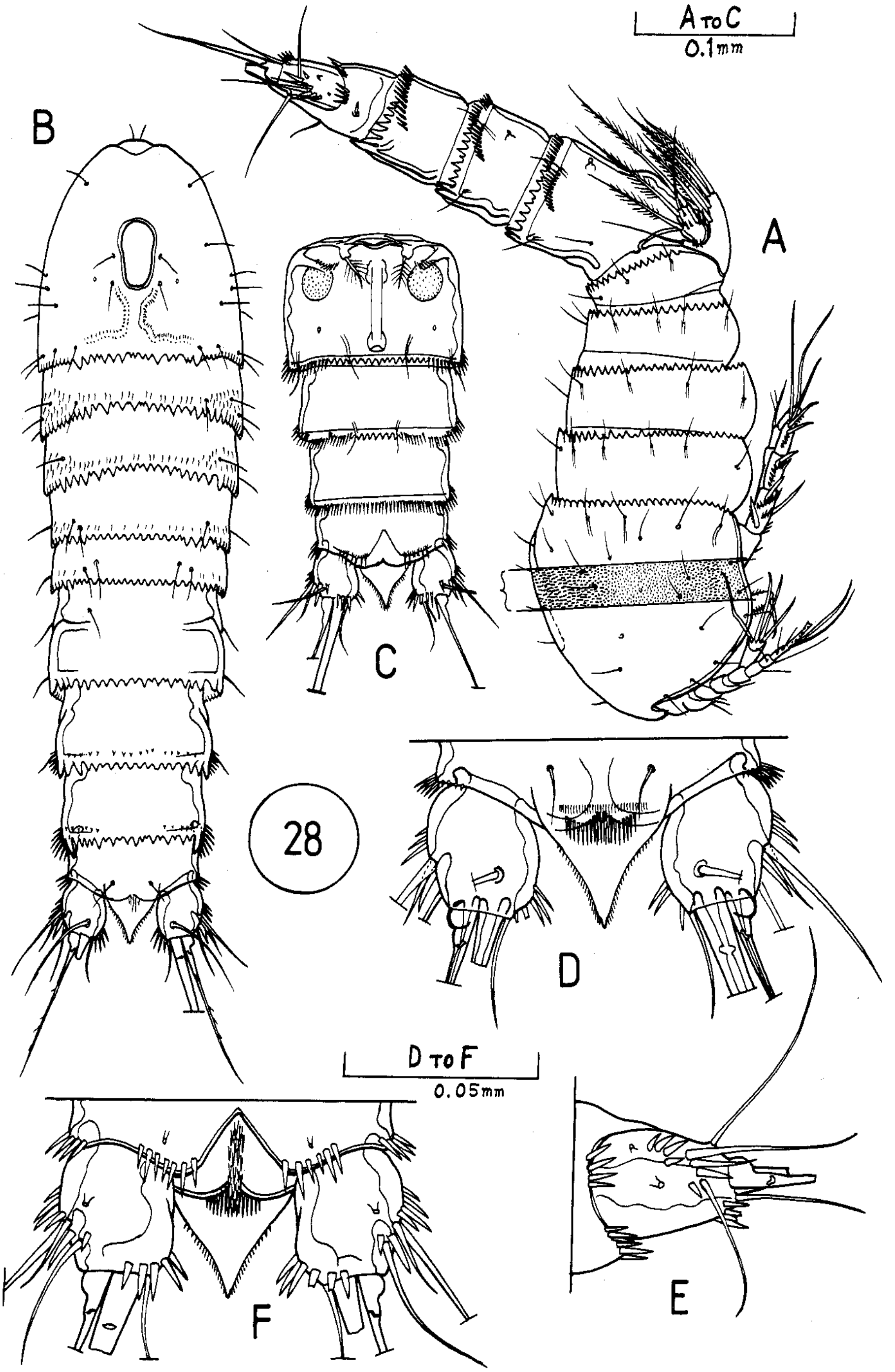


Fig. 28. *C. globulisetosus*, topotypic female. *A*, side, and *B*, dorsal, views of whole animal (in *A*, the stippled band across the prosome represents the micropores); *C*, ventral view of Abd; *D*, dorsal, *E*, left side, and *F*, ventral, views of op + FRs.

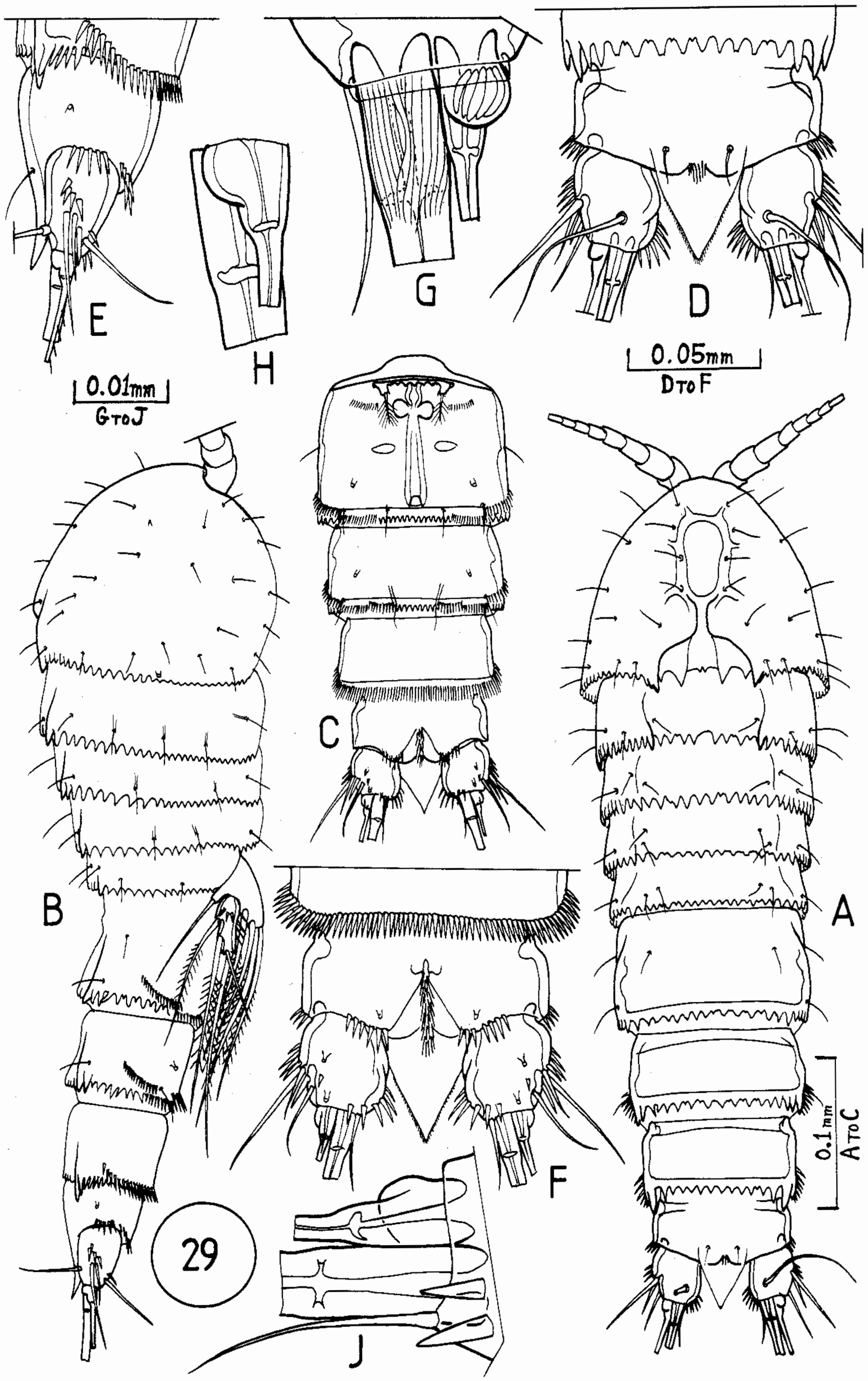


Fig. 29. *C. globulisetosus*, holotype female. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, dorsal, *E*, right side, and *F*, ventral, views of op+FRs; *G*, dorsal, *H*, right side, and *J*, ventral, views of bases of FRsetae 5–7.

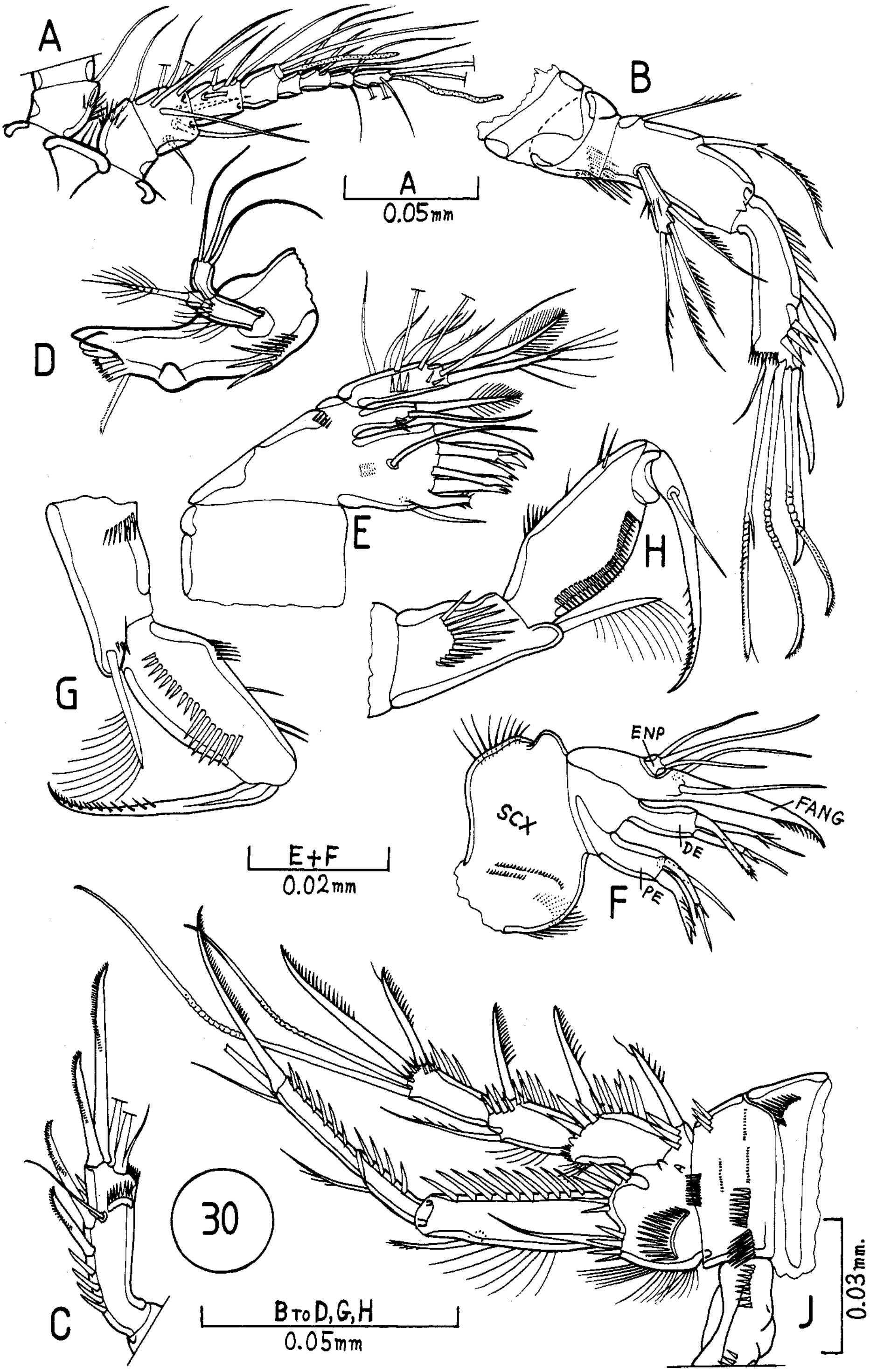


Fig. 30. *C. globulisetosus*, holotype female. *A*, A1; *B*, exop view of A2; *C*, abexp view of A2enp; *D*, Md; *E*, Mx1; *F*, Mx2; *G* and *H*, Mxp; *J*, P1. *D*, *G*, and *J*, front views; *E*, *F*, and *H*, rear views.

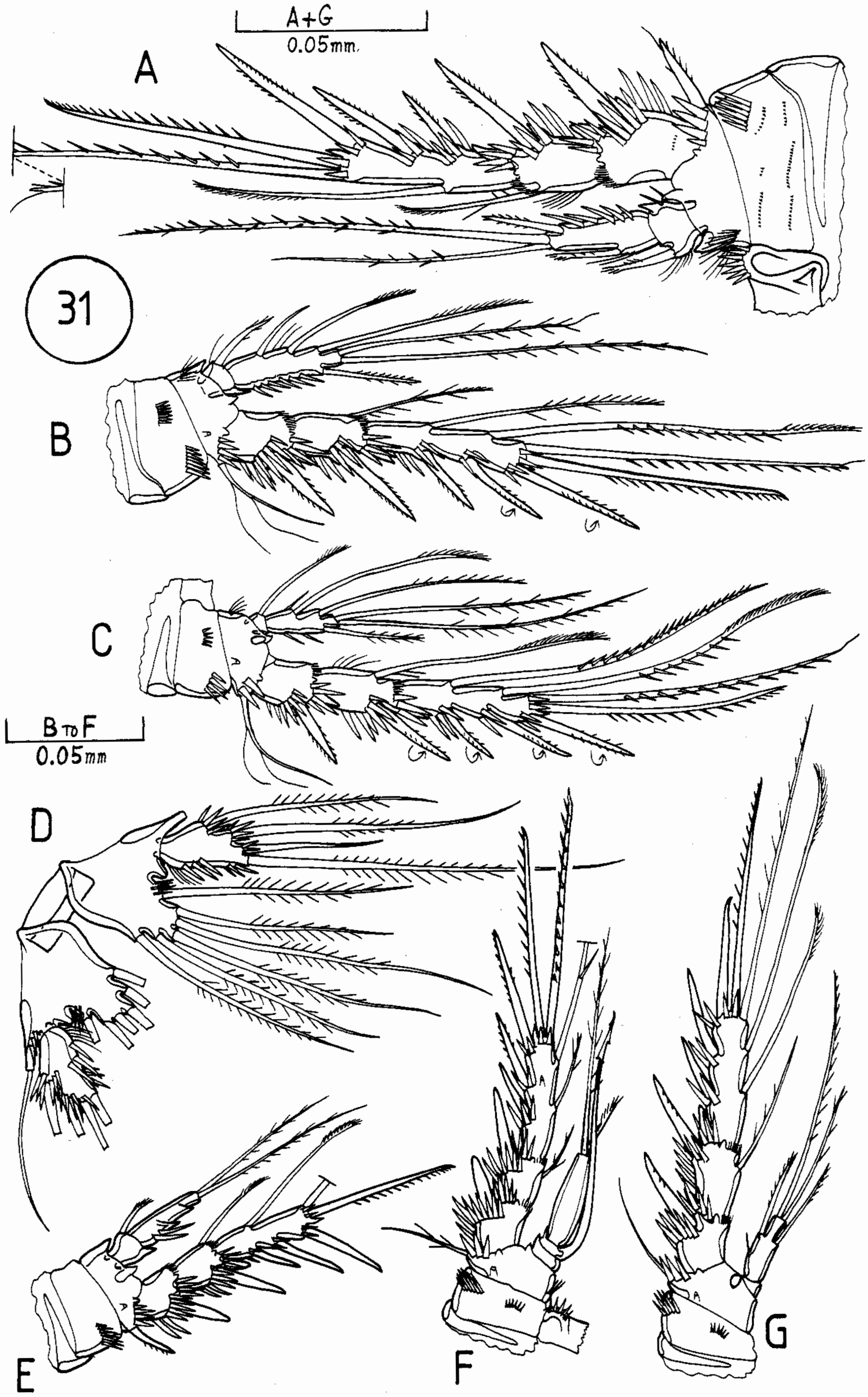


Fig. 31. *C. globulisetosus*. *A–D*, P2–P5 in that order of the holotype female; *E–G*, P2–P4 in that order of the allotype male.

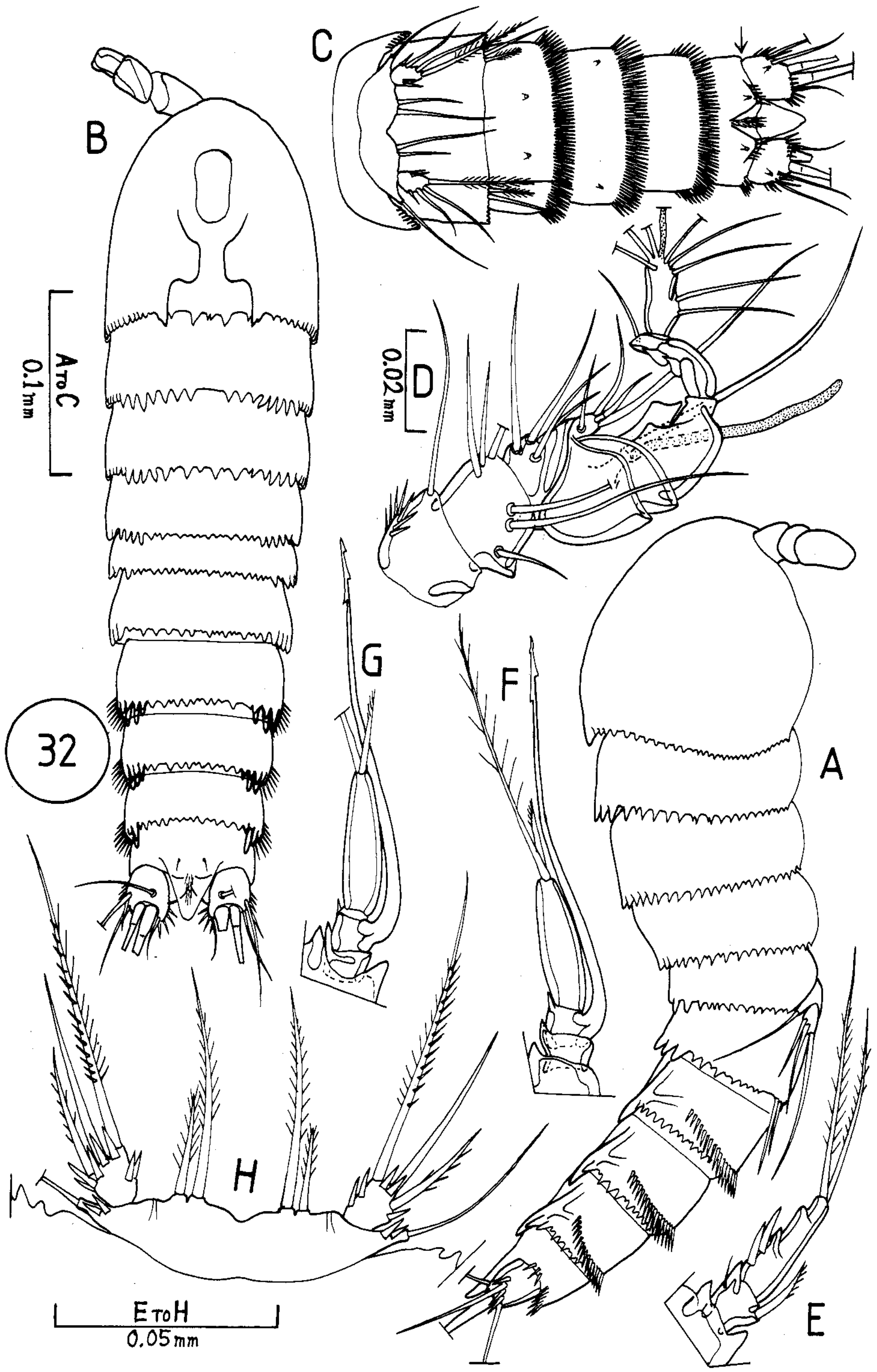


Fig. 32. *C. globulisetosus*, allotype male. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, A1; *E*, front view of P2enp; *F*, front, and *G*, rear, views of P3enp; *H*, paired P5s.

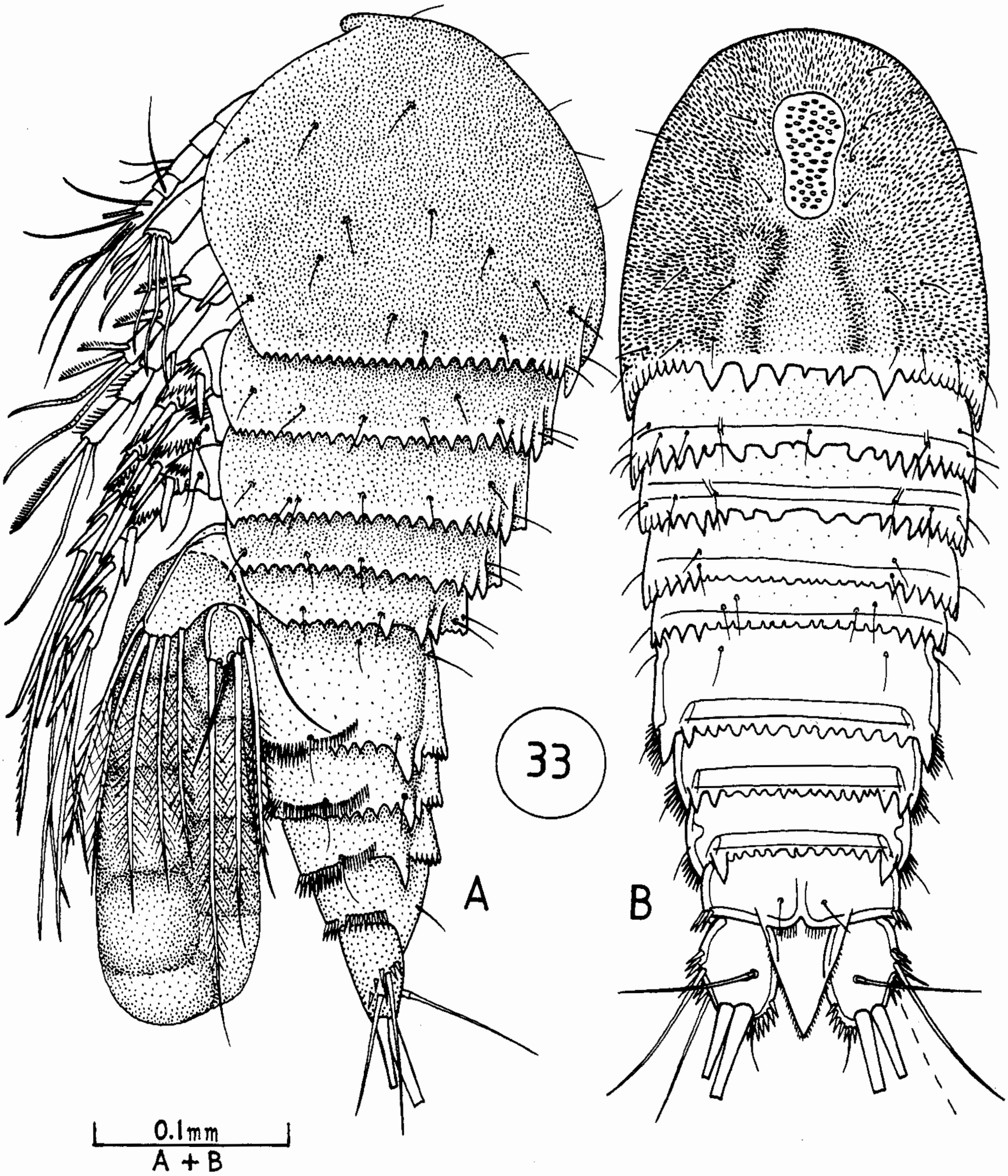


Fig. 33. *C. mortoni*, holotype female. *A*, side, and *B*, dorsal, views of whole animal.

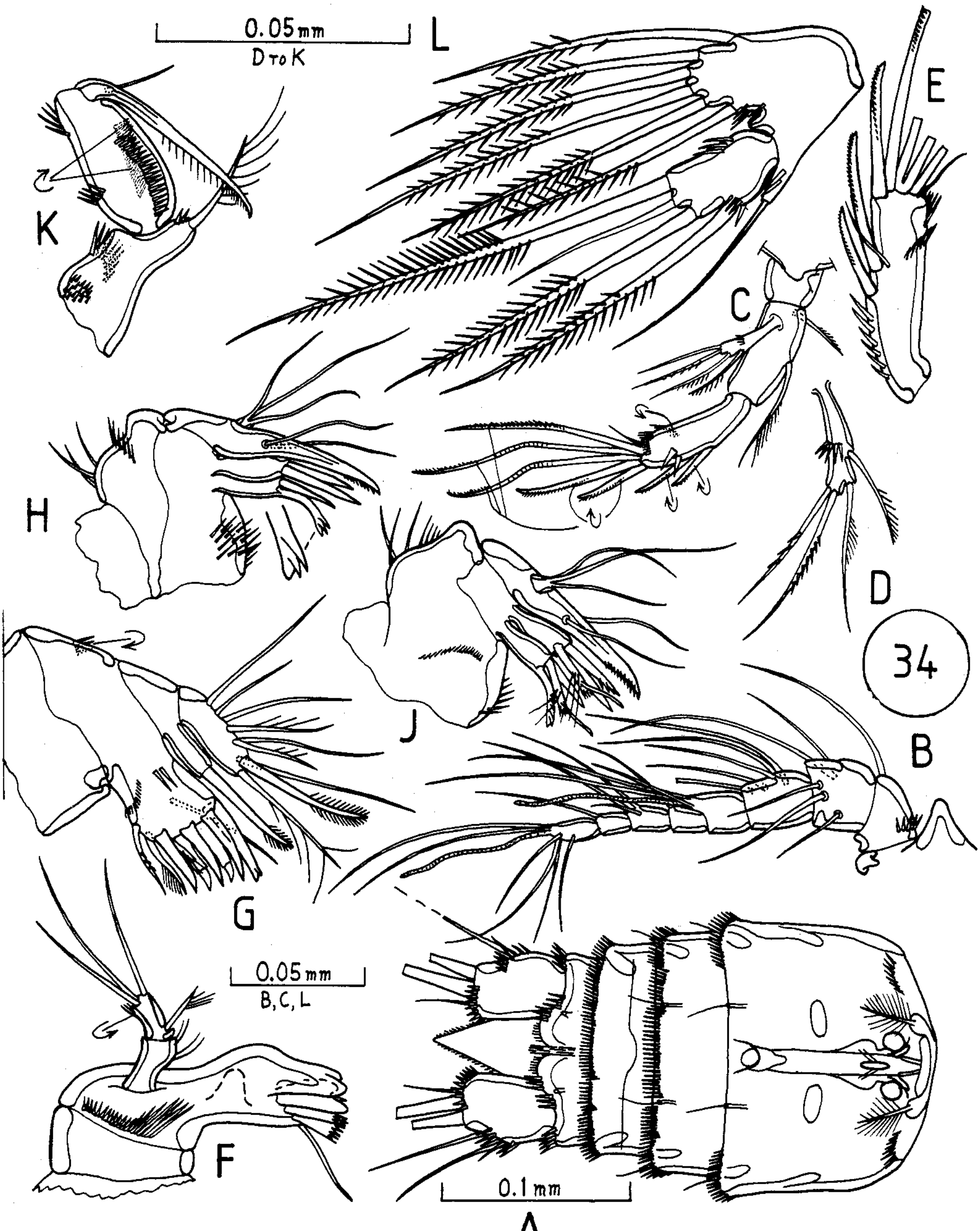


Fig. 34. *C. mortoni*, holotype female. *A*, ventral view of Abd; *B*, R+A1; *C*, A2; *D*, A2exp enlarged in exop view; *E*, abexp view of A2enp; *F*, Md; *G*, Mx1; *H* and *J*, Mx2; *K*, Mxp; *L*, P5. *F–L* in front view, except *J* which is in rear view.

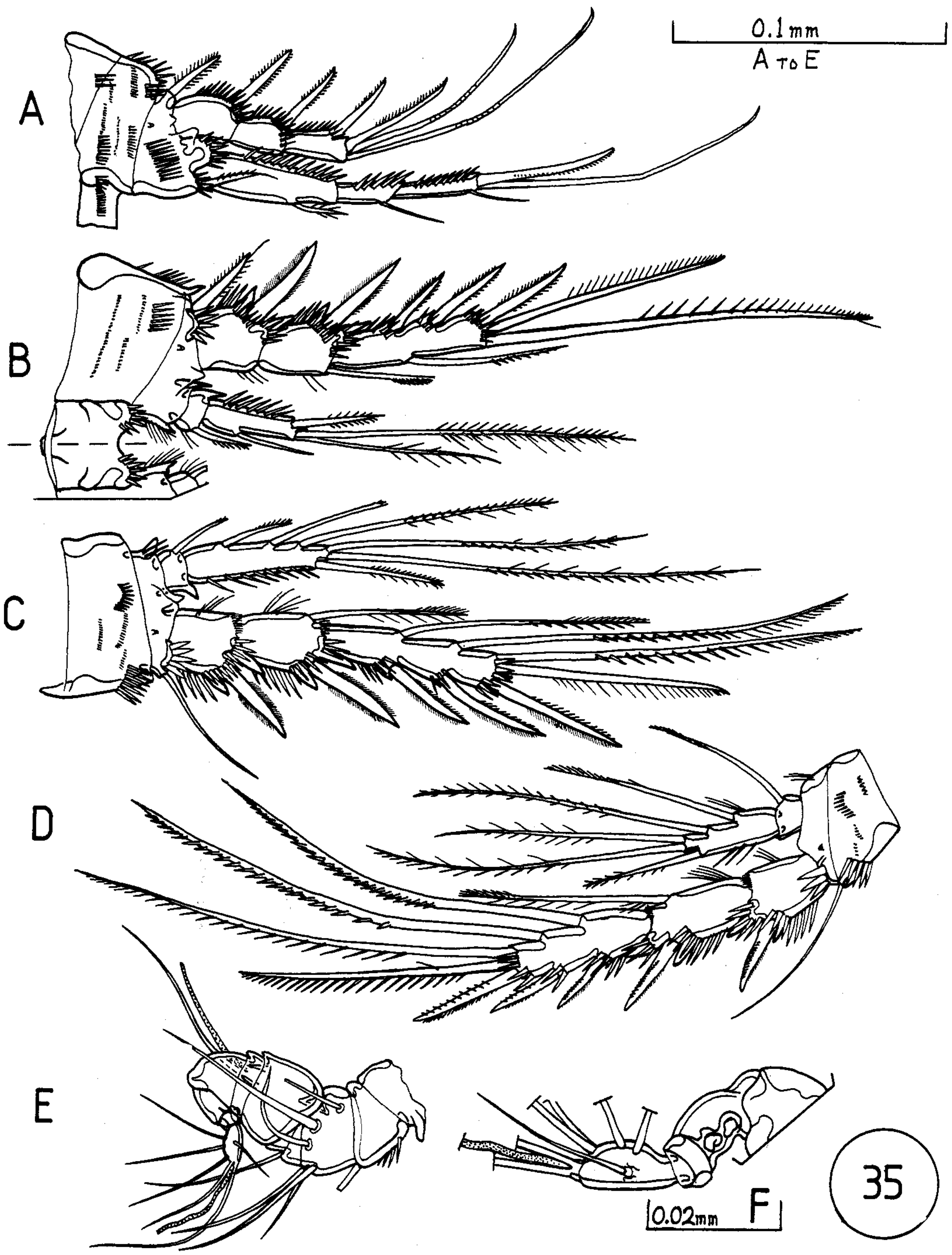


Fig. 35. *C. mortoni*; *E* and *F*, allotype male; the others from the holotype female. *A*, P1; *B*, P2; *C*, P3; *D*, P4; *E*, A1; *F*, distal part of A1 (see text). For male P2 and P4 see Figs 97*D*–97*F*.

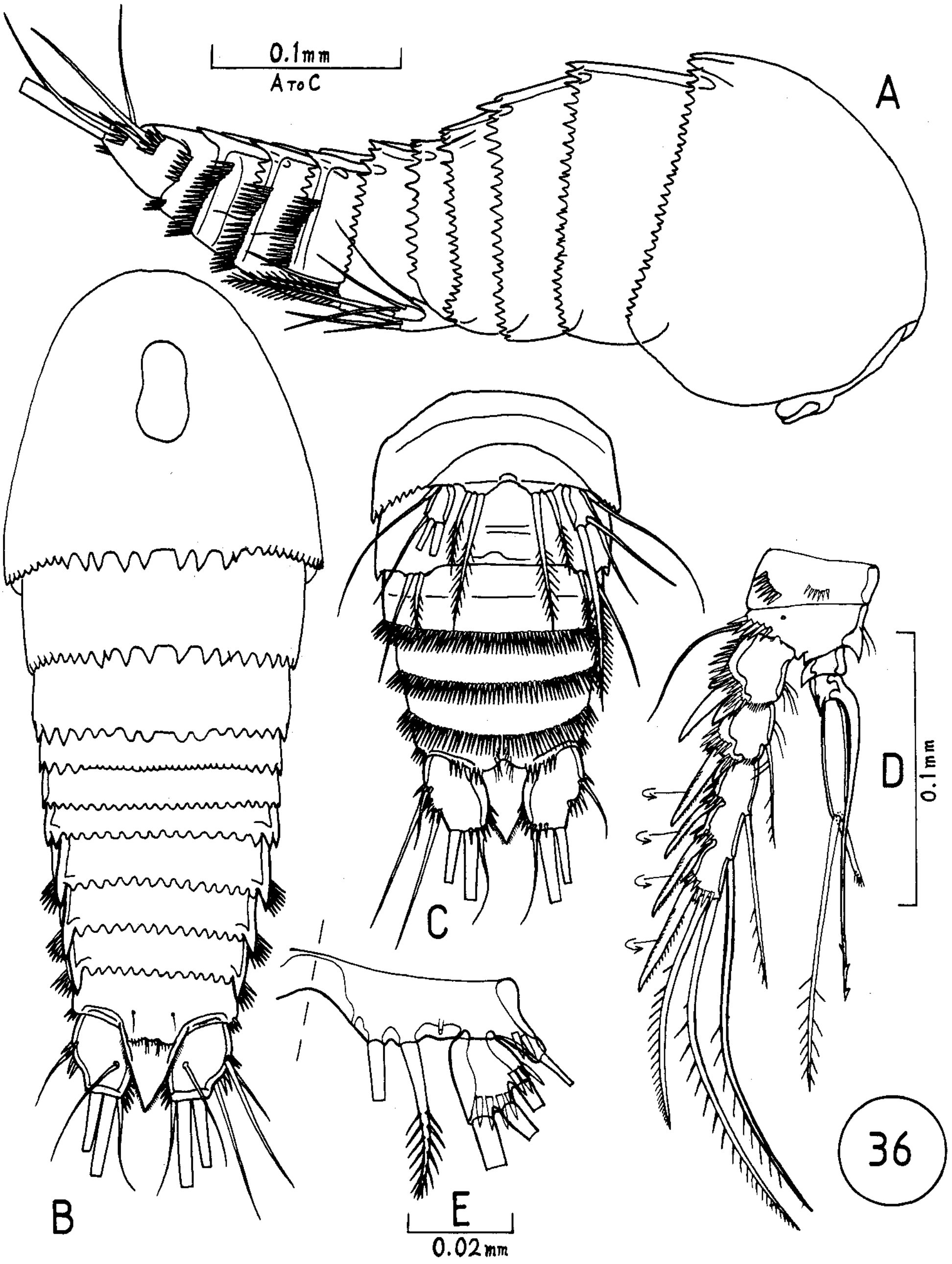


Fig. 36. *C. mortoni*, allotype male. *A*, side, and *B*, dorsal, views of whole animal; *C*, ventral view of Abd; *D*, P3; *E*, P5.

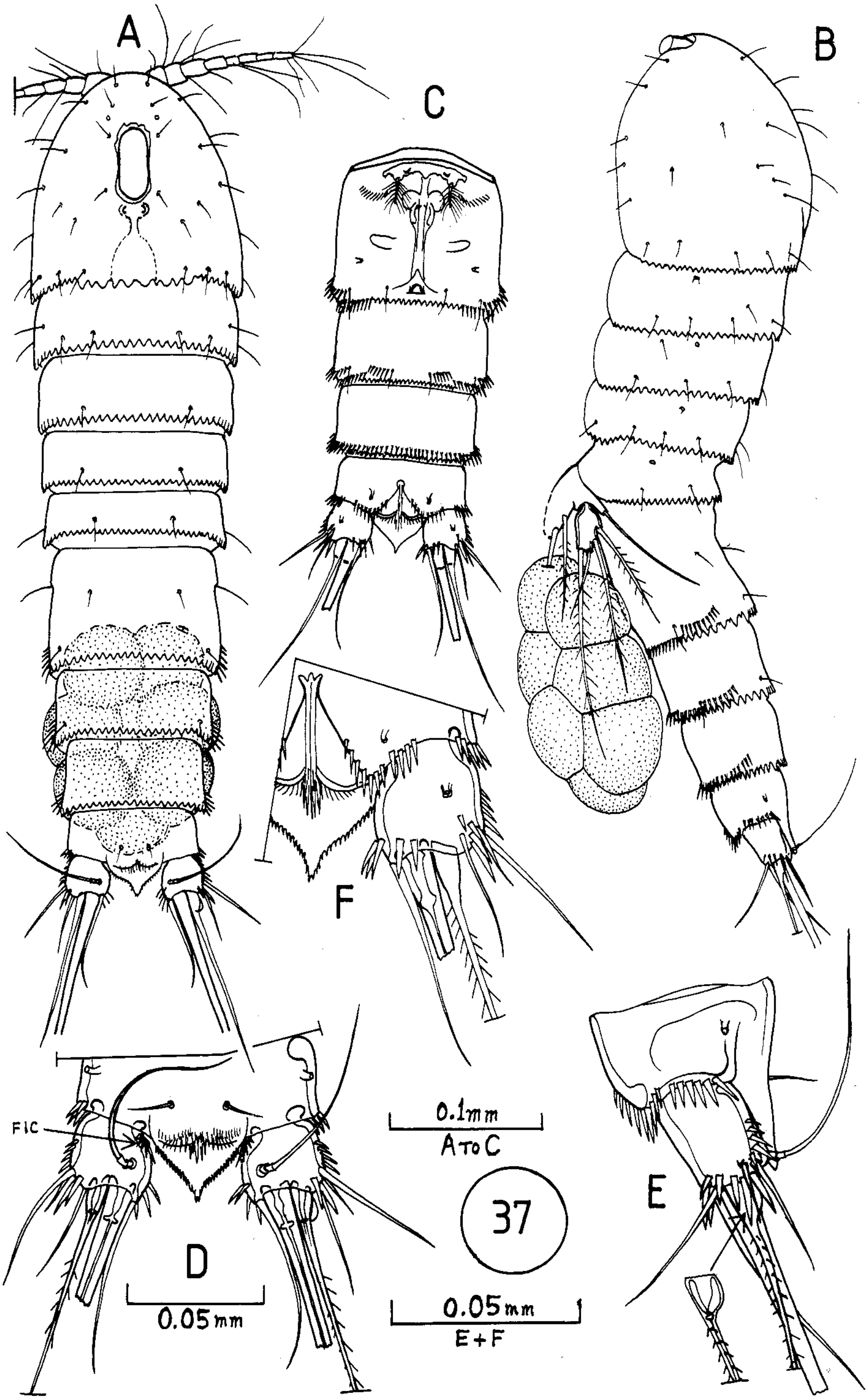


Fig. 37. *C. timmsi*, holotype female. *A*, dorsal, and *B*, side, views of the entire animal (P5enp shown partly dashed in *B*, where it was covered by the tangled legs, omitted here); *C*, ventral view of Abd; *D*, dorsal, *E*, left side, and *F*, ventral, views of op with FRs.

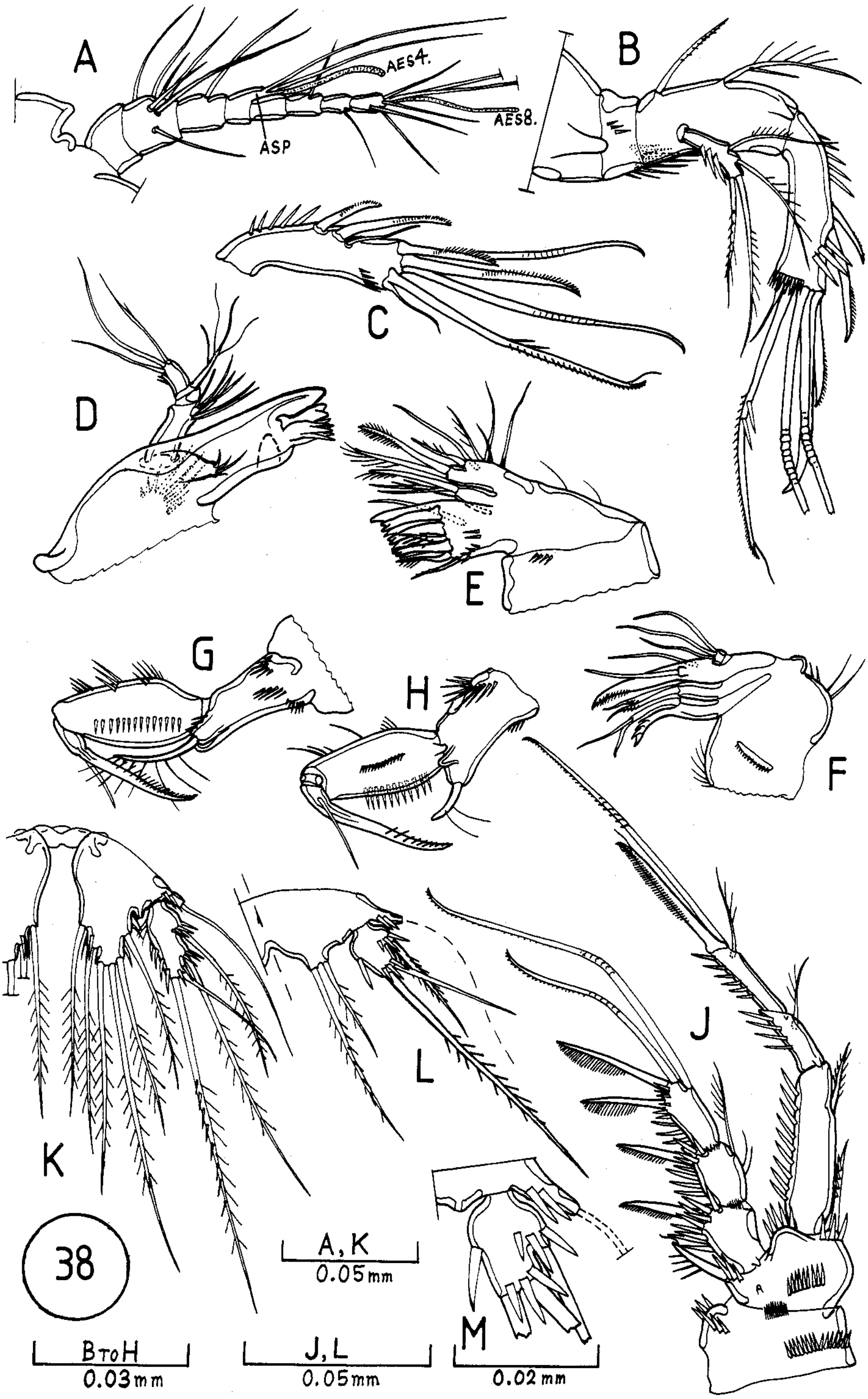


Fig. 38. *C. timmsi*; *A–K*, holotype female; *L* and *M*, allotype male. *A*, A1; *B*, exop view of A2; *C*, abexp view of A2enp; *D*, rear view of Md; *E*, front view of Mx1; *F*, rear view of Mx2; *G*, front, and *H*, rear, views of Mxp; *J*, P1; *K* and *L*, entire P5; *M*, P5exp enlarged.

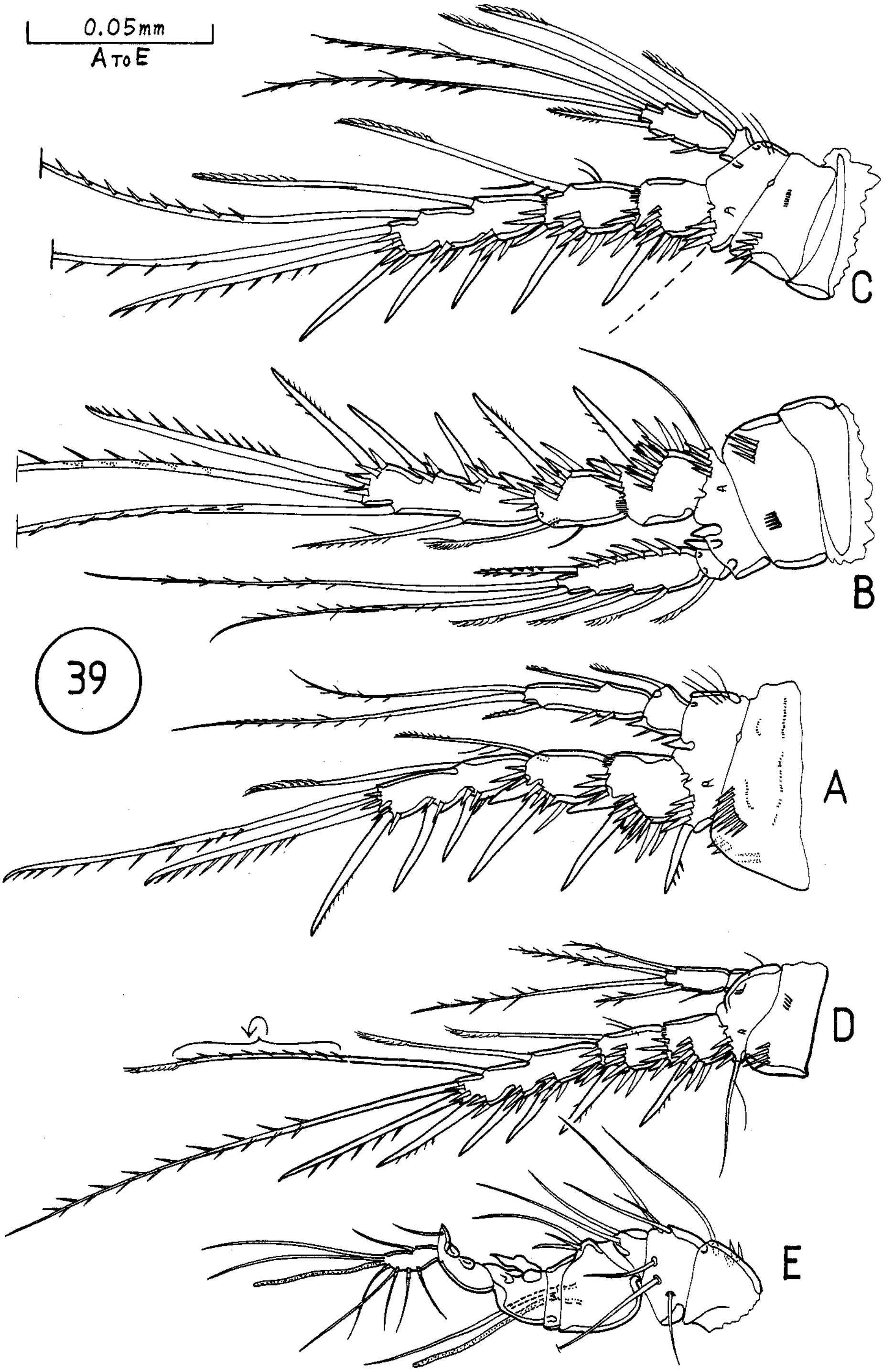


Fig. 39. *C. timmsi*; *A–C*, holotype female; *D* and *E*, allotype male. *A*, P2; *B*, P3; *C* and *D*, P4; *E*, A1.

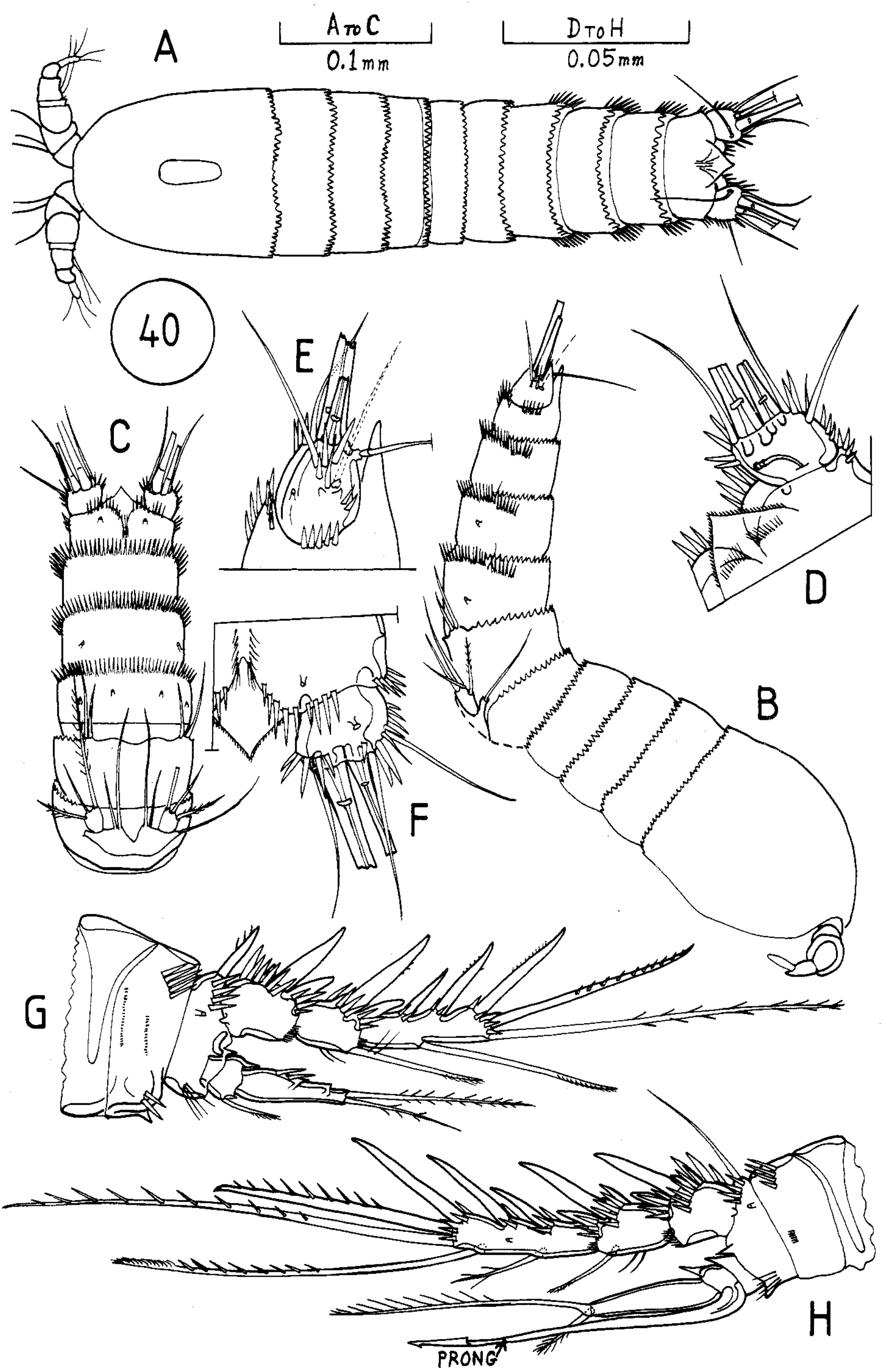


Fig. 40. *C. timmsi*, allotype male. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd with P5 and P6; *D*, dorsal, *E*, right side, and *F*, ventral, views of op with one FR; *G*, P2; *H*, P3.

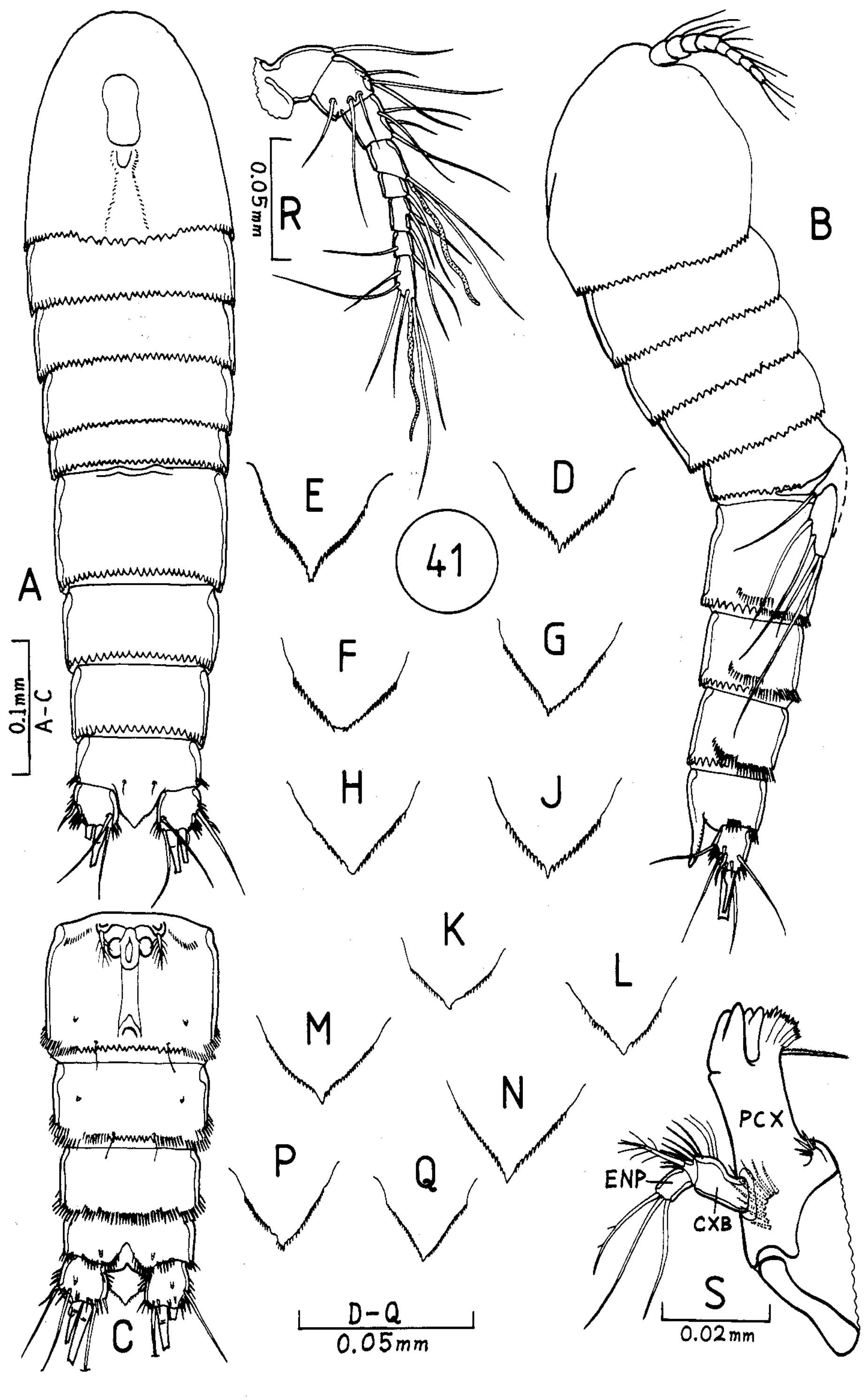


Fig. 41. *C. timmsi*; *K*, *L*, *P*, and *Q* male, the rest female. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D–Q*, ops; *R*, A1; *S*, Md. *A–C*, *E*, *R*, and *S* from Burnie (female No. 1, see text), *D* from Burnie (female No. 2), and *M–Q* also from locality 8 on Map 6; *F–L* unnumbered paratypes, all from locality 14 on Map 6.

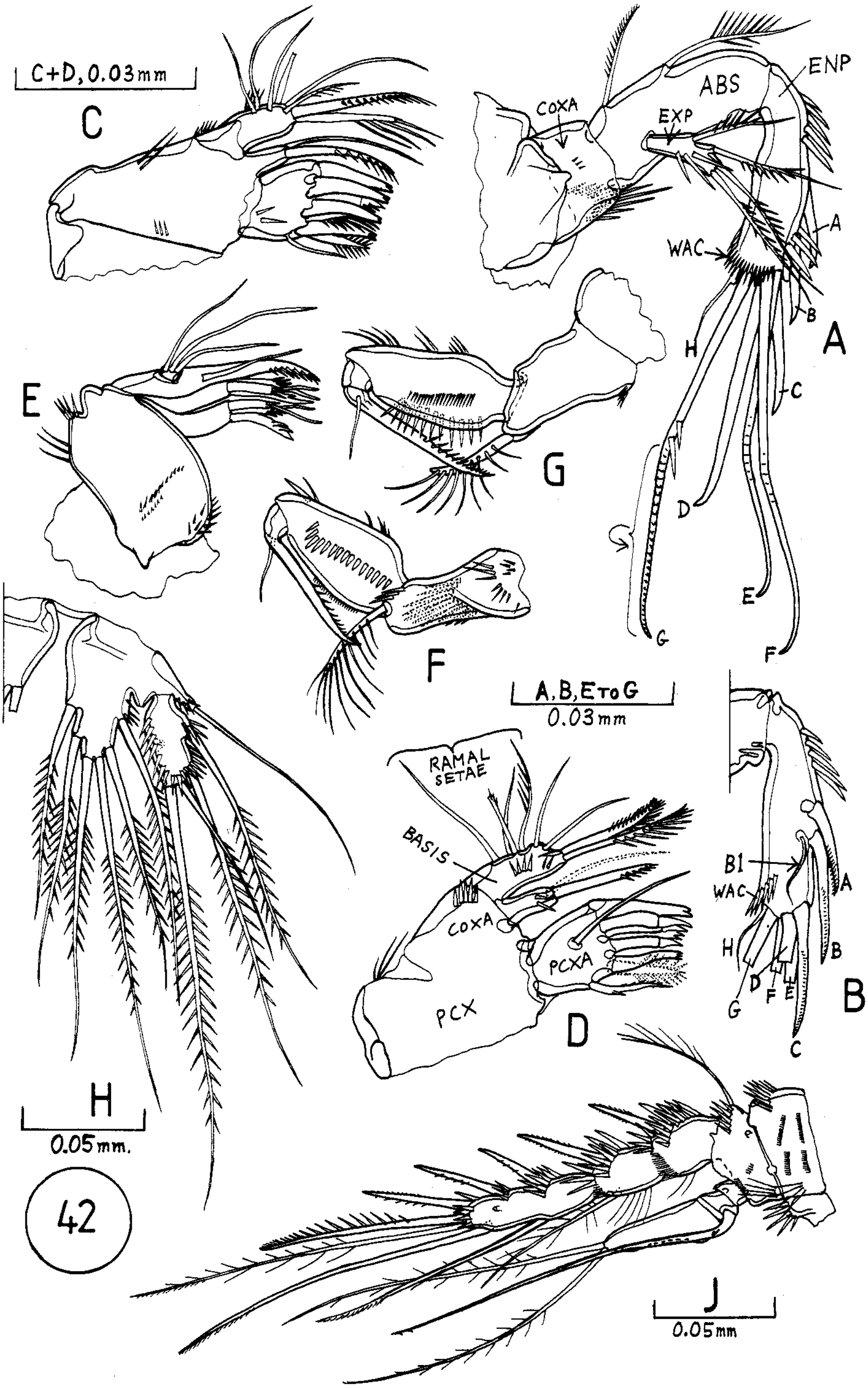


Fig. 42. *A–H*, *C. timmsi*; *C*, *D*, and *H* Burnie female No. 2, the others Burnie female No. 1. *A*, exop view of A2; *B*, abexp view of A2enp; *C* and *D*, Mx1; *E*, Mx2; *F* and *G*, Mxp; *H*, P5. *C* and *F* in front view; *D*, *E*, and *G* in rear view. Note that the two missing setae in *D* (shown dotted) are rear-side setae, present but partly concealed in *C*. *J*, *C. billwilliamsi*; P3 of male allotype.

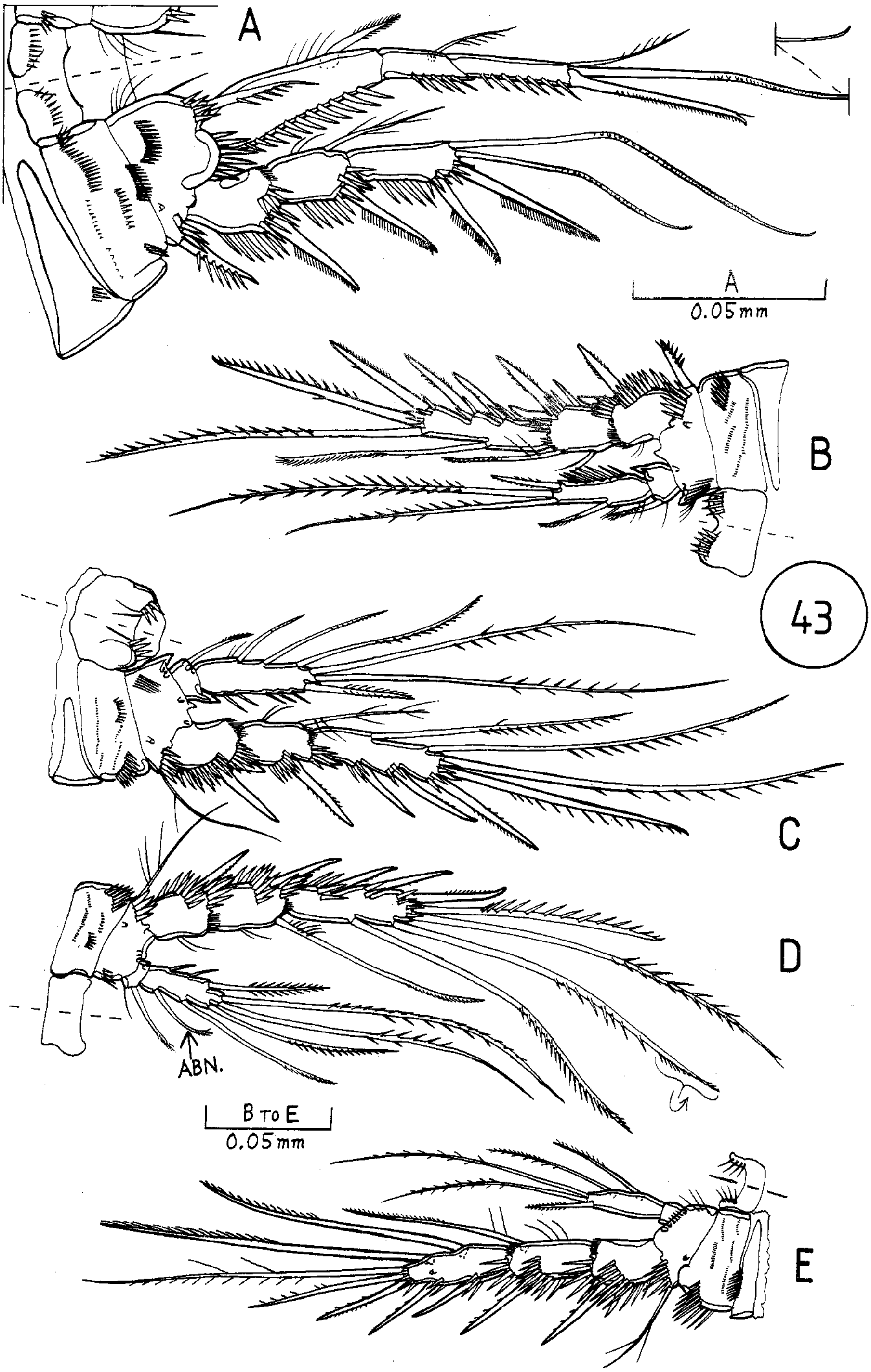


Fig. 43. *A–D*, *C. timmsi*, Burnie female No. 1; *A*, P1; *B*, P2; *C*, P3 (ABN, abnormal extra seta; for the normal setation see Fig. 39*C*); *D*, P4. *E*, *C. billwilliamsi*, P4 of male allotype.

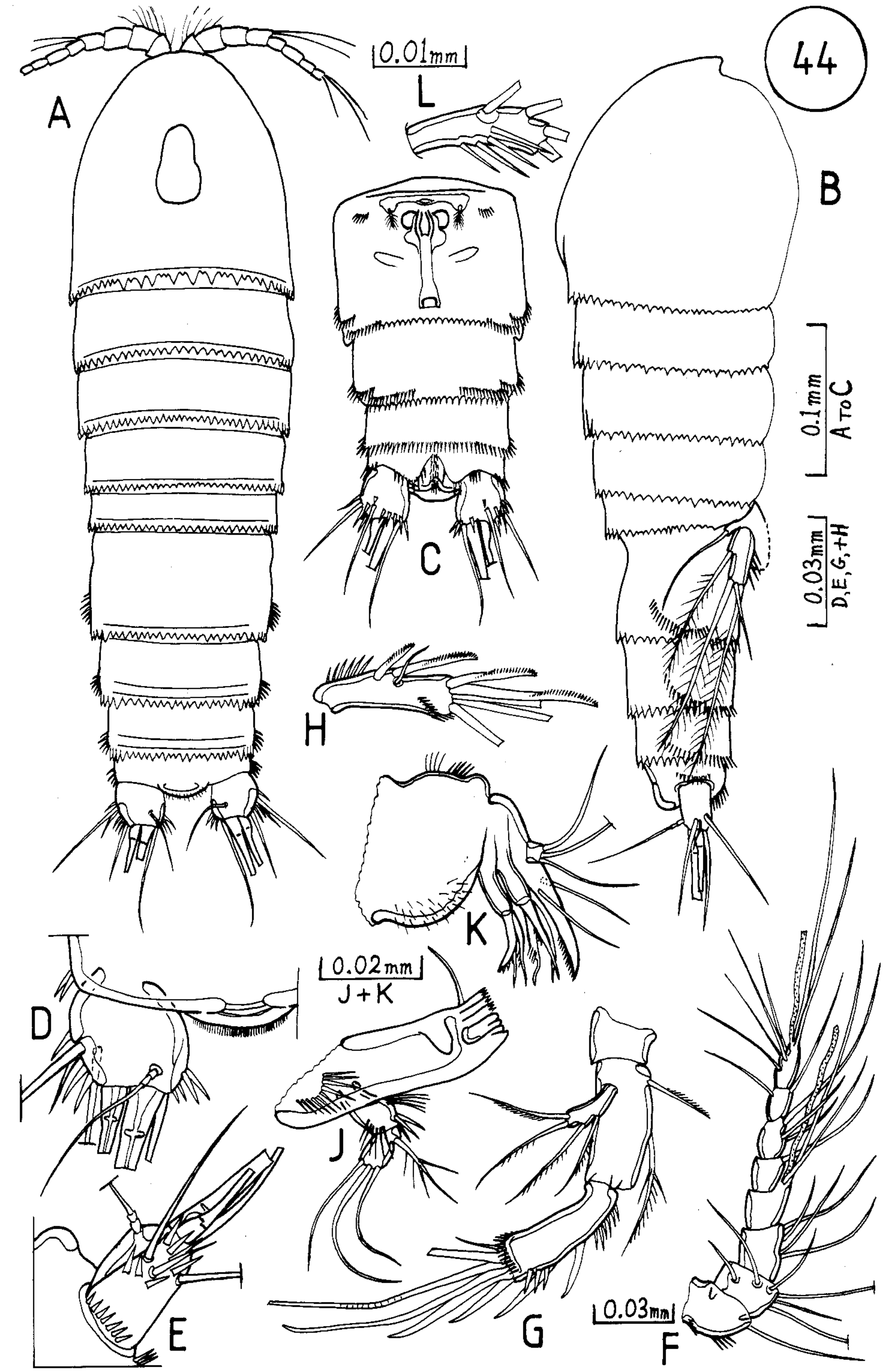


Fig. 44. Female *C. timmsi* with abnormal op (see text). *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, dorsal, and *E*, side, views of FR (*D* also shows op); *F*, A1; *G*, exop view of A2; *H*, abexp view of A2enp; *J*, rear view of Md; *K*, Mx2 in rear view; *L*, A2exp as in *G* but enlarged to show surficial spinules.

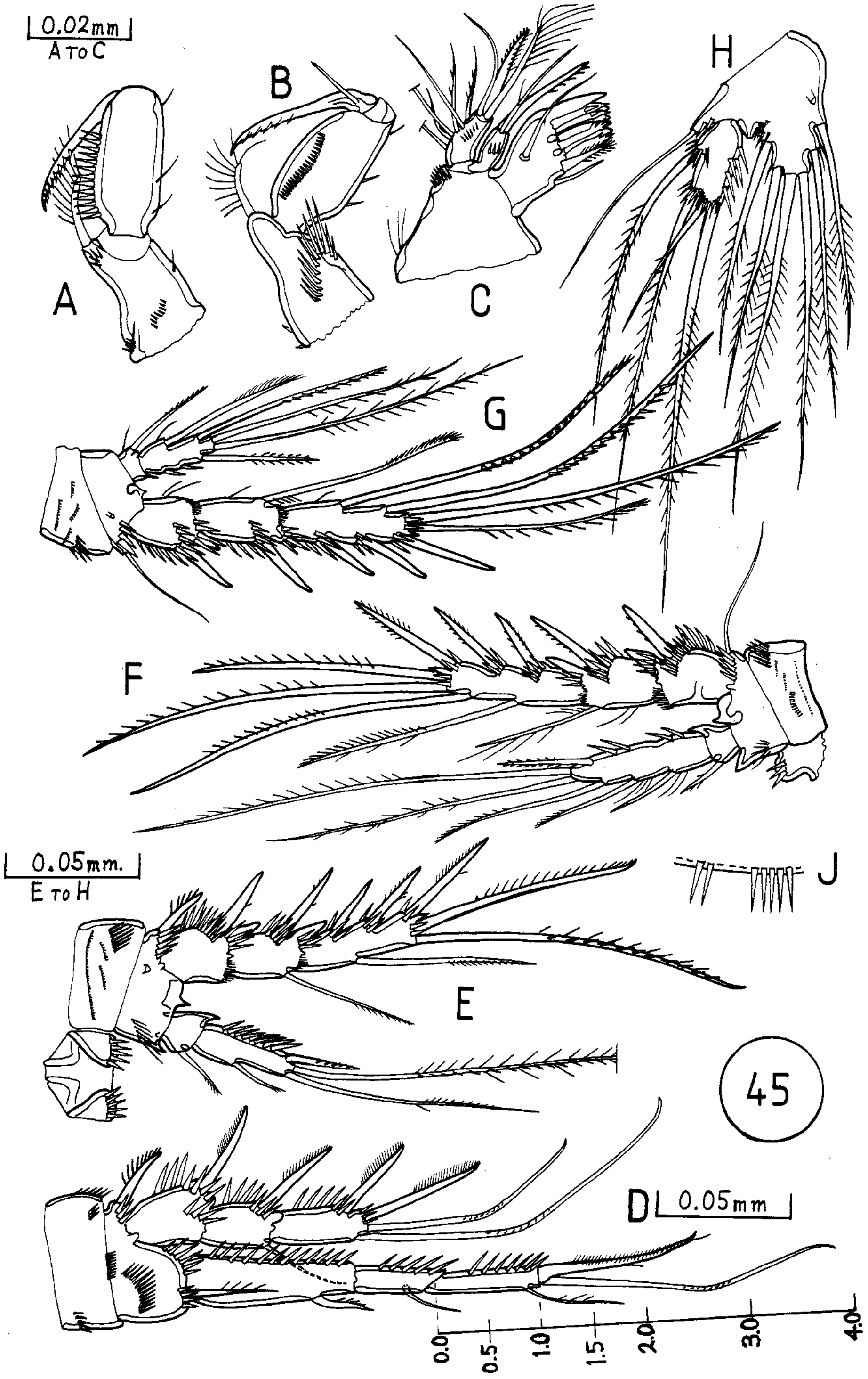


Fig. 45. As Fig. 44 (*q.v.*). *A*, front, and *B*, rear, views of Mxp; *C*, rear view of Mx1; *D*, P1; *E*, P2; *F*, P3; *G*, P4; *H*, P5; *J*, freehand enlargement (to no specified scale) of op edge, to show spinules and spinule-scars. See p. 1035 for the proportional scale against *D*.

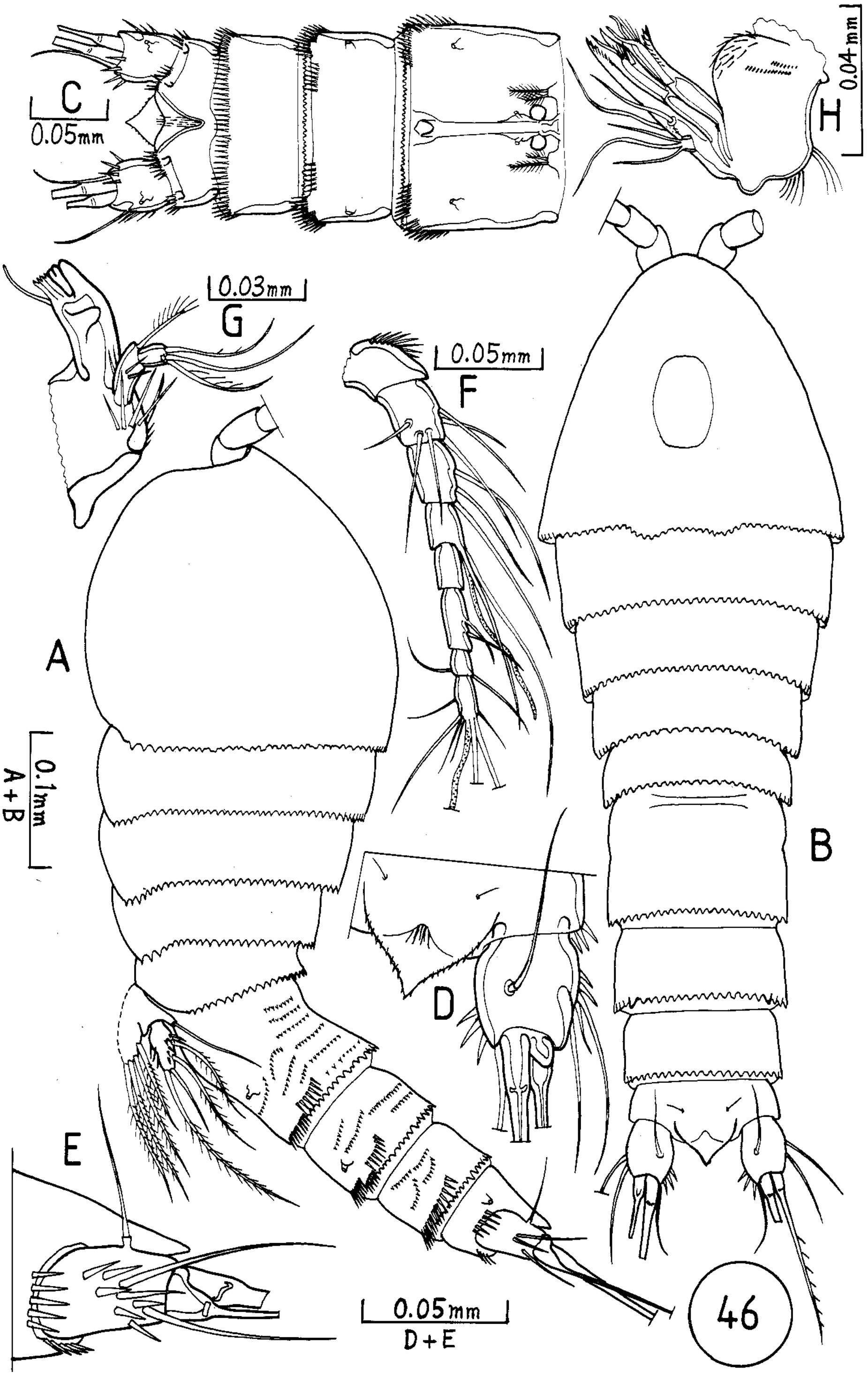


Fig. 46. *C. dedeckkeri*, female holotype. *A*, side, and *B*, dorsal, views of whole animal; *C*, ventral view of Abd; *D*, dorsal, and *E*, left side, views of op with FR; *F*, A1; *G*, front view of Md; *H*, rear view of Mx2. *C*, *F*, *G* and *H* each have own scales.

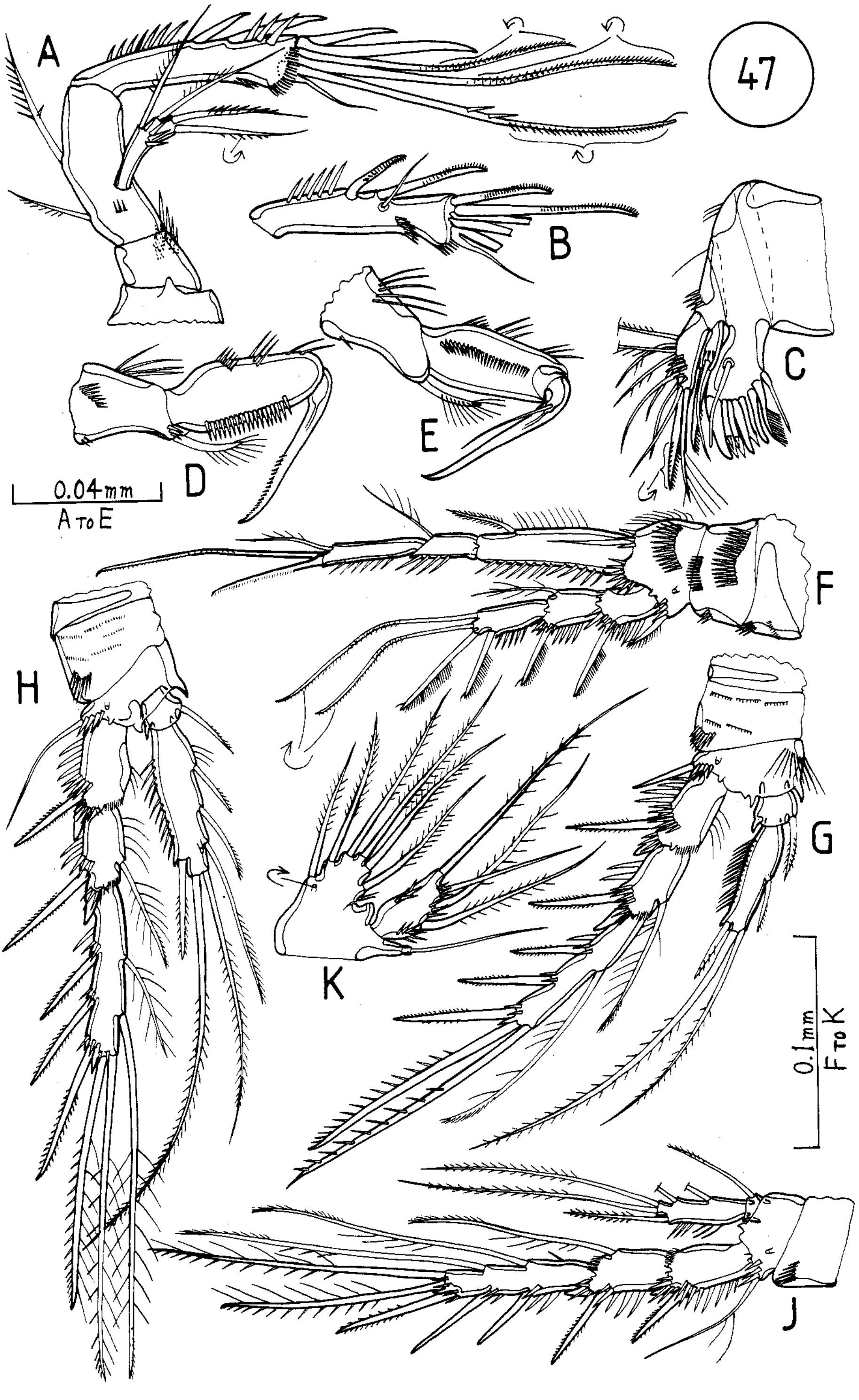


Fig. 47. *C. dedeckkeri*, female holotype. *A*, exop view of A2; *B*, abexp view of A2enp; *C*, rear side of Mx1; *D*, front, and *E*, rear, views of Mxp; *F*, P1; *G*, P2; *H*, P3; *J*, P4; *K*, P5.

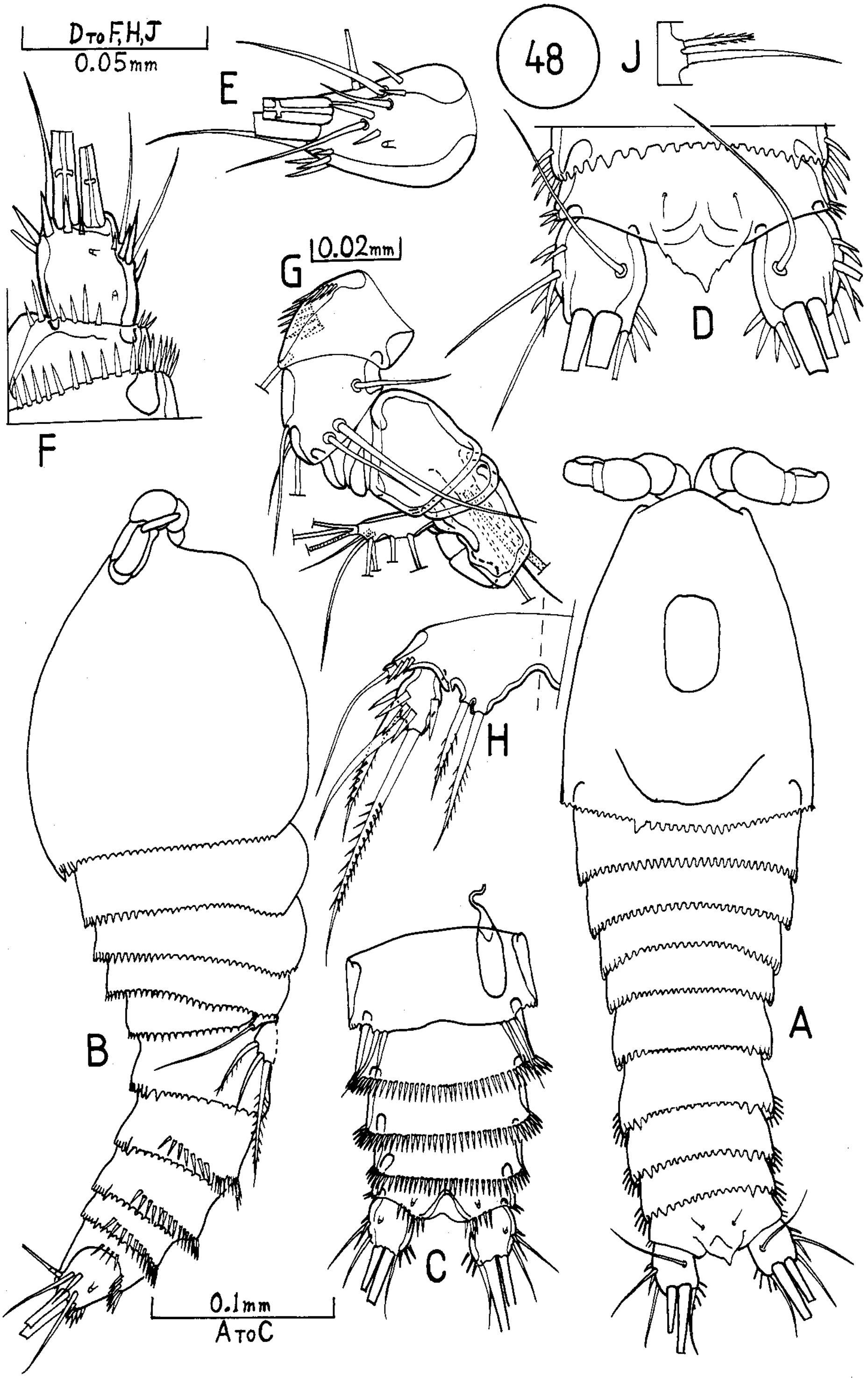


Fig. 48. *C. dedeckkeri*, male allotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd with P6 and spermatophore; *D*, dorsal, *E*, side, and *F*, ventral, views of FRs (*D* also shows op); *G*, A1; *H*, P5; *J*, P6; *G* has own scale. For remaining figures of male, see Figs 62*E*–62*H*.

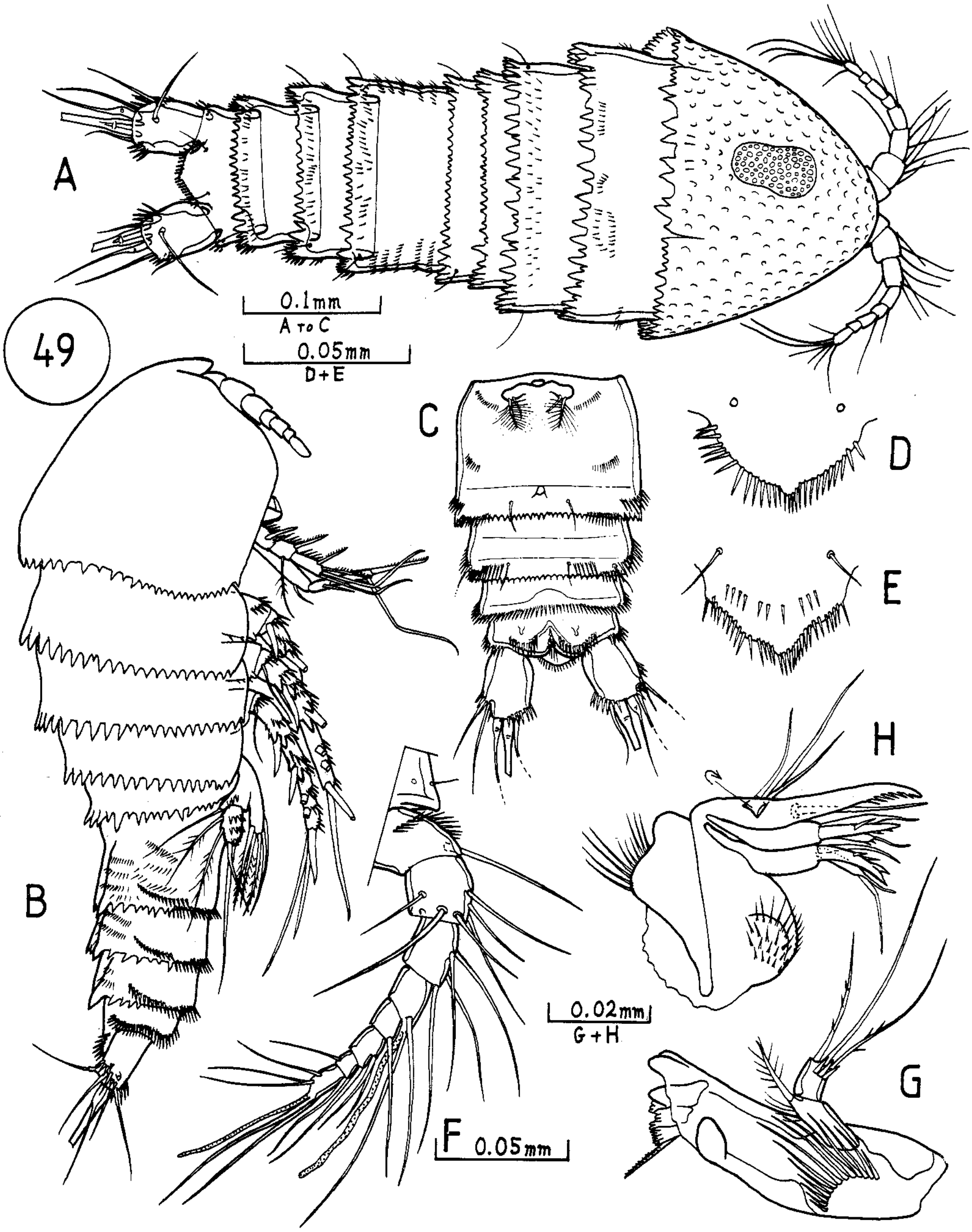


Fig. 49. *C. clavifurcatus*, female; *A* and *D* from paratype 2, the others from the holotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D* and *E*, op; *F*, A1; *G*, front view of Md; *H*, front view of Mx2.

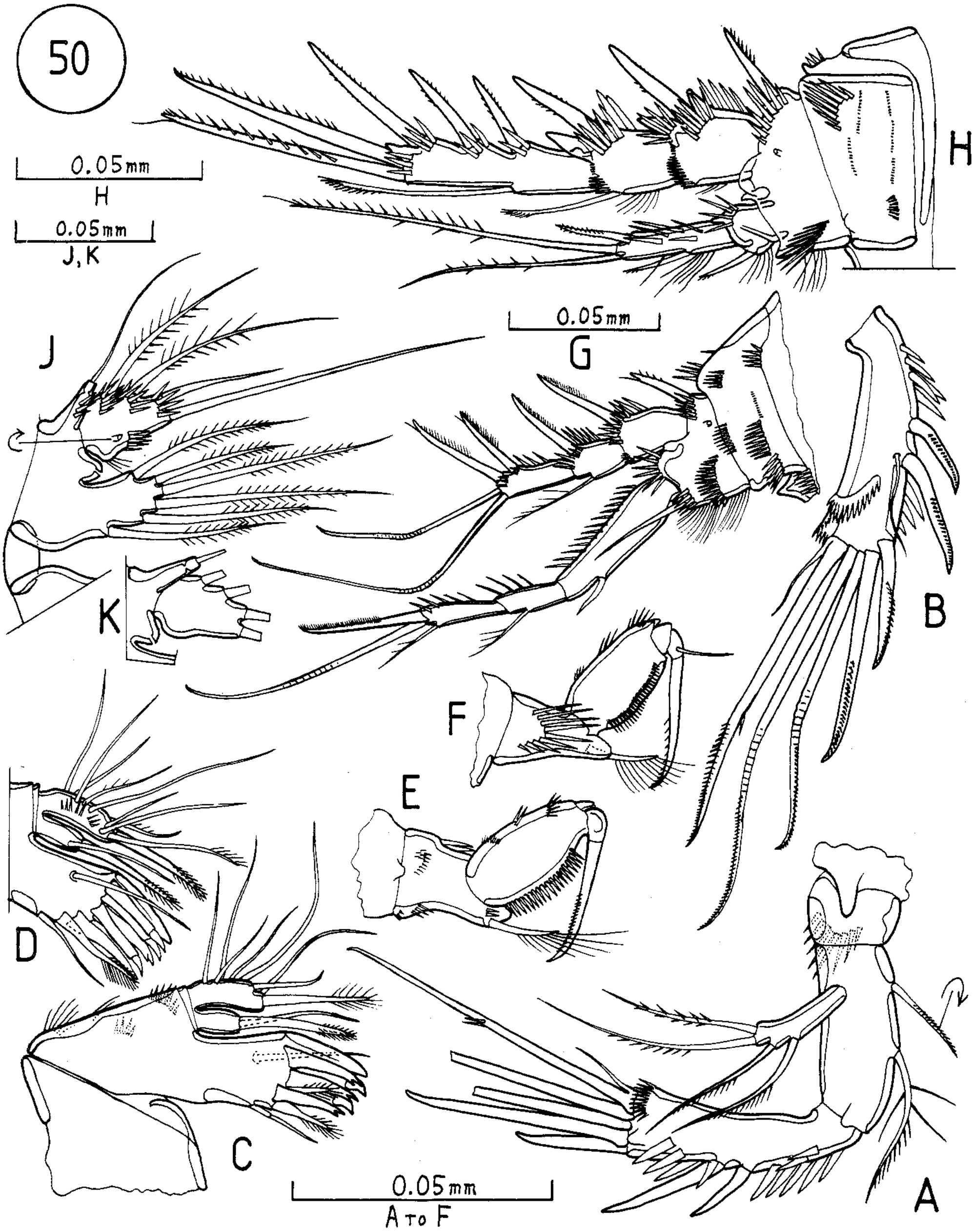


Fig. 50. *C. clavifurcatus*, female; *G* and *H* from holotype; *A*, *C*, and *F* from paratype 1; the rest from paratype 2. *A*, exop view of A2; *B*, abexp view of A2enp; *G*, P1; *H*, P2; *J*, P5; *K*, outline of P5exp without spinules. *G* has own scale.

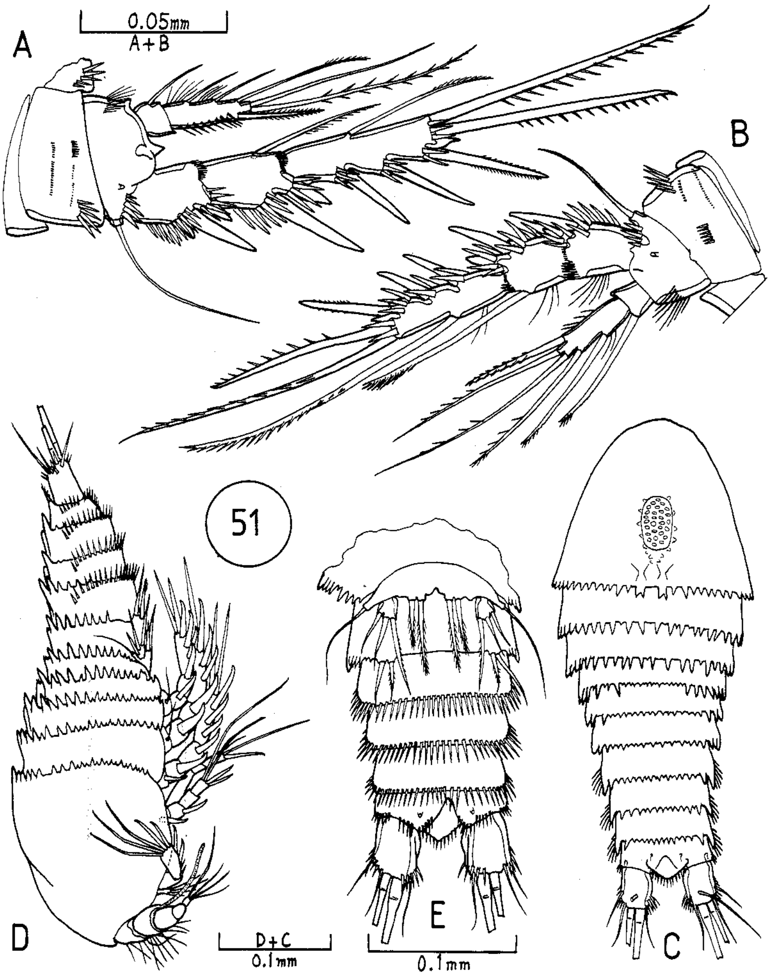


Fig. 51. *C. clavifurcatus*; *A* and *B* female, the others from the allotype male. *A*, P3 of paratype 1; *B*, P4 in which the coxa, basis and the whole outer edge of the exp (spines *C* and *D* conjectural) are from the holotype, and the rest of P4 is from paratype 1; *C*, dorsal, and *D*, side, views of whole animal; *E*, ventral view of Abd with P5 and P6. *E* has own scale.

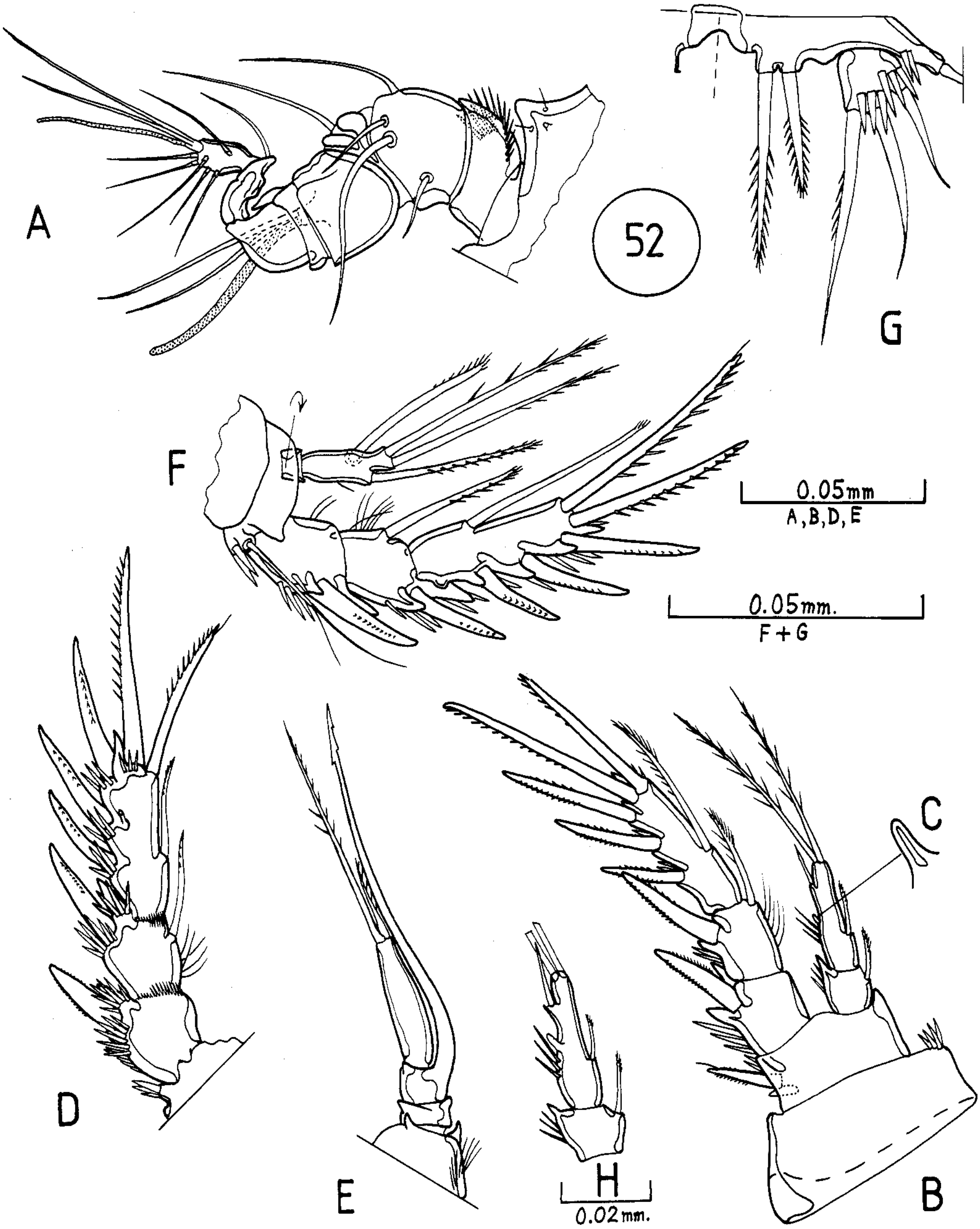


Fig. 52. *C. clavifurcatus*, allotype male. *A*, A1; *B*, P2; *C*, papilla on P2enp2 (see connecting line); *D*, P3exp; *E*, P3enp; *F*, P4; *G*, P5; *H*, other P2enp; *D*, *E*, *G*, and *H* in front view, *B* and *F* in rear view; *C* drawn freehand to no exact scale.

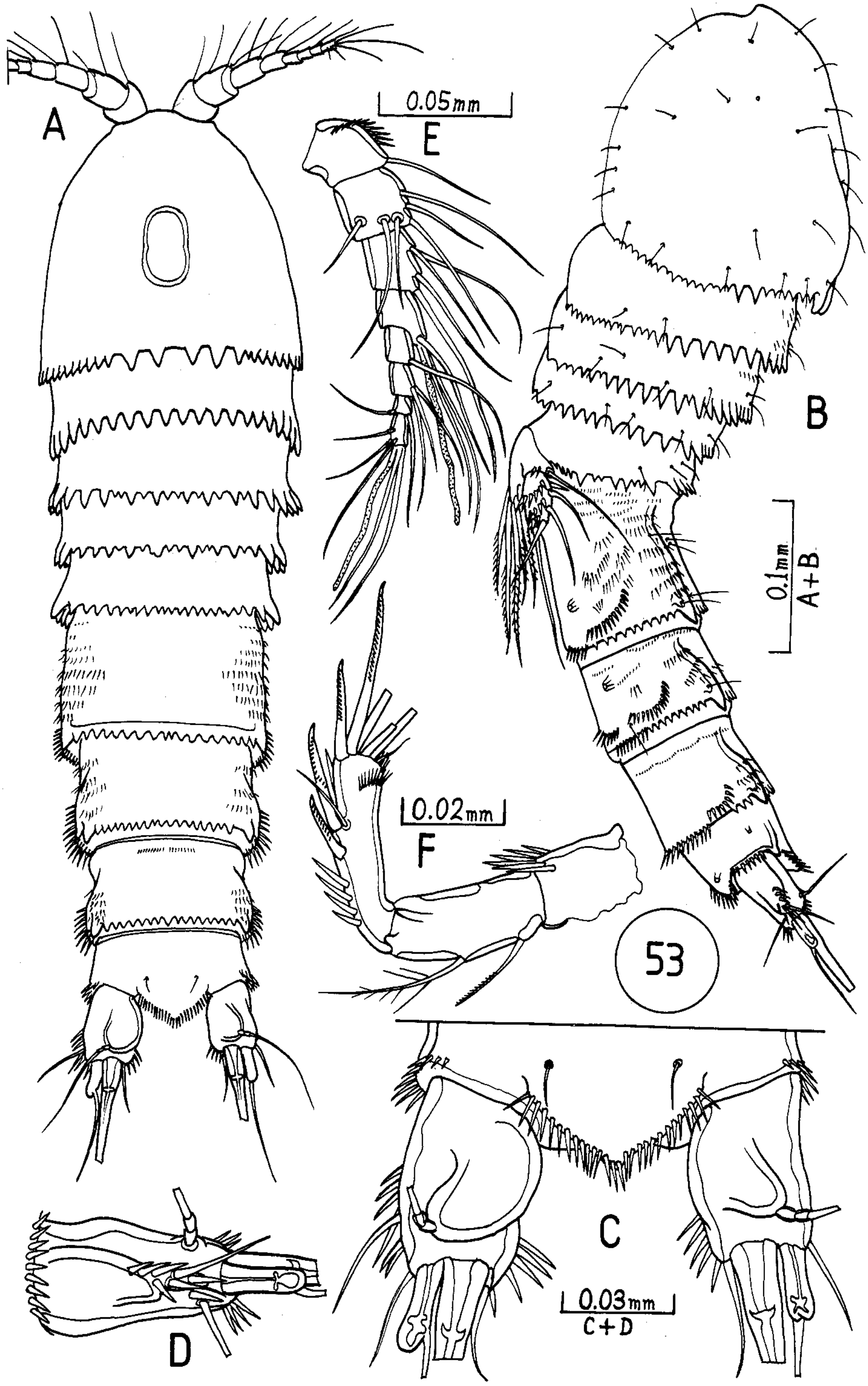


Fig. 53. *C. caecosetosus*, female holotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, dorsal view of op+FRs; *D*, side view of left FR; *E*, A1; *F*, abexp view of A2.

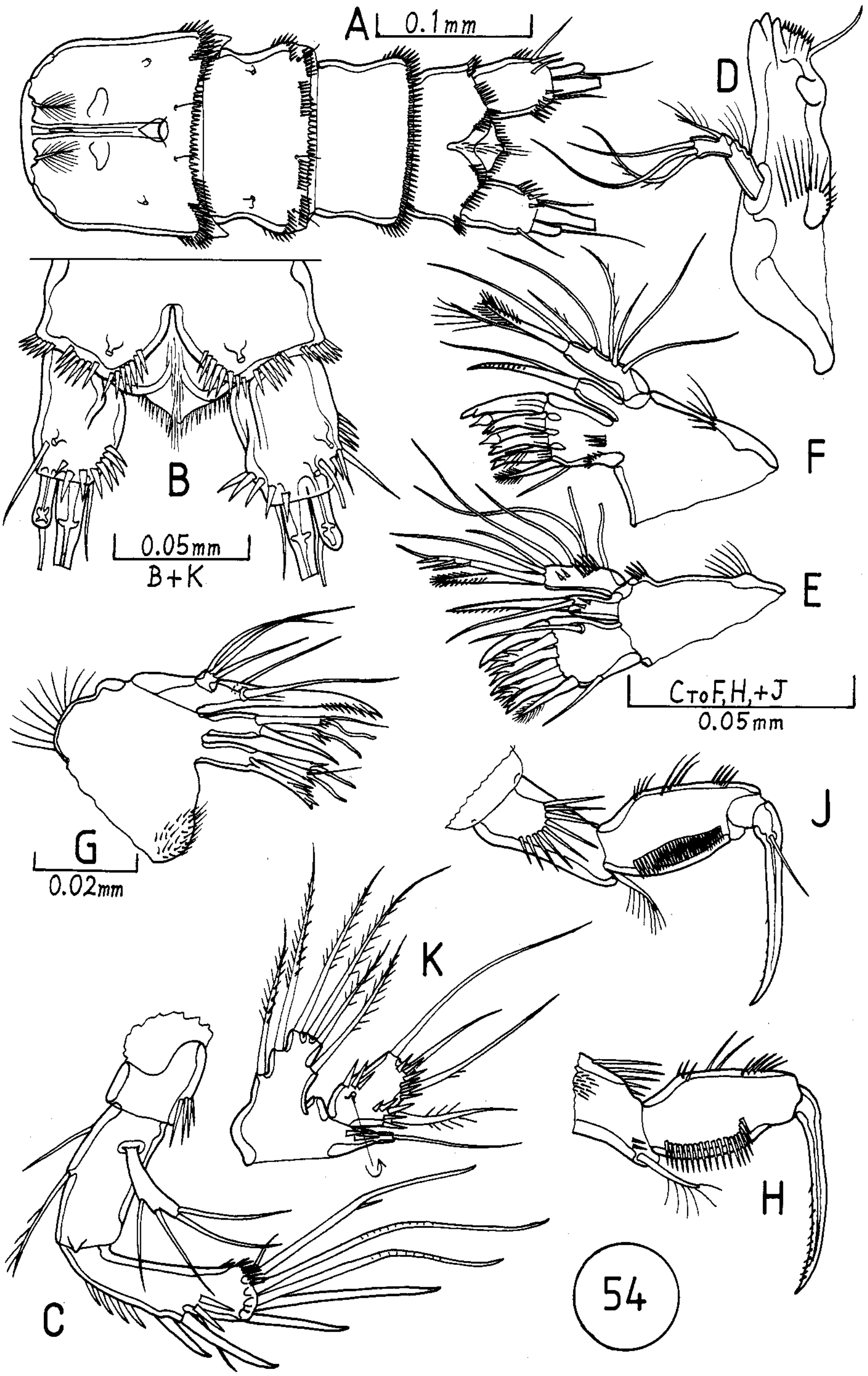


Fig. 54. *C. caecosetosus*, female; *H* and *J* from paratype 2, the remainder from the holotype. *A*, ventral view of Abd; *B*, ventral view of subanal sinus and FRs; *C*, exop view of A2; *D*, Md; *E*, rear, and *F*, front, views of Mx1; *G*, rear view of Mx2; *H*, front, and *J*, rear, views of Mxp; *K*, P5.

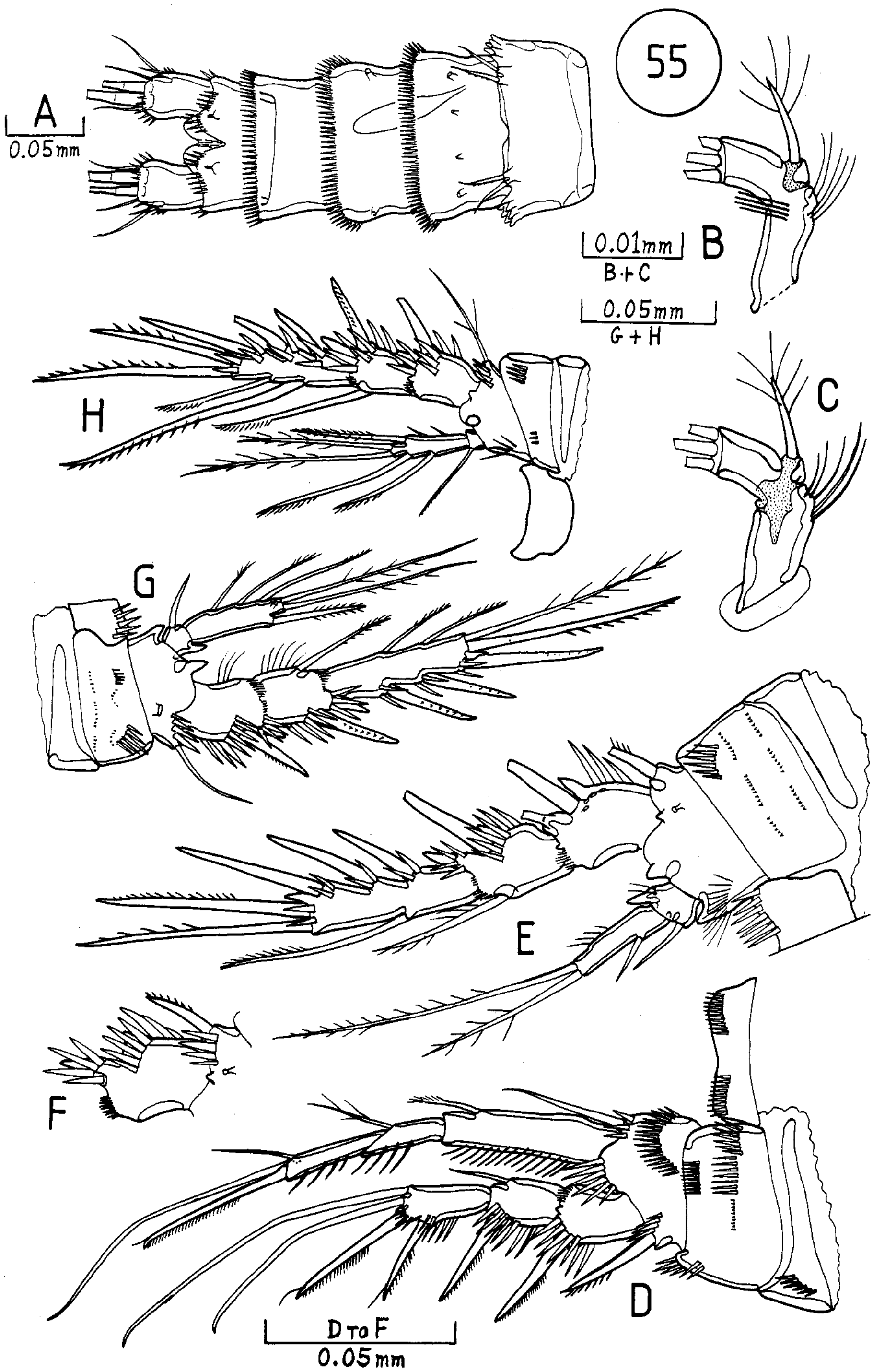


Fig. 55. *C. caecosetosus*; *A* from the allotype male, all the others from the female paratype 1. *A*, ventral view of Abd including P6; *B*, front, and *C*, rear, views of Md palp; *D*, P1; *E*, P2; *F*, complete outer-edge spinulation of basis and exp1 of the other P2 (drawn because these spinules are mostly abraded in *E*); *G*, P3; *H*, P4. See p. 1067 for stippling in *B* and *C*.

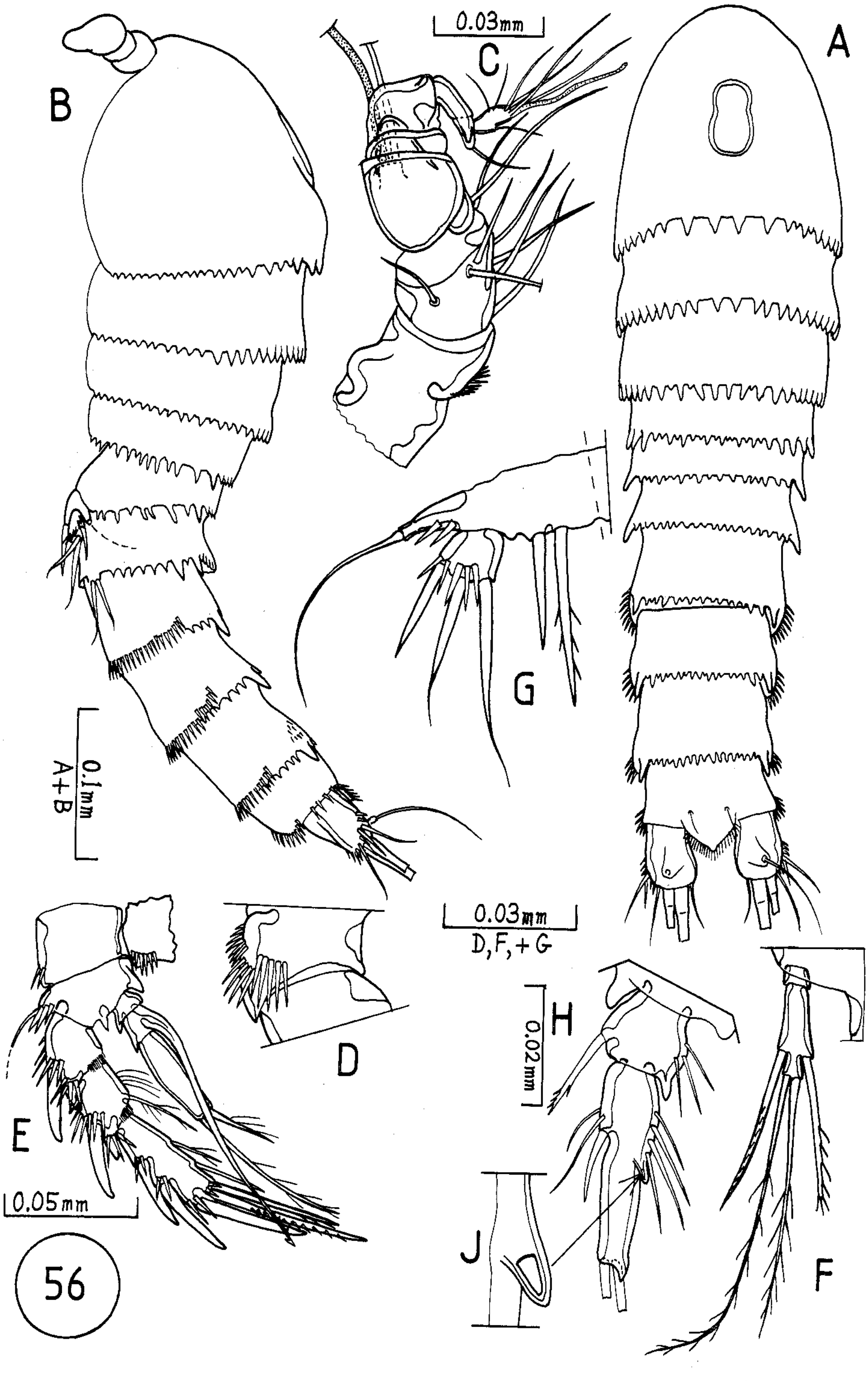


Fig. 56. *C. caecosetosus*, allotype male. *A*, dorsal, and *B*, side, views of entire animal; *C*, A1 (the offset terminal seg added from paratype A); *D*, distal part of A1seg1 to show the arrangement of the spinules in 3 combs; *E*, P3; *F*, P4enp; *G*, P5; *H*, P2enp to show papilla; *J*, papilla enlarged freehand, to no exact scale.

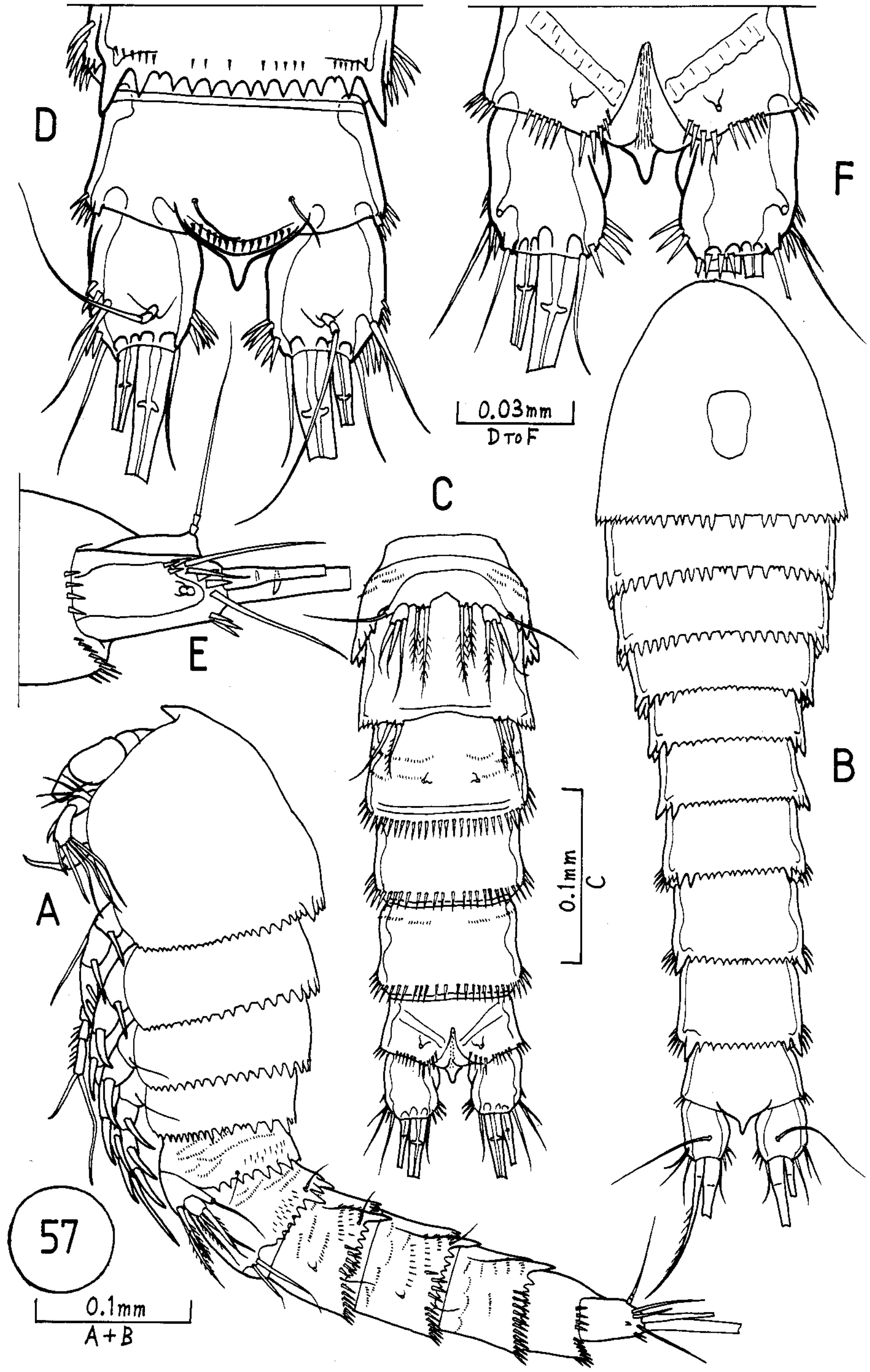


Fig. 57. *Canthocamptus* sp. 1, male. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd with P5 and P6; *D*, dorsal view of op with FRs; *E*, left-side view of FR; *F*, ventral view of subanal sinus with FRs.

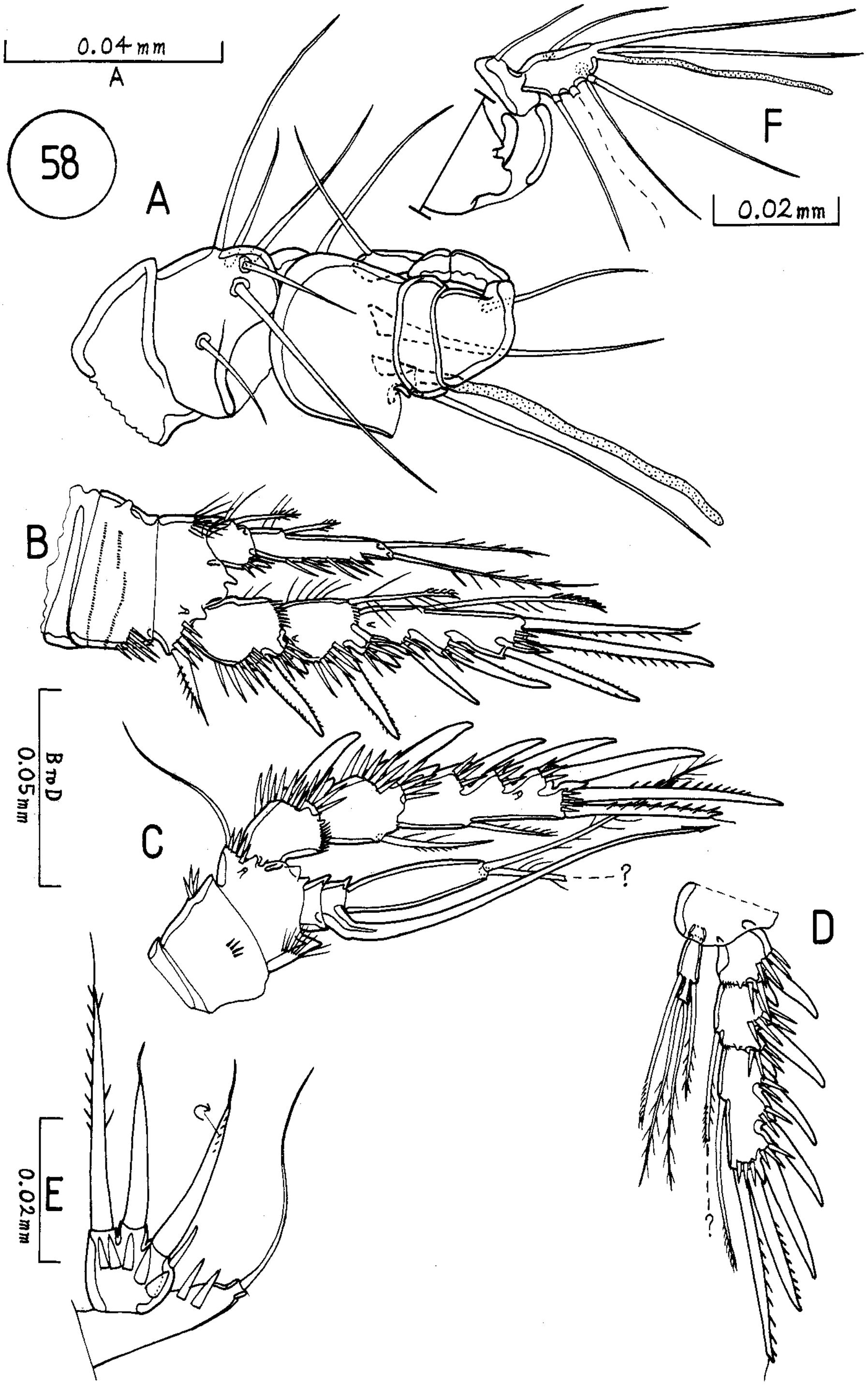


Fig. 58. *Canthocamptus* sp. 1, male. *A*, A1; *B*, P2; *C*, P3; *D*, P4; *E*, P5; *F*, terminal part of A1 redrawn after it had partly uncurled so as to settle lying flat.

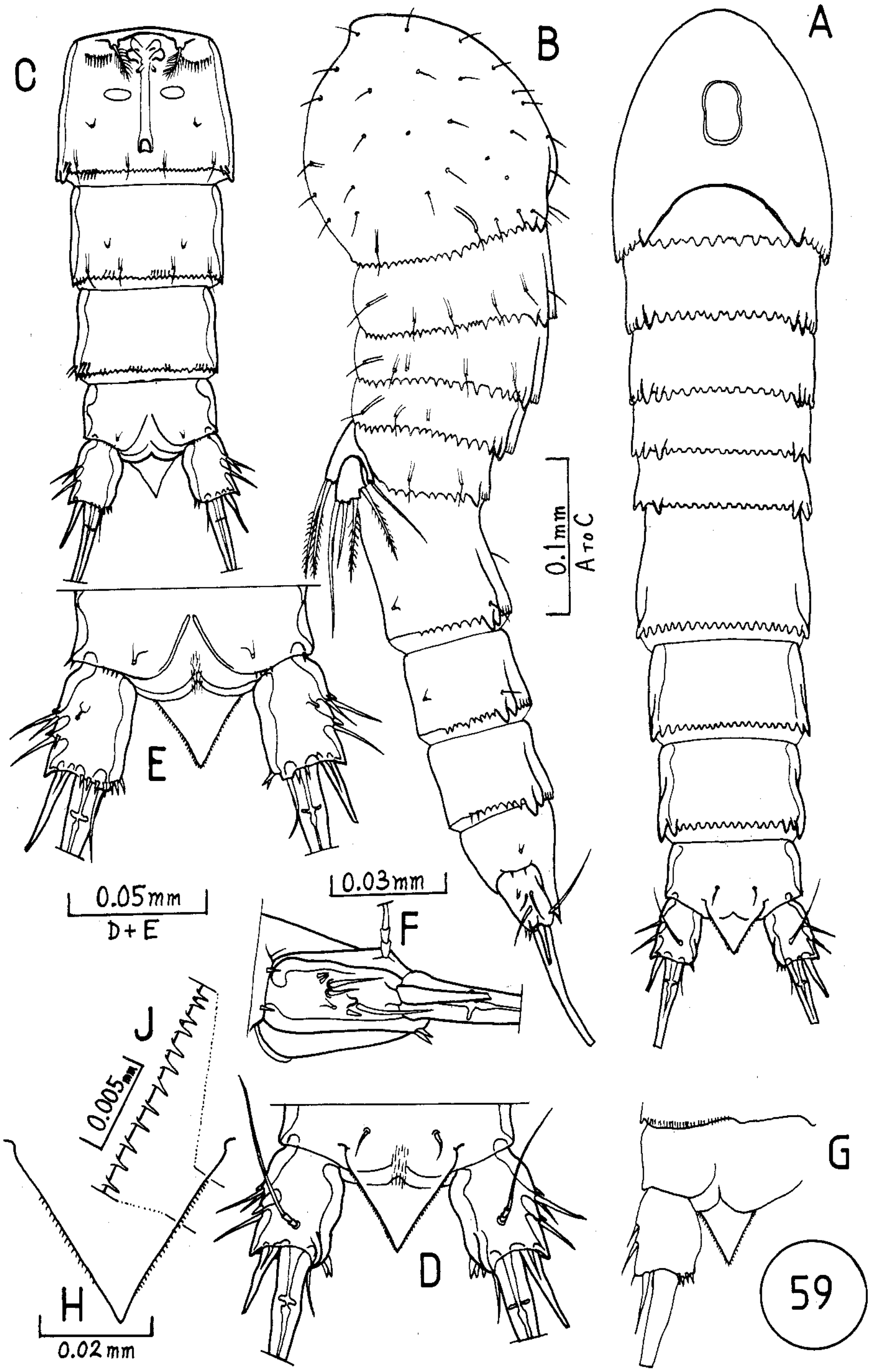


Fig. 59. *C. tasmaniae*, female neoholotype. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D*, dorsal, and *E*, ventral, views of op with FRs; *G*, as for *E* but copied from fig. 20 of Chappuis (1951); *F*, side view of left-hand FR; *H*, whole op; *J*, the part of the op edge indicated in *H*, magnified still more to show how the denticles arise somewhat dorsal to the edge rather than exactly on it.

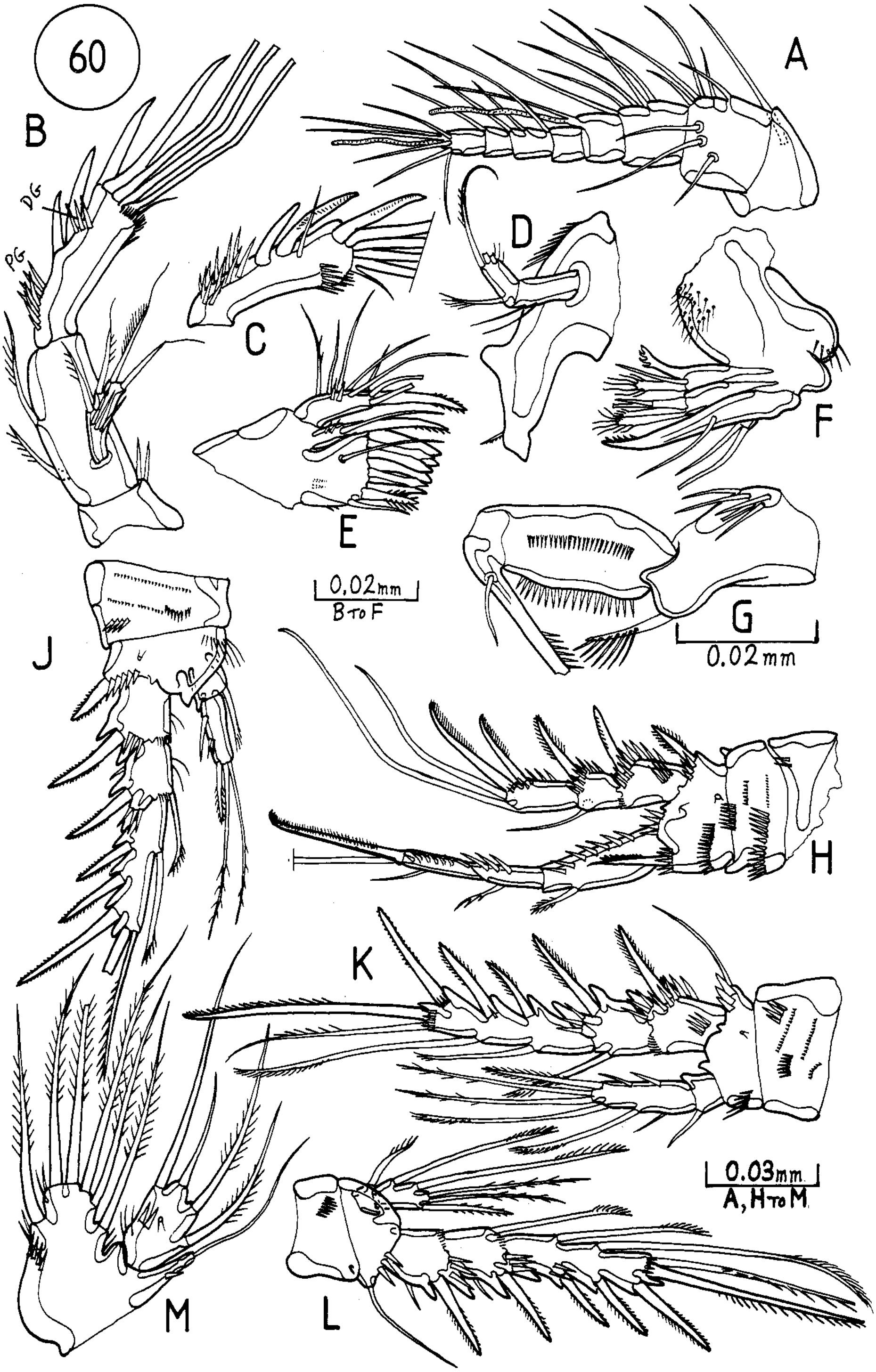


Fig. 60. *C. tasmaniae*, female neoholotype. *A*, A1; *B*, exop view of A2; *C*, abexp view of A2enp; *D*, Md; *E*, Mx1; *F*, Mx2; *G*, Mxp; *H-M*, P1–P5 in that order. *D-M* in front view, except *E* and *G* which are in rear view.

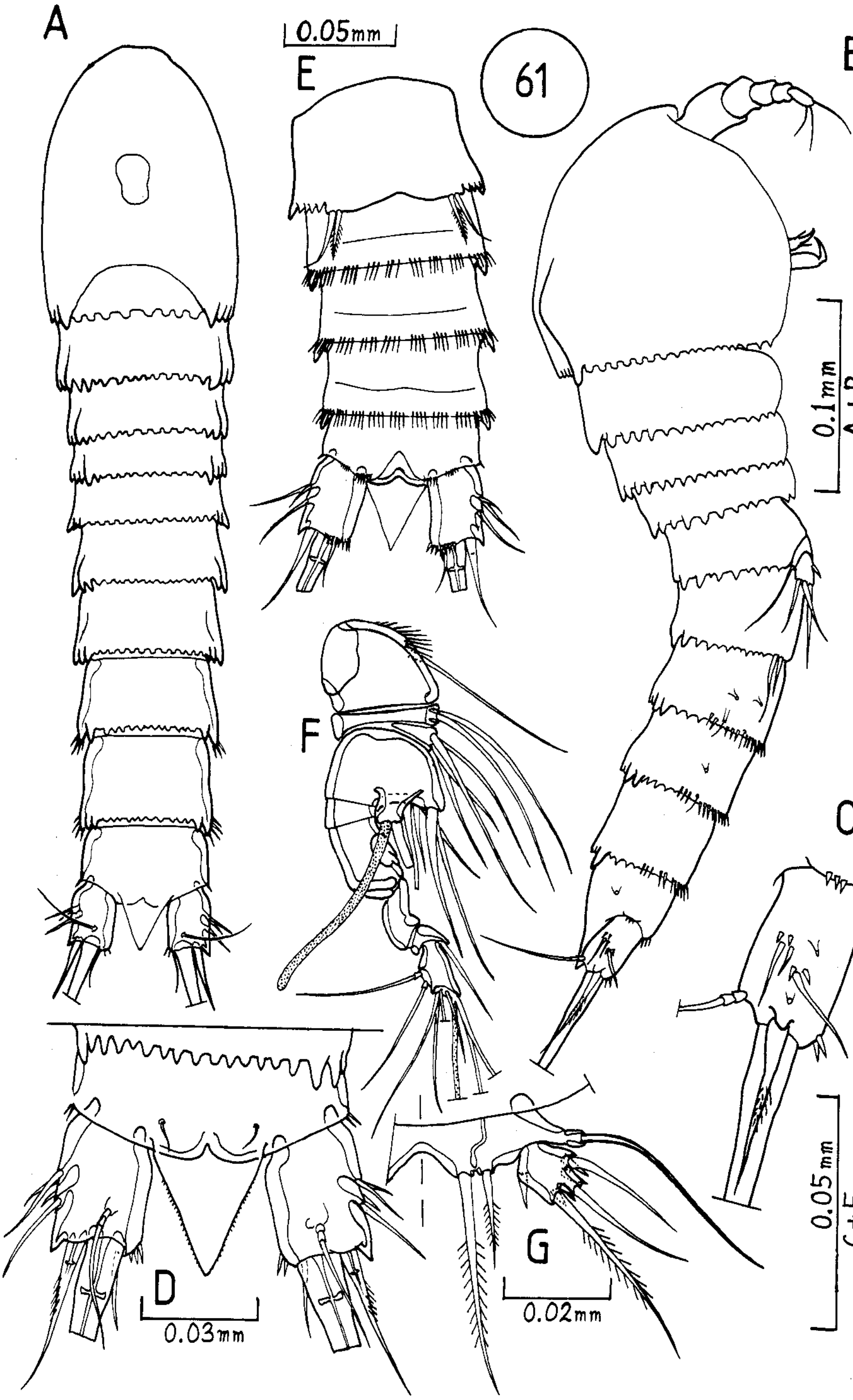


Fig. 61. *C. tasmaniae*, males; *A–D*, paratype A (lost soon after these drawings were made); *E–G*, allotype. *A*, dorsal, and *B*, side, views of entire animal; *C*, side view of FR; *D*, dorsal view of op and FRs; *E*, ventral view of Abd including P6; *F*, A1; *G*, P5; *D*, *E*, and *G* have own scales.

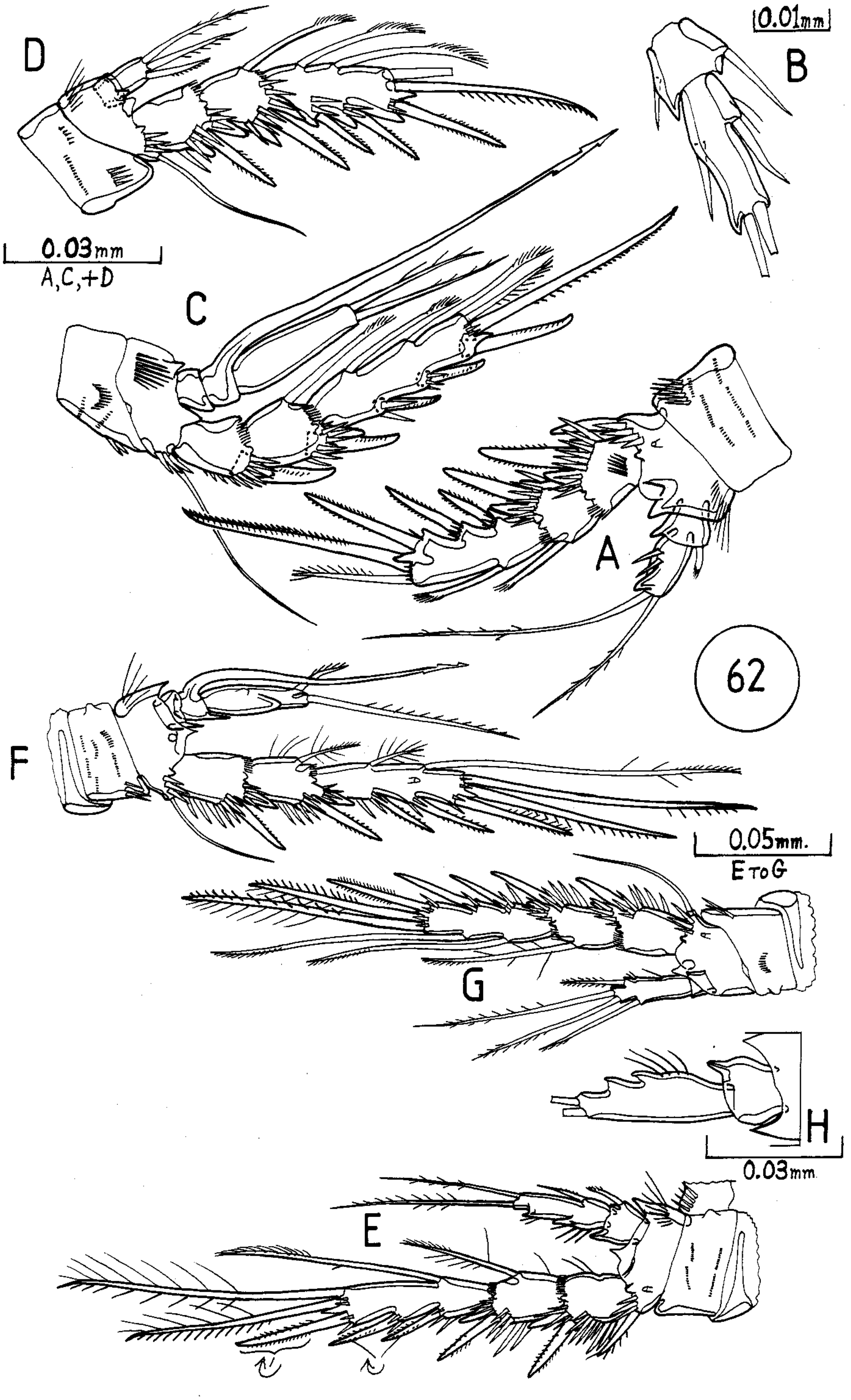


Fig. 62. *A–D*, *C. tasmaniae*, allotype male. *A*, P2; *B*, enp of other P2 (with own scale); *C*, P3; *D*, P4. *E–H*, *C. dedeckkeri*, allotype male. *E*, P2; *F*, P3; *G*, P4; *H*, enp of other P2 (with own scale).

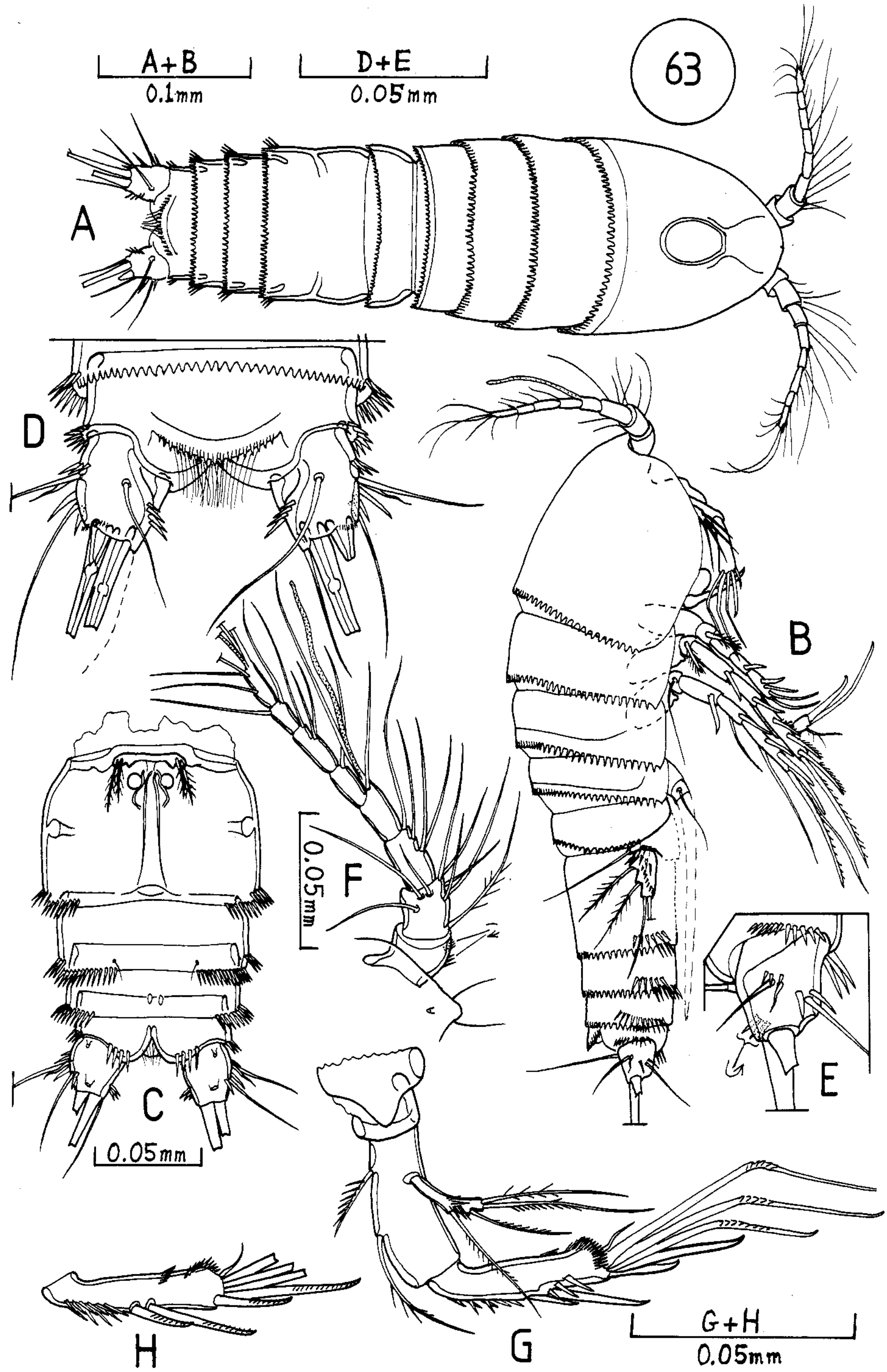


Fig. 63. *C. longipes*, holotype female. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D*, dorsal view of Abd5 with SRE9, op, and FRs; *E*, right-hand FR in side view (cf. *B*); *F*, A1; *G*, A2; *H*, abexp view of A2enp.

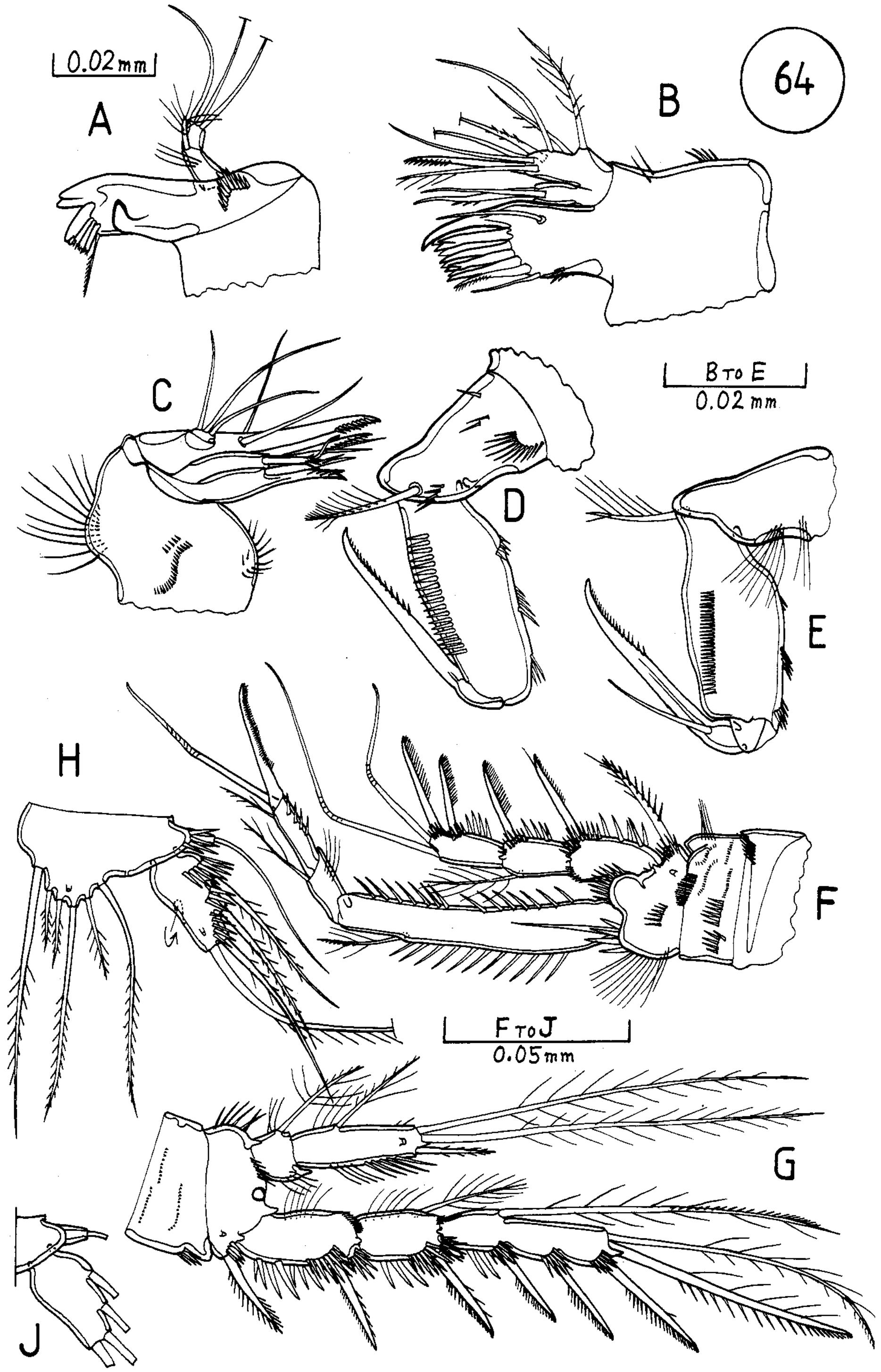


Fig. 64. *C. longipes*, holotype female. *A*, Md; *B*, Mx1; *C*, Mx2; *D* and *E*, Mxp; *F*, P1; *G*, P2; *H*, P5; *J*, outline of P5exp from *H*. *A* has own scale; *A-C* and *E* in rear view, the others in front view.

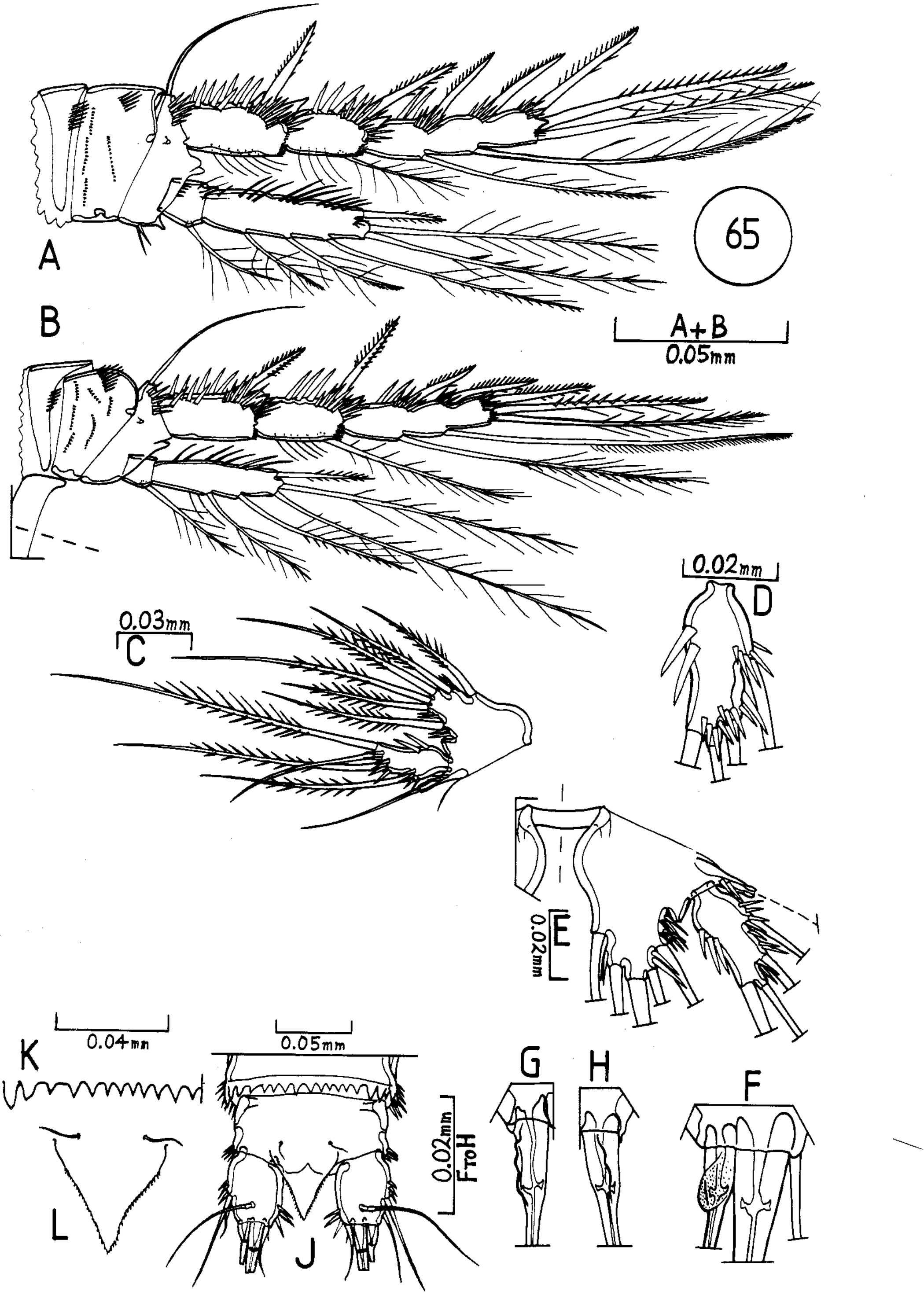


Fig. 65. *A* and *B*, *C. longipes*, holotype female. *A*, P3; *B*, P4. *C–H*, *C. henryae*, female; *C–E*, P5 (cf. Figs 7*K* and 7*L*); *F–H*, dorsal view of FRseta5. *C* and *D* from holotype; *E* and *F* from paratype 2; *G* and *H* from paratype 3. *C–E* have own scales. *J–L*, *C. longifurca*, female, locality 23 on Map 6; *J*, SRE9 and SRE10 with FRs; *K*, SRE9, left half enlarged; *L*, op enlarged.

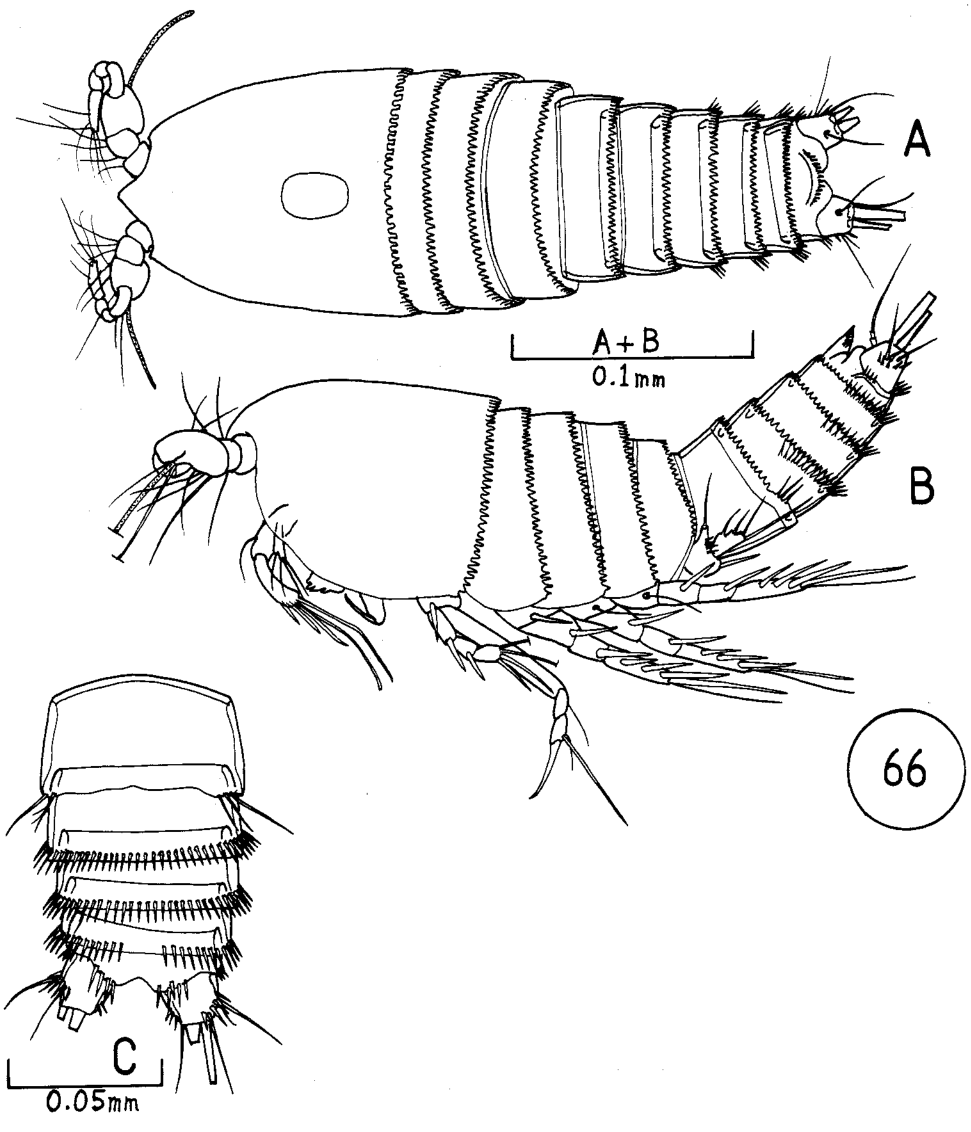


Fig. 66. *C. longipes*, allotype male (lost immediately after these figures had been drawn). *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd including ped6.

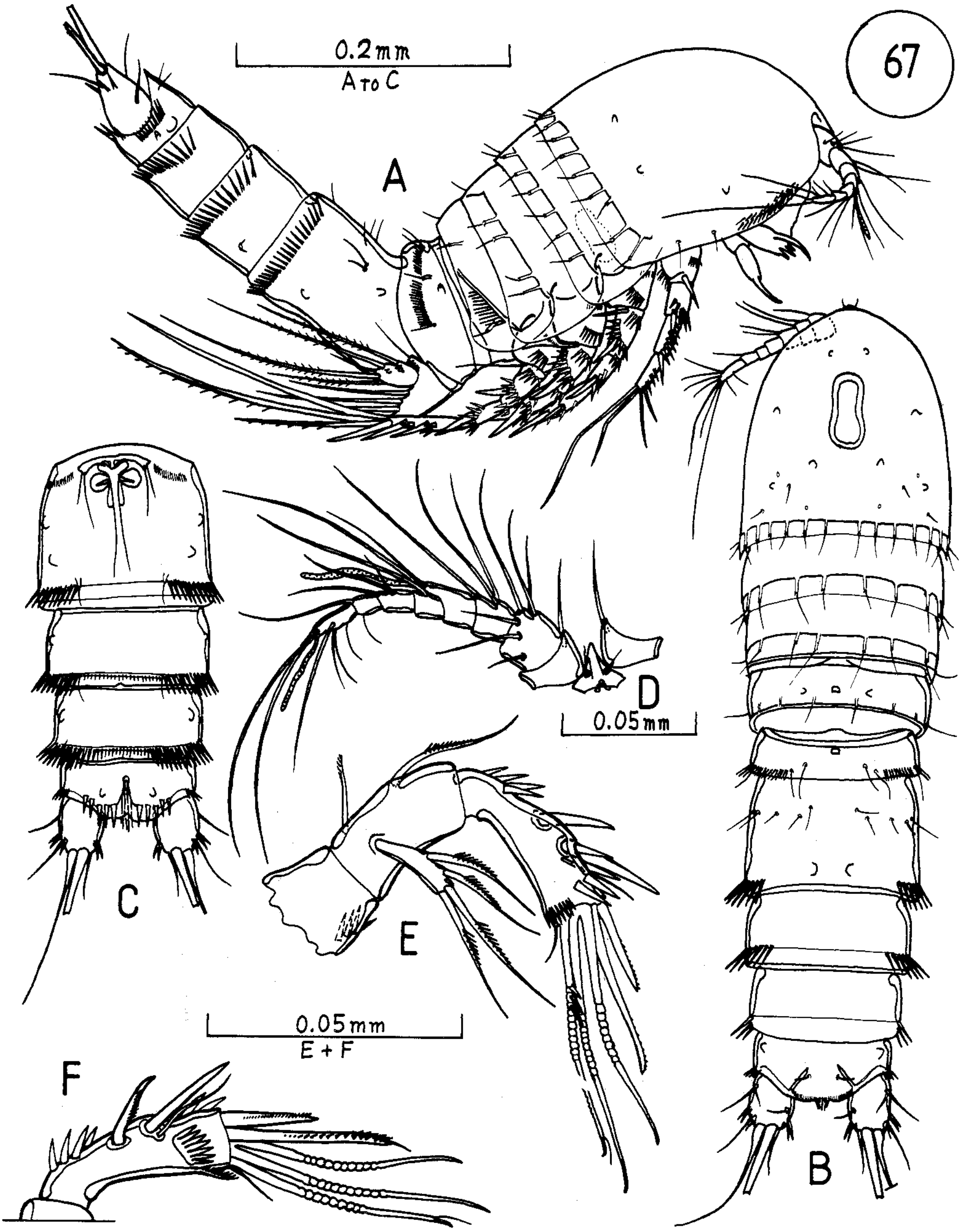


Fig. 67. *C. hirsutus*, female neoholotype. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, R and A1; *E*, exop view of entire A2; *F*, abexp view of A2enp. From Guide River Falls, Tasmania.

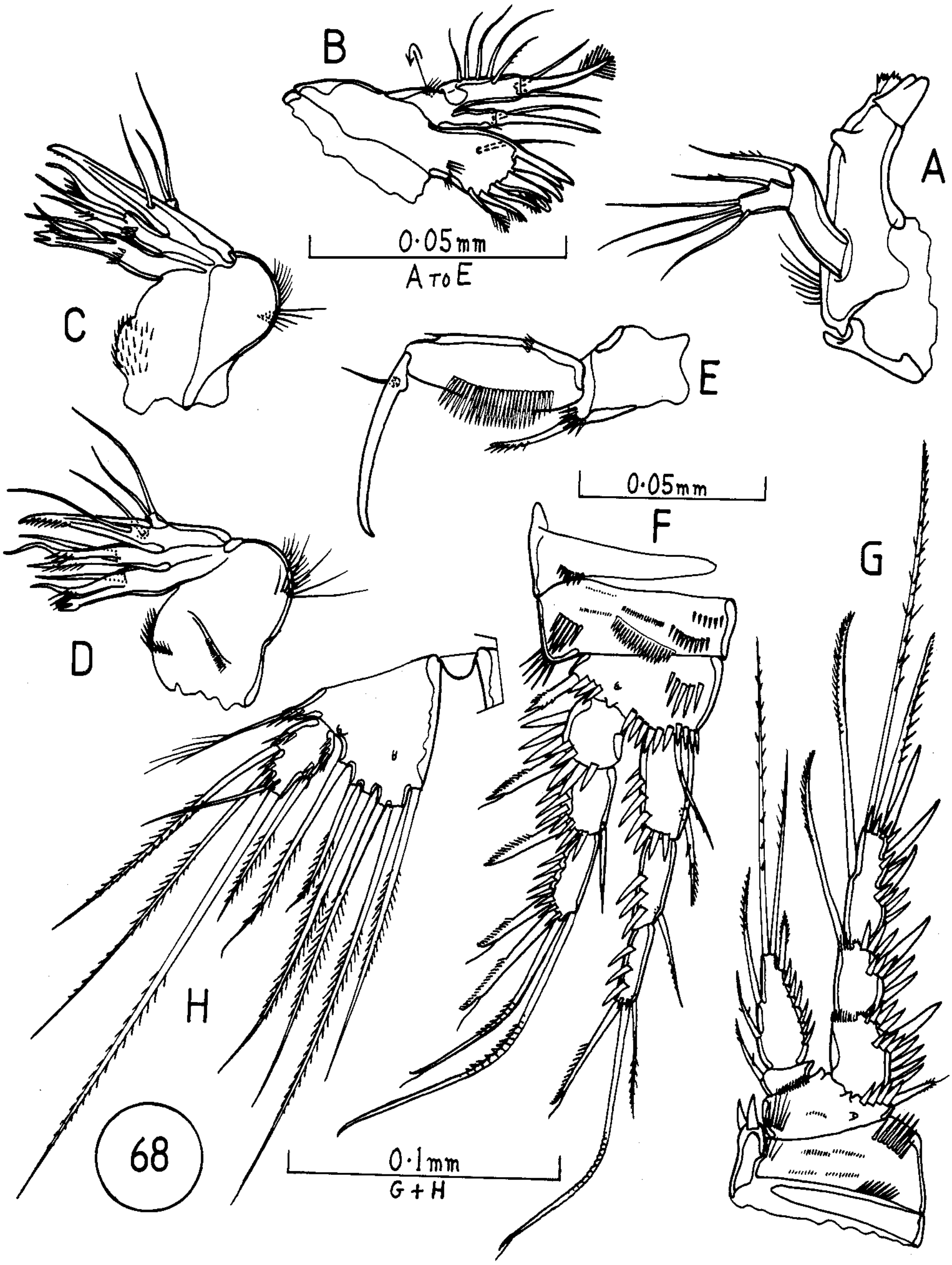


Fig. 68. *C. hirsutus*, neoholotype female; *D* in rear view, the others in front view. *A*, Md; *B*, Mx1; *C* and *D*, Mx2; *E*, Mxp; *F*, P1; *G*, P2; *H*, P5. From Guide River Falls, Tasmania.

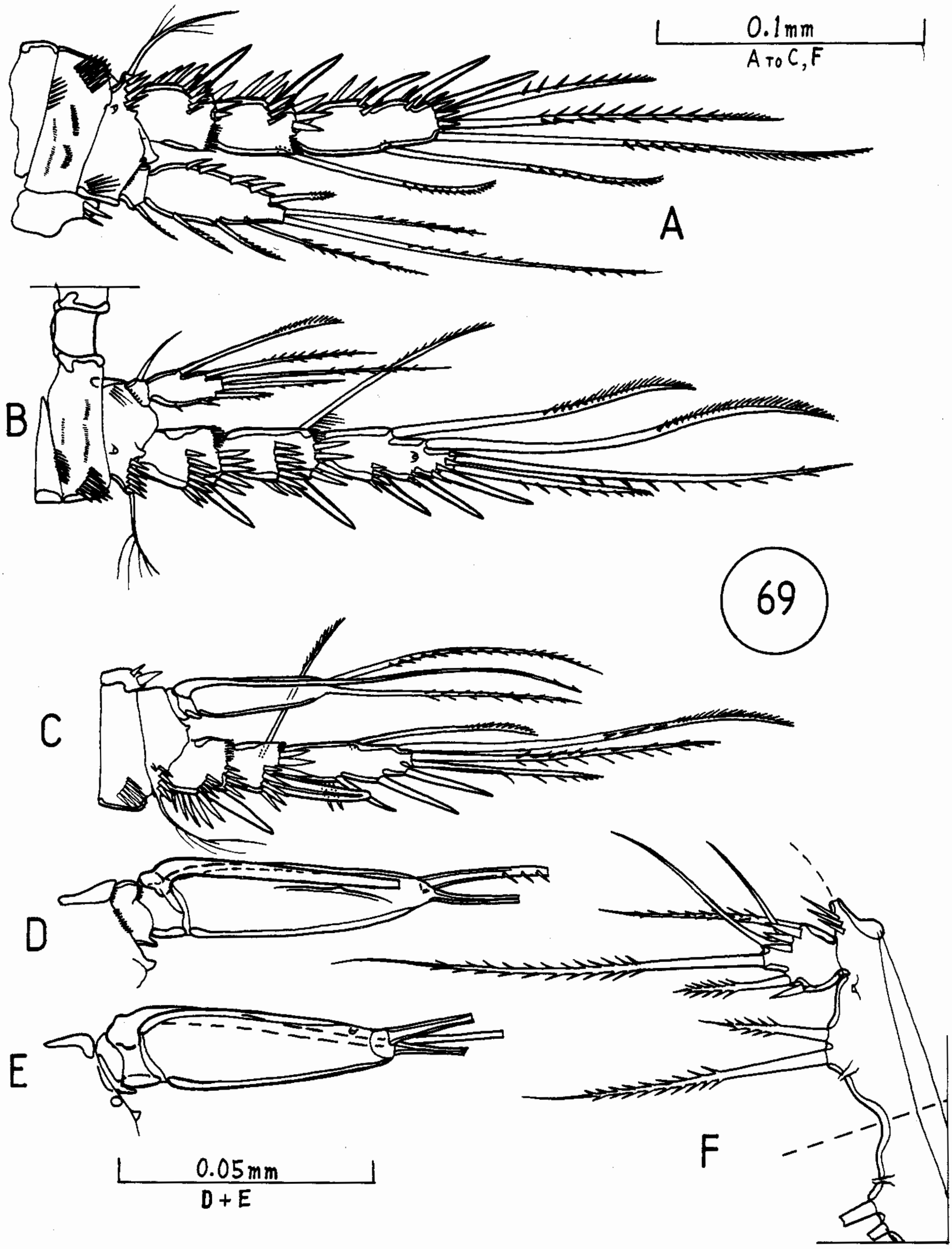


Fig. 69. *C. hirsutus*; *A* and *B*, female neoholotype, the others from the male neoallotype; *E* in rear view, the others in front view. *A* and *C*, P3; *B*, P4; *D* and *E*, P3enp (setae cut short); *F*, P5. From Guide River Falls, Tasmania.

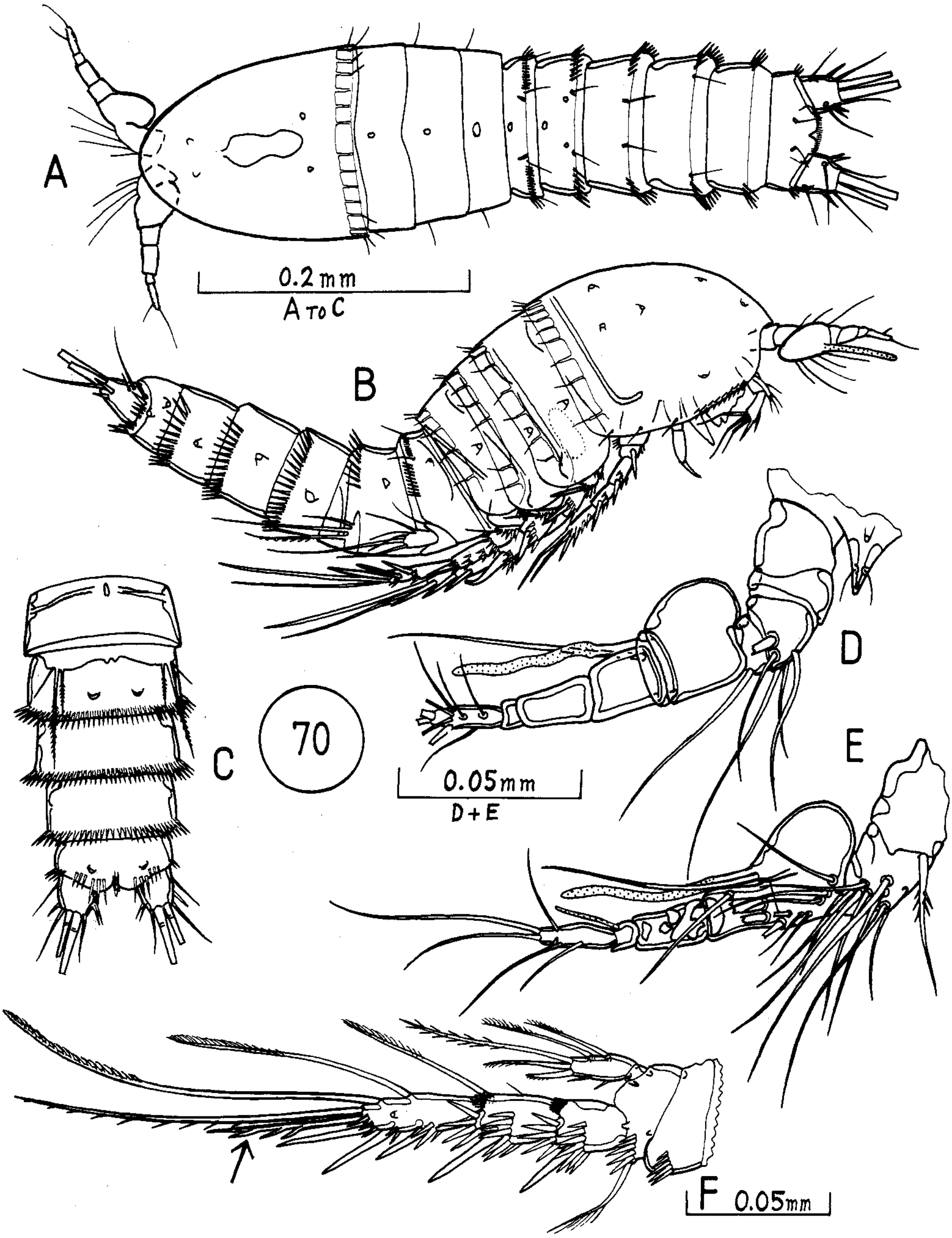


Fig. 70. *C. hirsutus*, male neoallotype. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D*, dorsal, and *E*, ventral, views of A1; *F*, P4. From Guide River Falls, Tasmania.

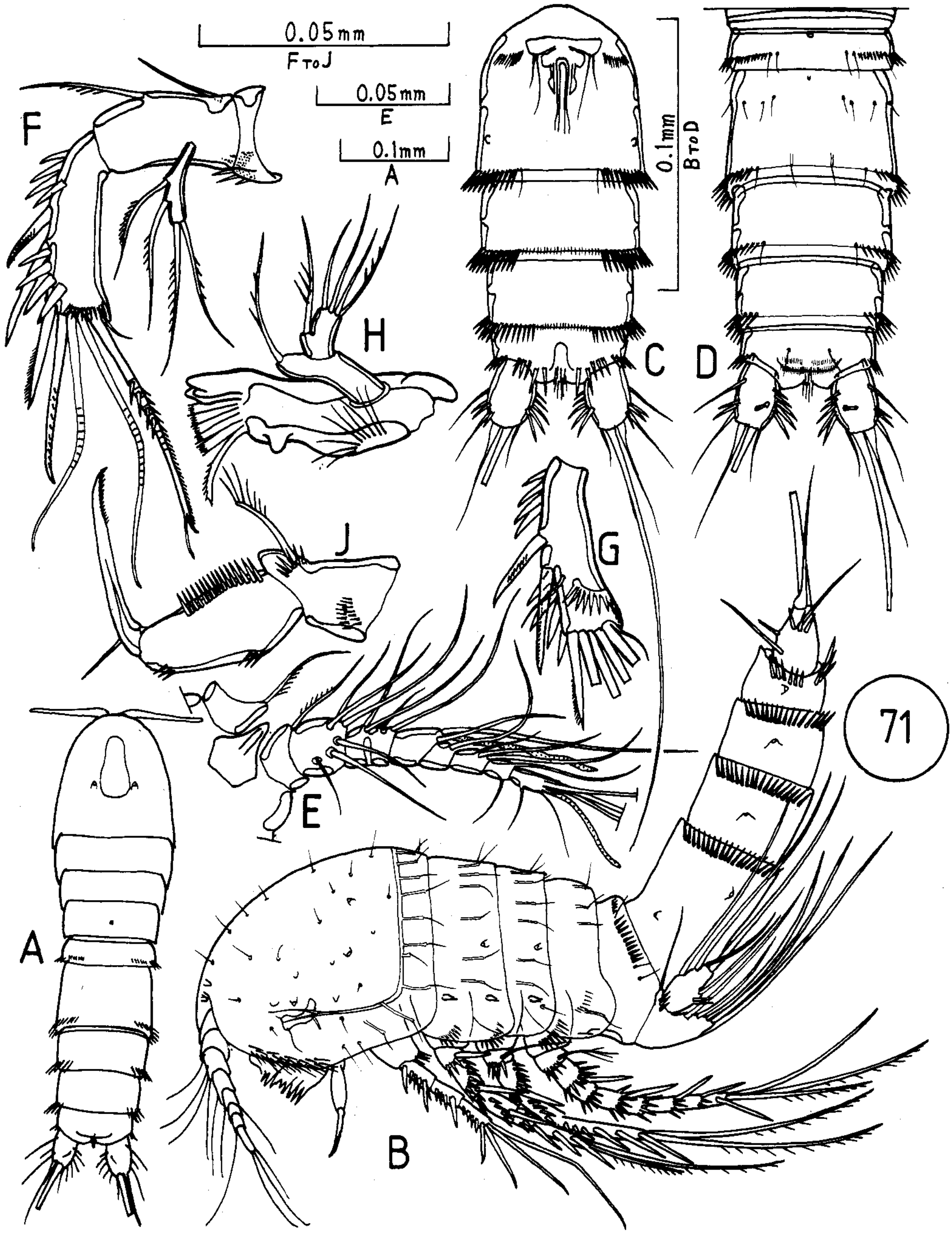


Fig. 71. *C. hirsutus*, female. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral, and *D*, dorsal, views of Abd; *E*, R and A1; *F*, A2 in exop view; *G*, abexp view of A2enp, with all setae cut short; *H*, Md; *J*, front view of Mxp. From Cora Lyn Falls, Victoria (see p. 1072, 'Variation').

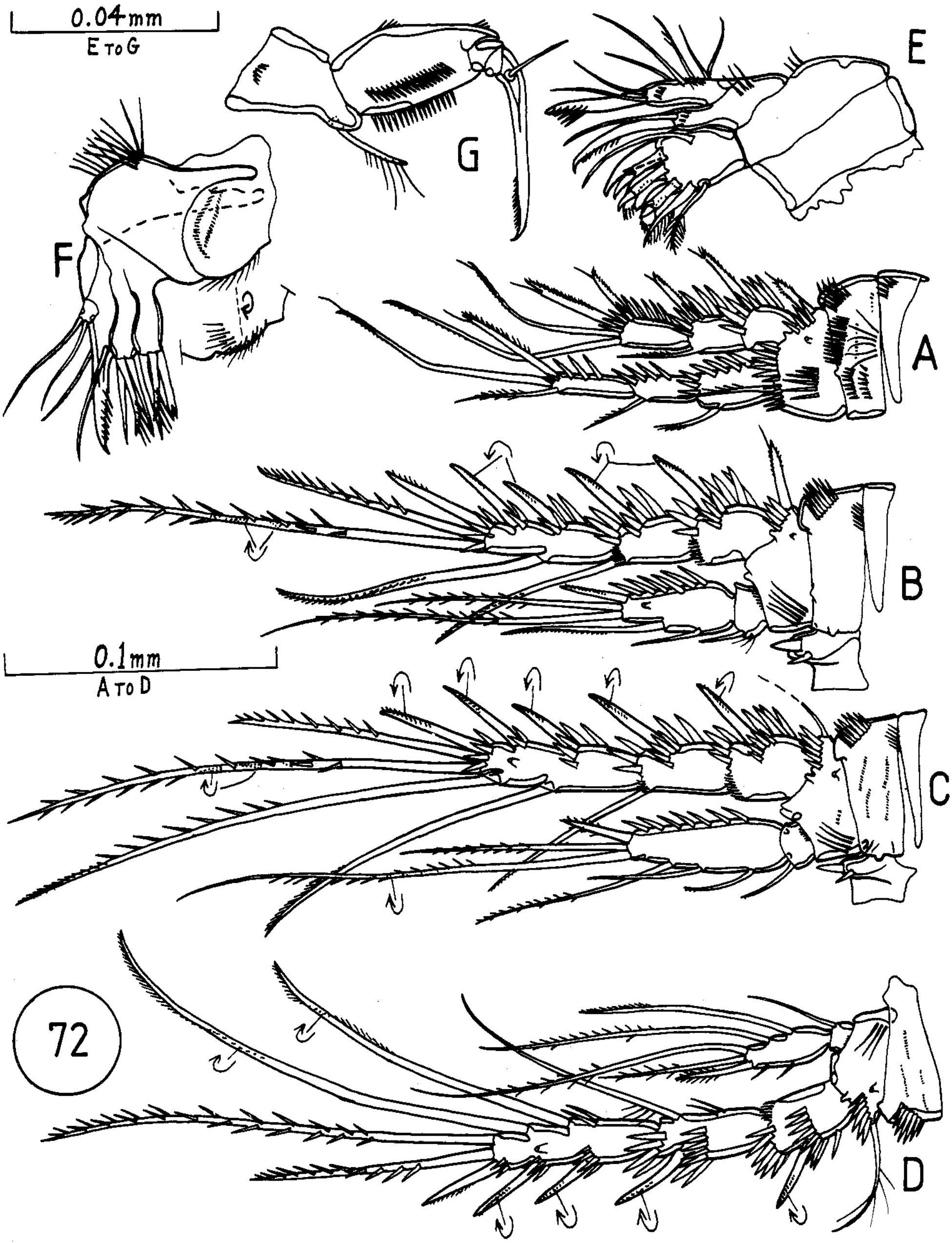


Fig. 72. *C. hirsutus*, female. *A*, P1; *B*, P2; *C*, P3; *D*, P4; *E*, Mx1; *F*, Mx2; *G*, Mxp; all in front view except *E–G* which are in rear view. From Cora Lyn Falls, Victoria (see p. 1072, 'Variation').

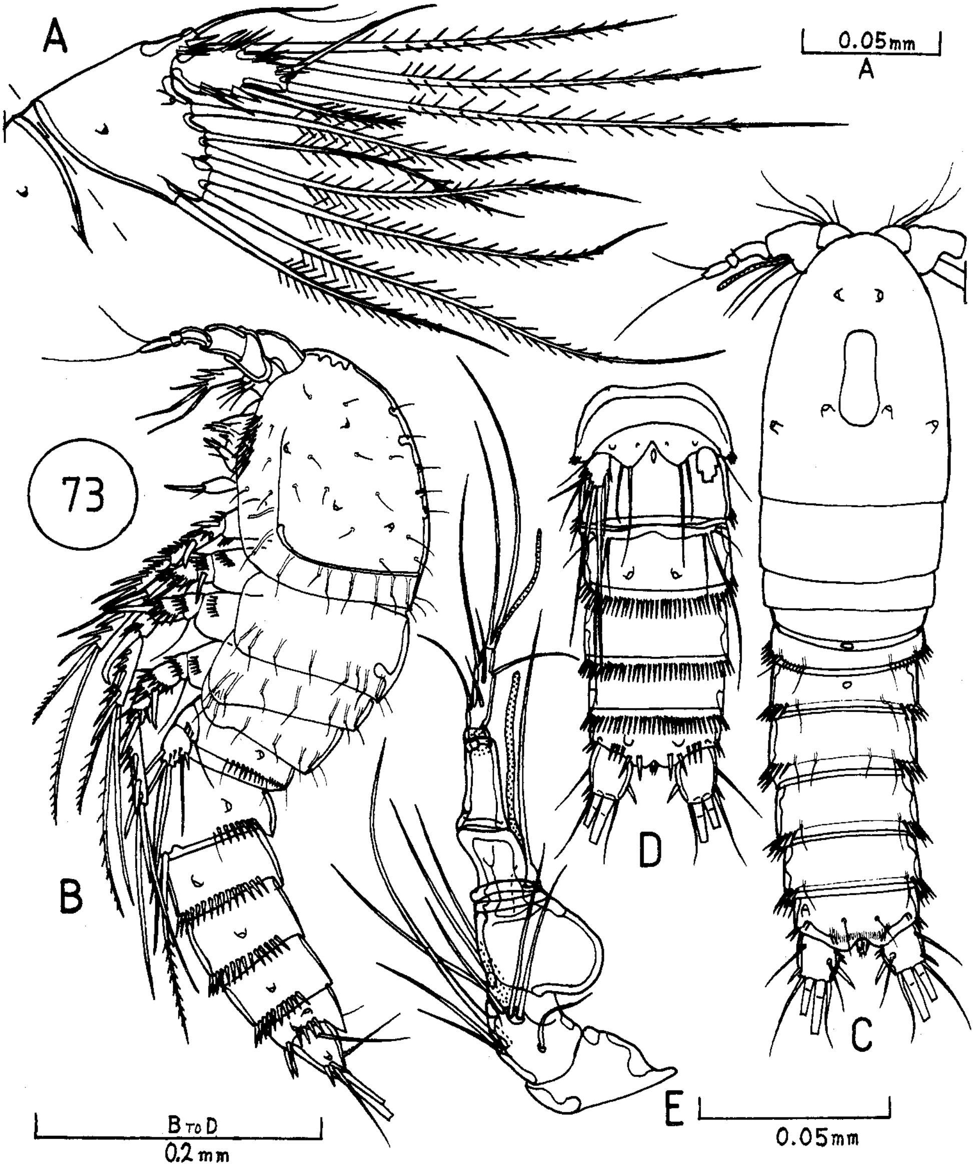


Fig. 73. *C. hirsutus*; *A*, female, the others male. *A*, P5; *B*, side, and *C*, dorsal, views of whole animal; *D*, ventral view of Abd with P5 and P6; *E*, A1 (with own scale). From Cora Lyn Falls, Victoria (see p. 1072, 'Variation').

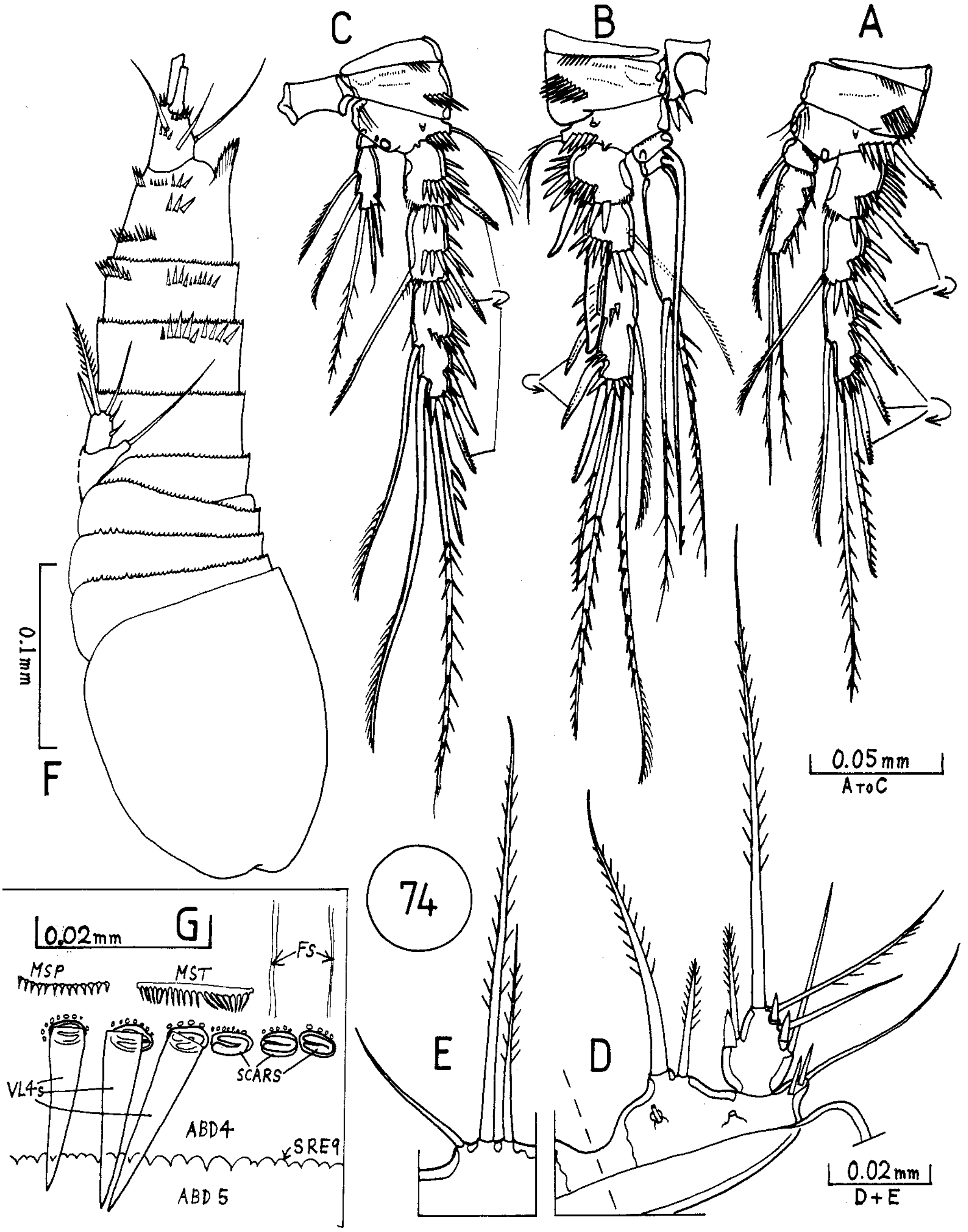


Fig. 74. *A–E*, *C. hirsutus*, male; *A*, P2; *B*, P3; *C*, P4; *D*, P5; *E*, P6; from Cora Lyn Falls, Victoria (see p. 1072, 'Variation'). *F* and *G*, *C. grandidieri*, female; *F*, entire subadult in side view; *G* (within the rectangle), integument of dorsal surface of Abd4 including the minutely denticulated SRE9, showing 2 faint furrows FS, a microcomb of microspinules MSP, and a microcomb of microsetules MST. Some of the ventrolateral spinules (VLs) have fallen off, leaving scars.

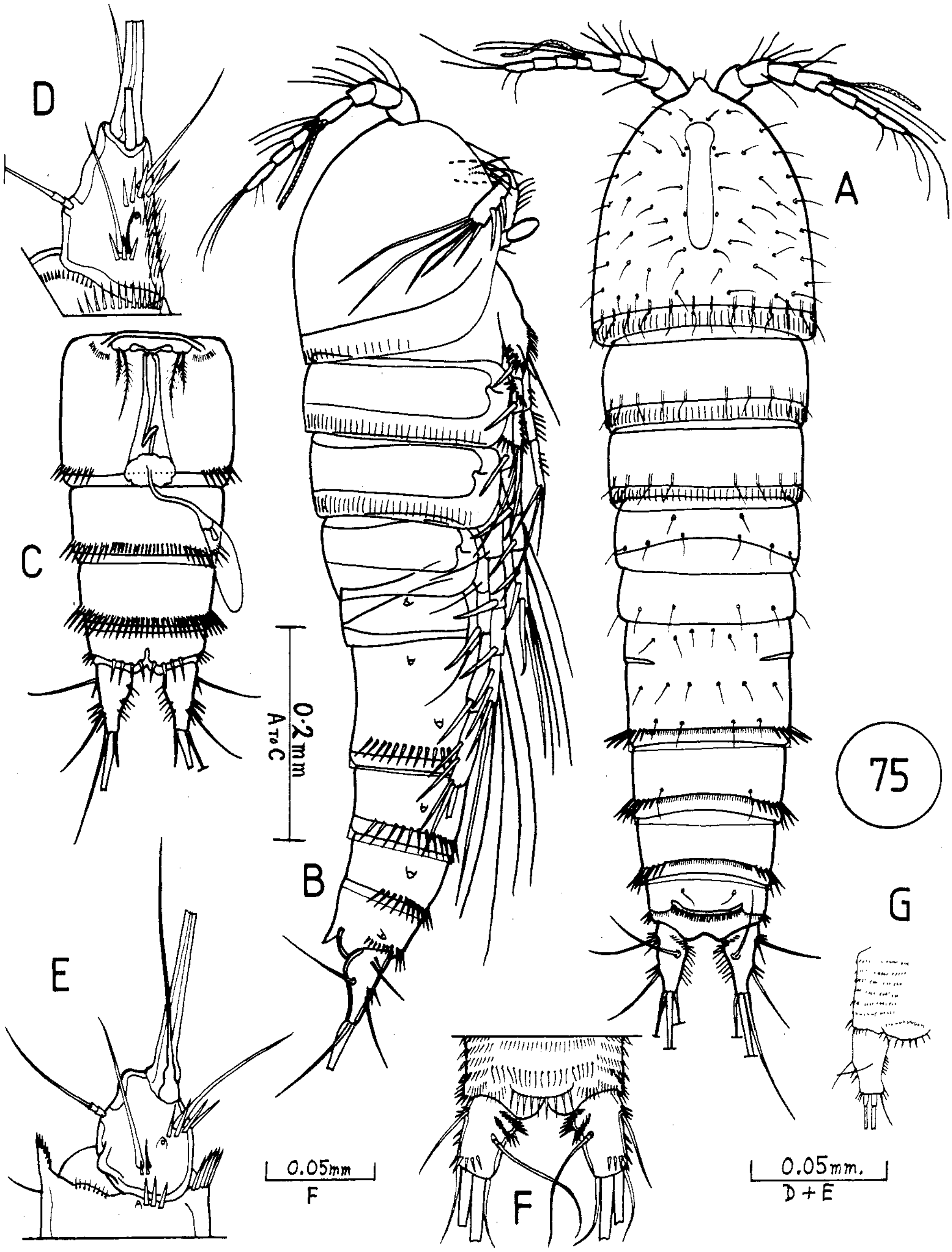


Fig. 75. *C. australicus*, female. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, normal FR; *E*, short-tailed FR; *F*, and *G*, op and FRs of subadults.

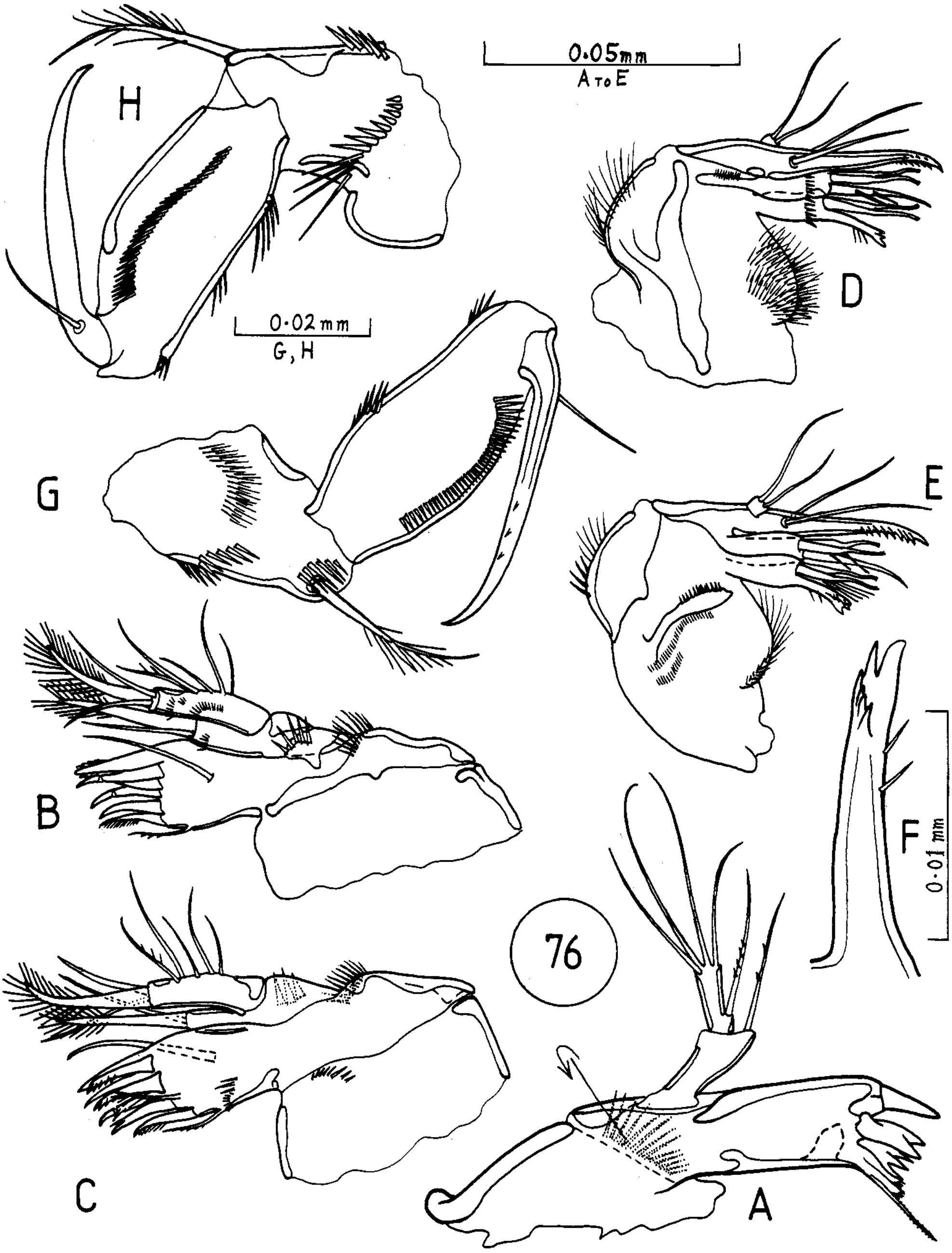


Fig. 76. *C. australicus*, female. *C*, *D*, and *G* in front view, the others in rear view. *A*, Md; *B* and *C*, Mx1; *D* and *E*, Mx2; *F*, thorn (=fused proximal seta) on proximal endite of Mx2, enlarged to show ornamentation; *G* and *H*, Mxp.

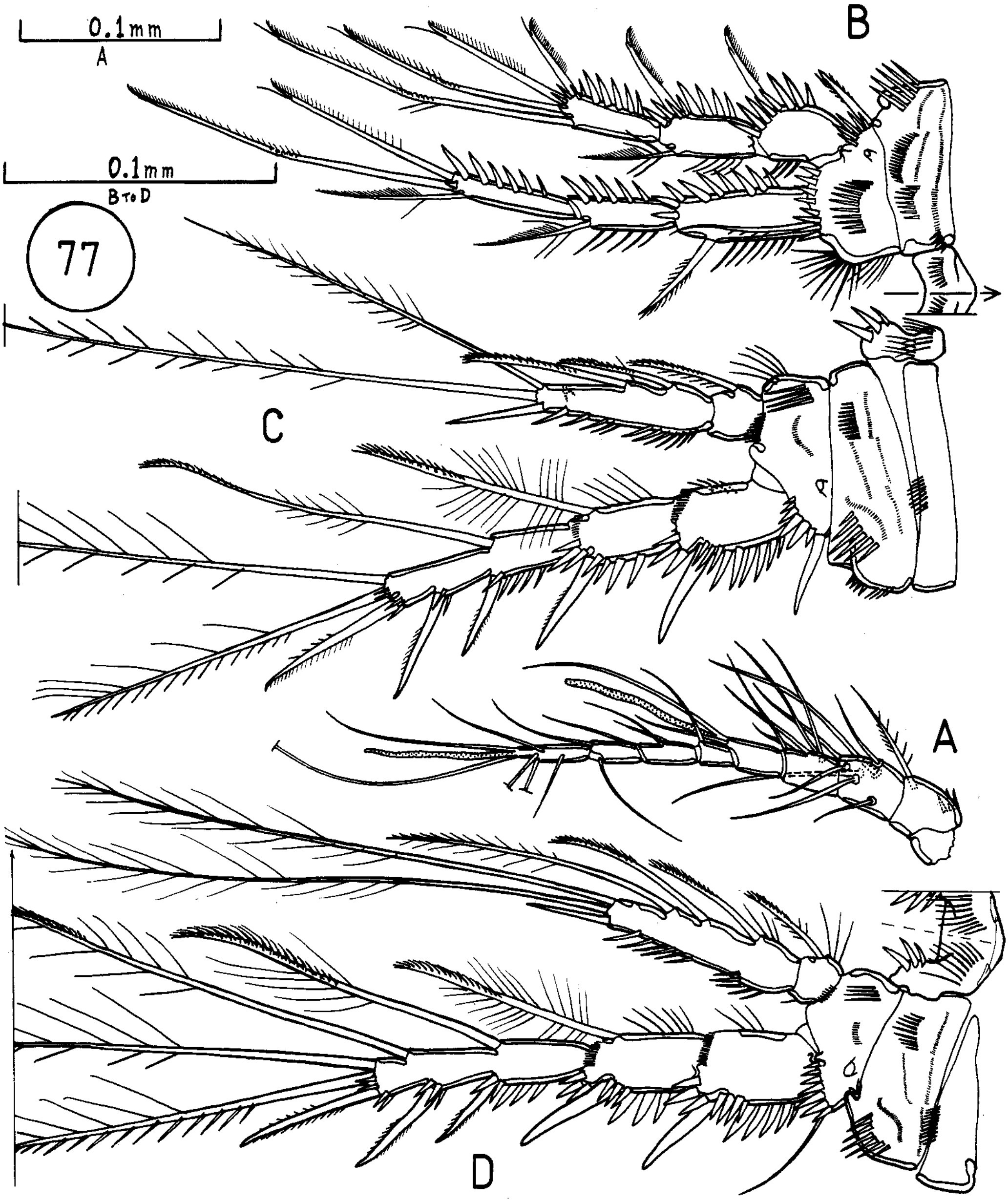


Fig. 77. *C. australicus*, female. *A*, A1; *B*, P1; *C*, P2; *D*, P3.

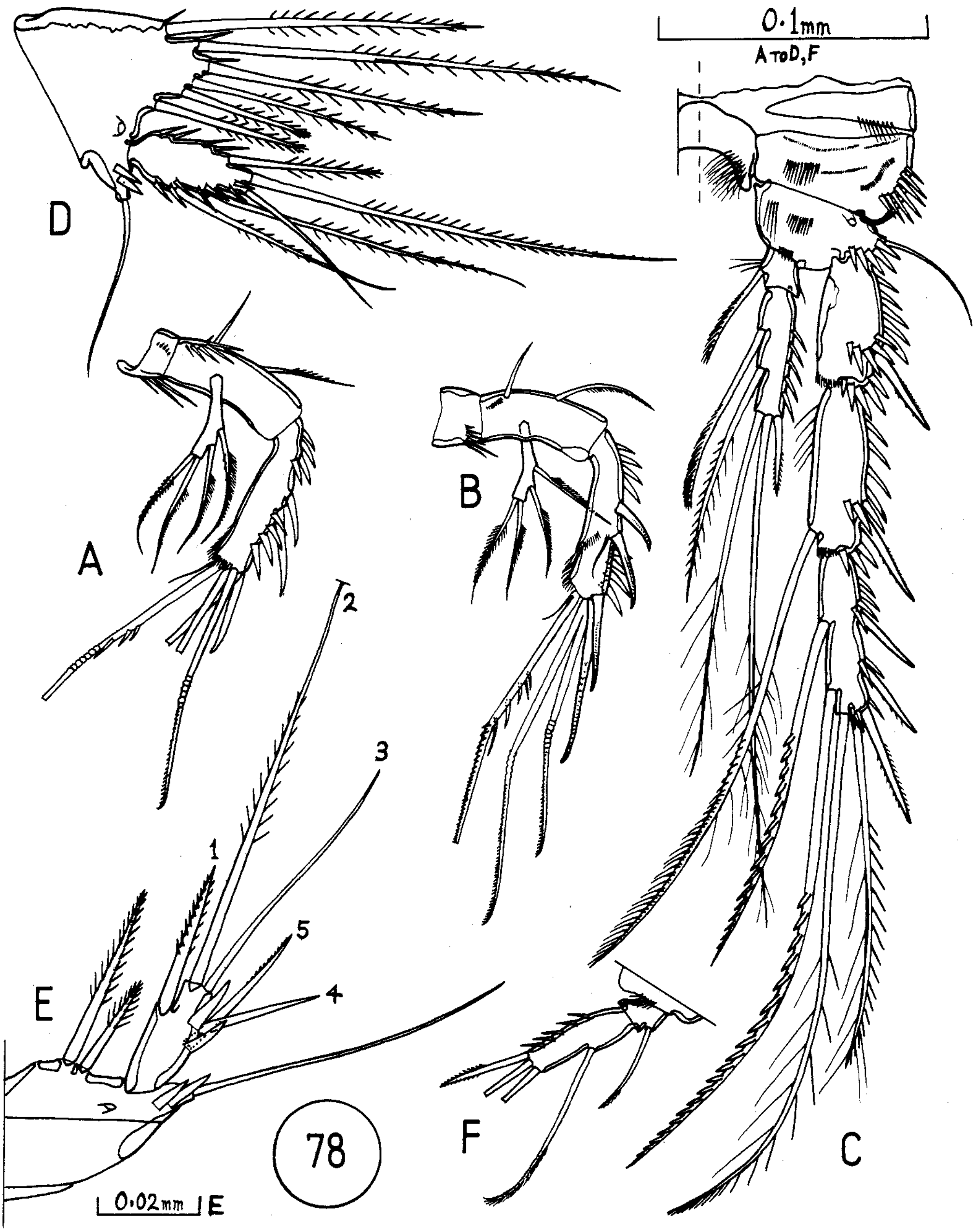


Fig. 78. *C. australicus*; *E*, male, the rest female. *A*, exop, and *B*, abexp, views of A2; *C*, P4; *D* and *E*, P5; *F*, abnormal P4enp.

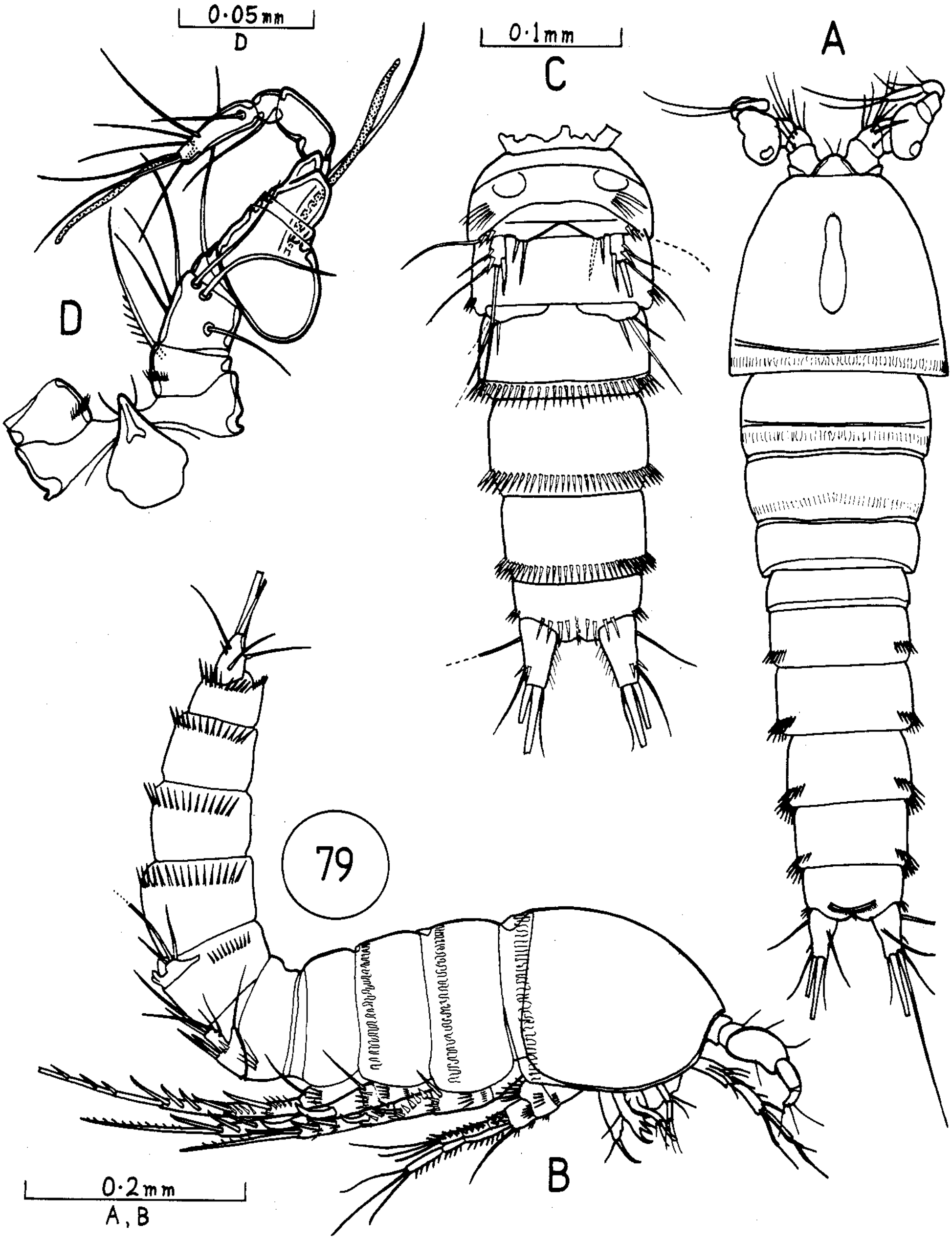


Fig. 79. *C. australicus*, male. *A*, dorsal, and *B*, side, views of entire animal; *C*, ventral view of Abd; *D*, R and A1.

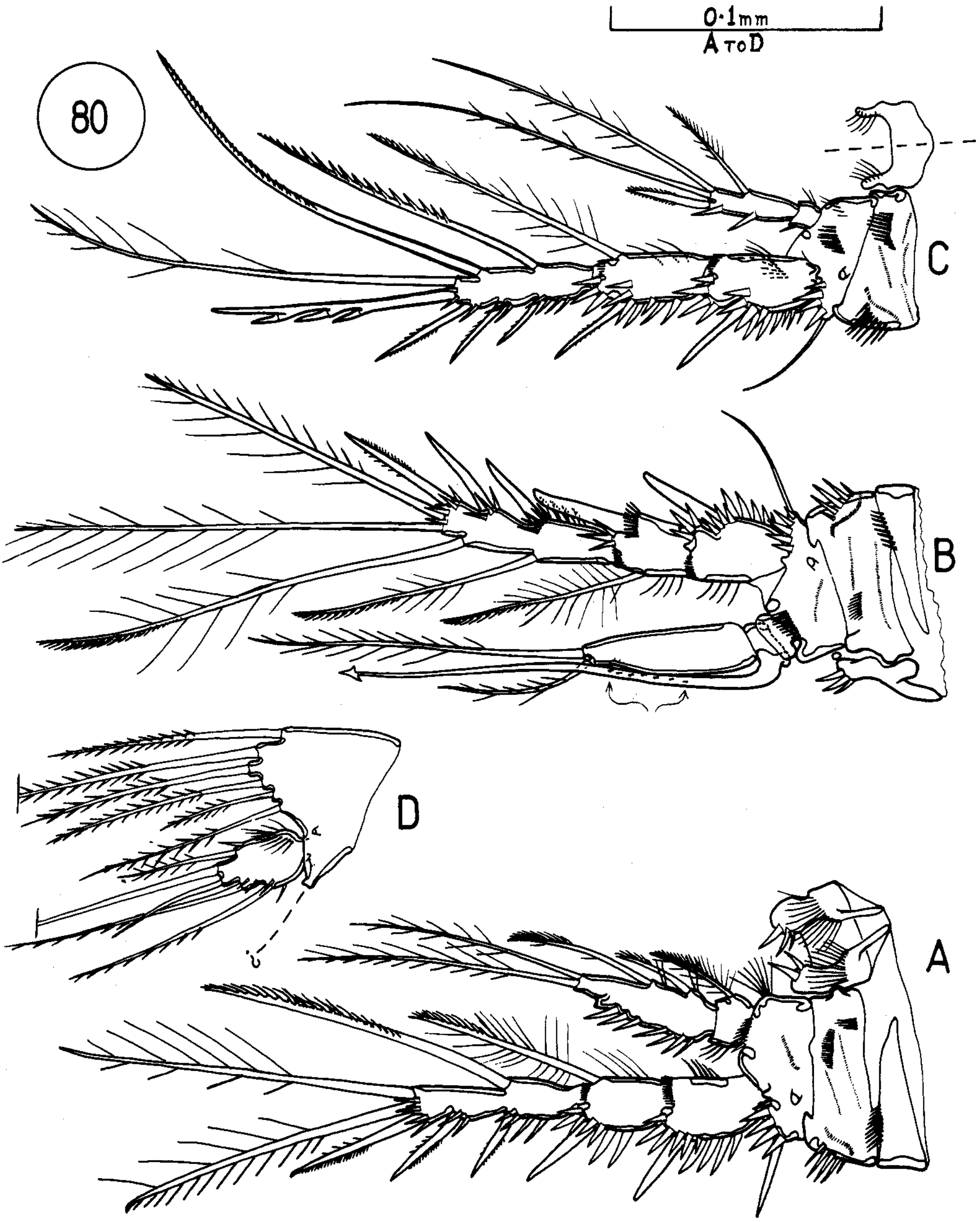


Fig. 80. *C. australicus.* *A–C*, male; *A*, P2; *B*, P3; *C*, P4; *D*, P5 of a short-tailed female.

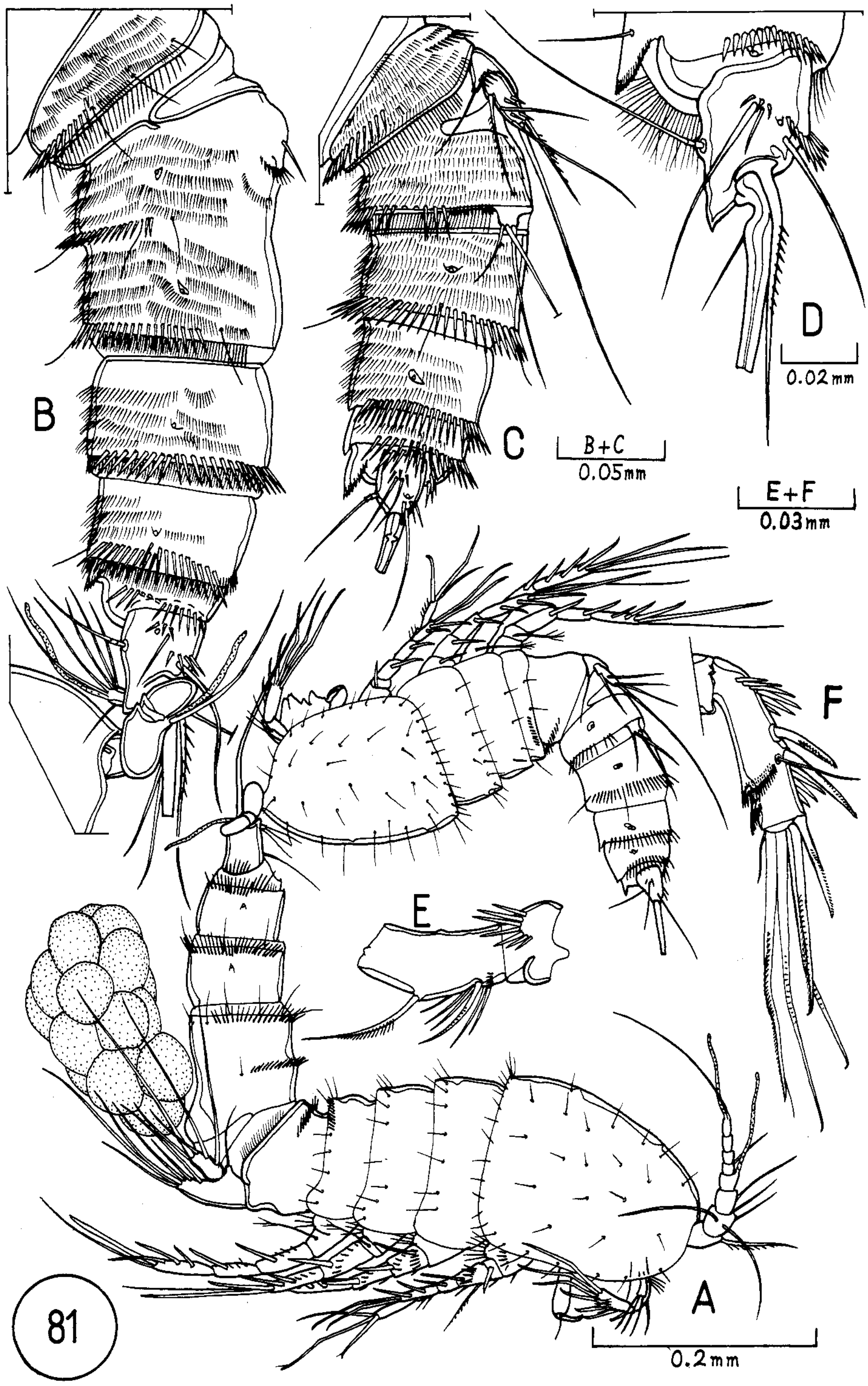


Fig. 81. *C. billwilliamsi.* *A*, holotype female grasped in precopula by allotype male; *B*, holotype, and *C*, allotype, side view of Abd showing spinules and microcombs of microsetules (the missing FRsetal in *B* is indicated by its hole); *D*, side view of FR of lost paratype female; *E*, allobasis, and *F*, enp, of holotype A2 in abexp view.

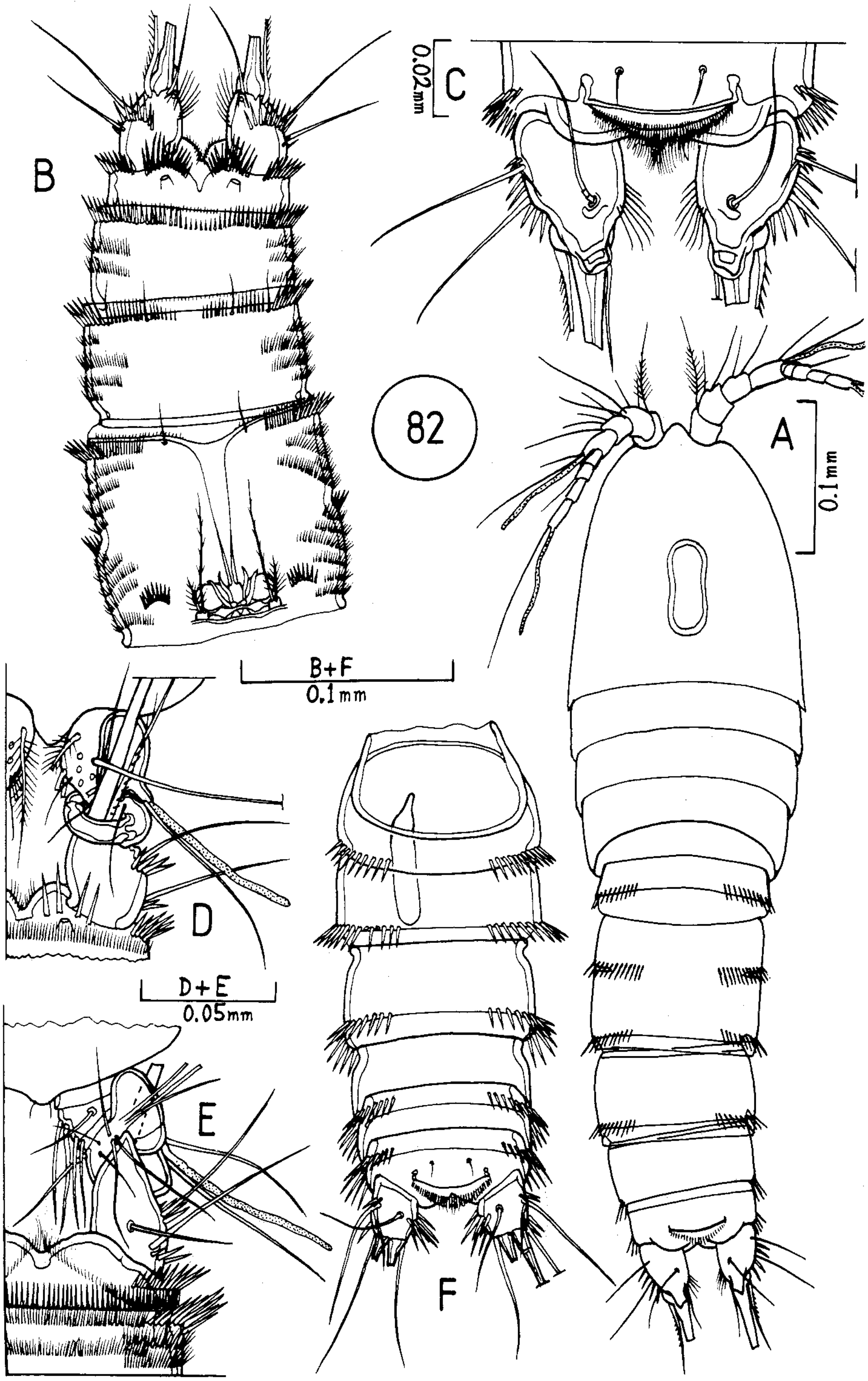


Fig. 82. *C. billwilliamsi.* *A–C*, lost paratype female; *A*, dorsal view of whole animal; *B*, ventral view of Abd; *C*, op and FRs in dorsal view; *D*, dorsal, and *E*, ventral, views of FRsetae 5–7 of holotype being grasped by A1 of allotype; *F*, Abd of allotype male in dorsal view.

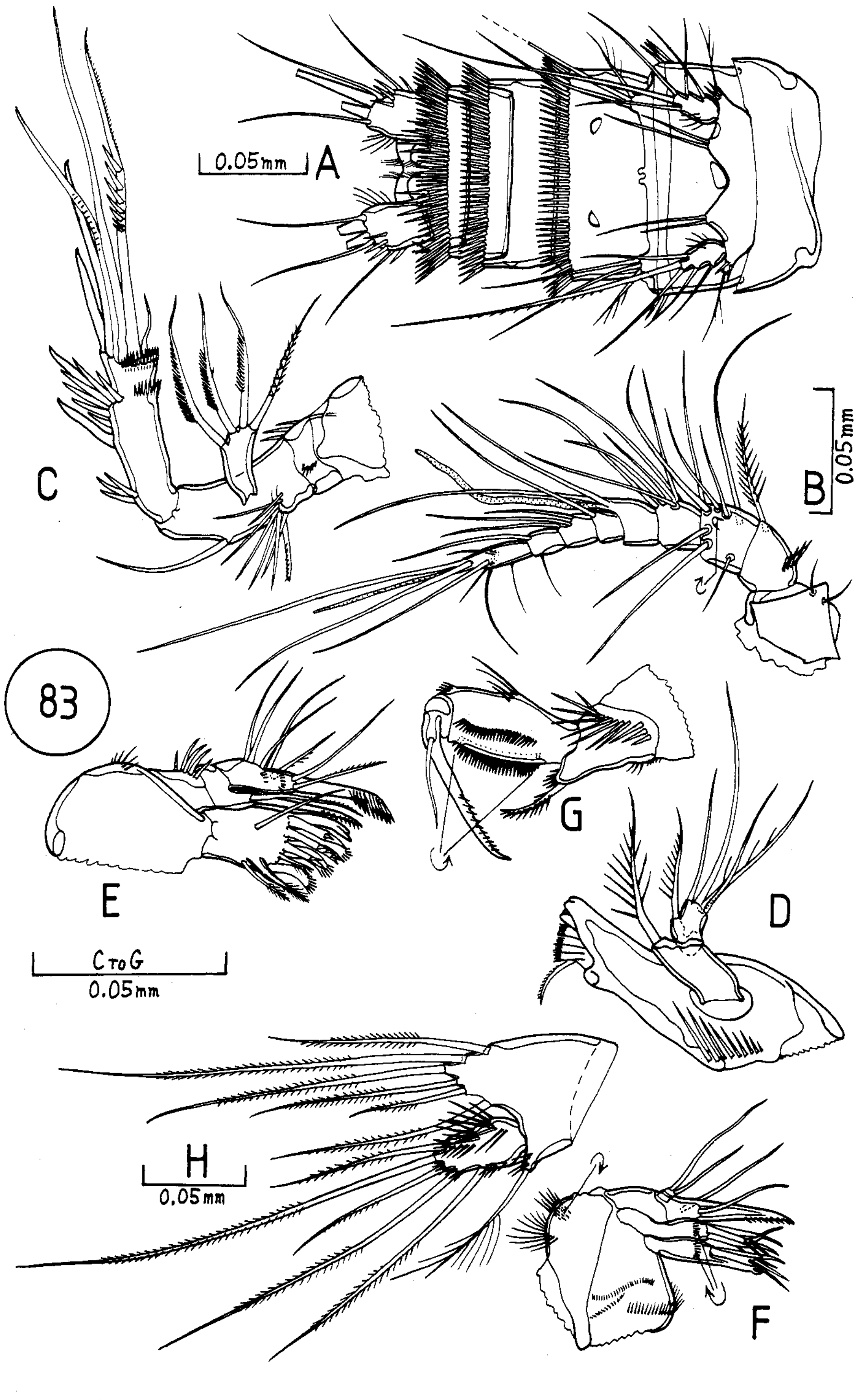


Fig. 83. *C. billwilliamsi.* *A*, Abd of allotype in ventral view; *B–H*, holotype; *B*, R and A1; *C*, exop view of A2; *D* and *H* in front view, *E–G* in rear view; *D*, Md; *E*, Mx1; *F*, Mx2; *G*, Mxp; *H*, P5.

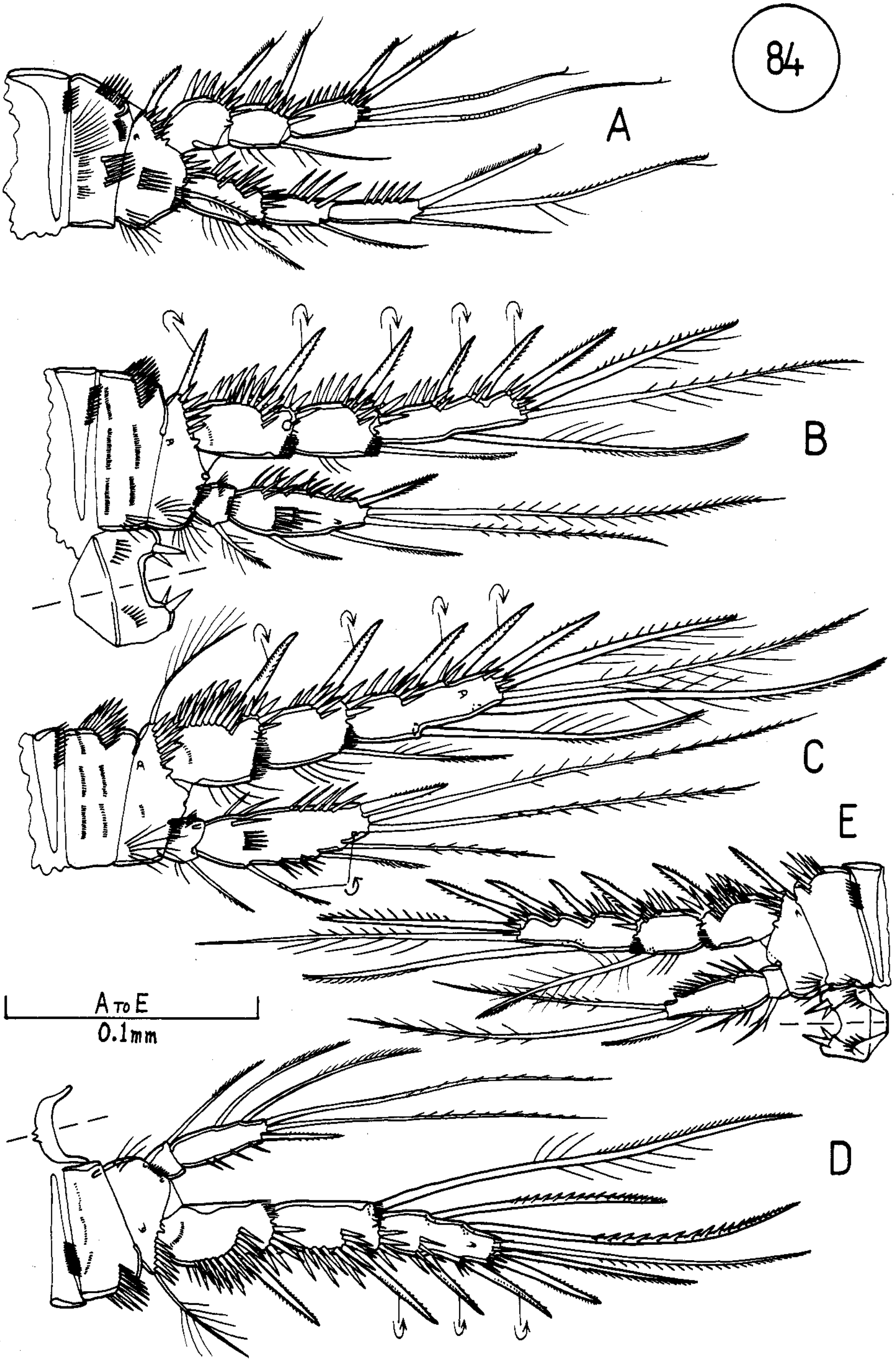


Fig. 84. *C. billwilliamsi*; *E* from the allotype, the rest from the holotype. *A*, P1; *B* and *E*, P2; *C*, P3; *D*, P4 (P3 and P4 of allotype on Figs 42*J* and 43*E*).

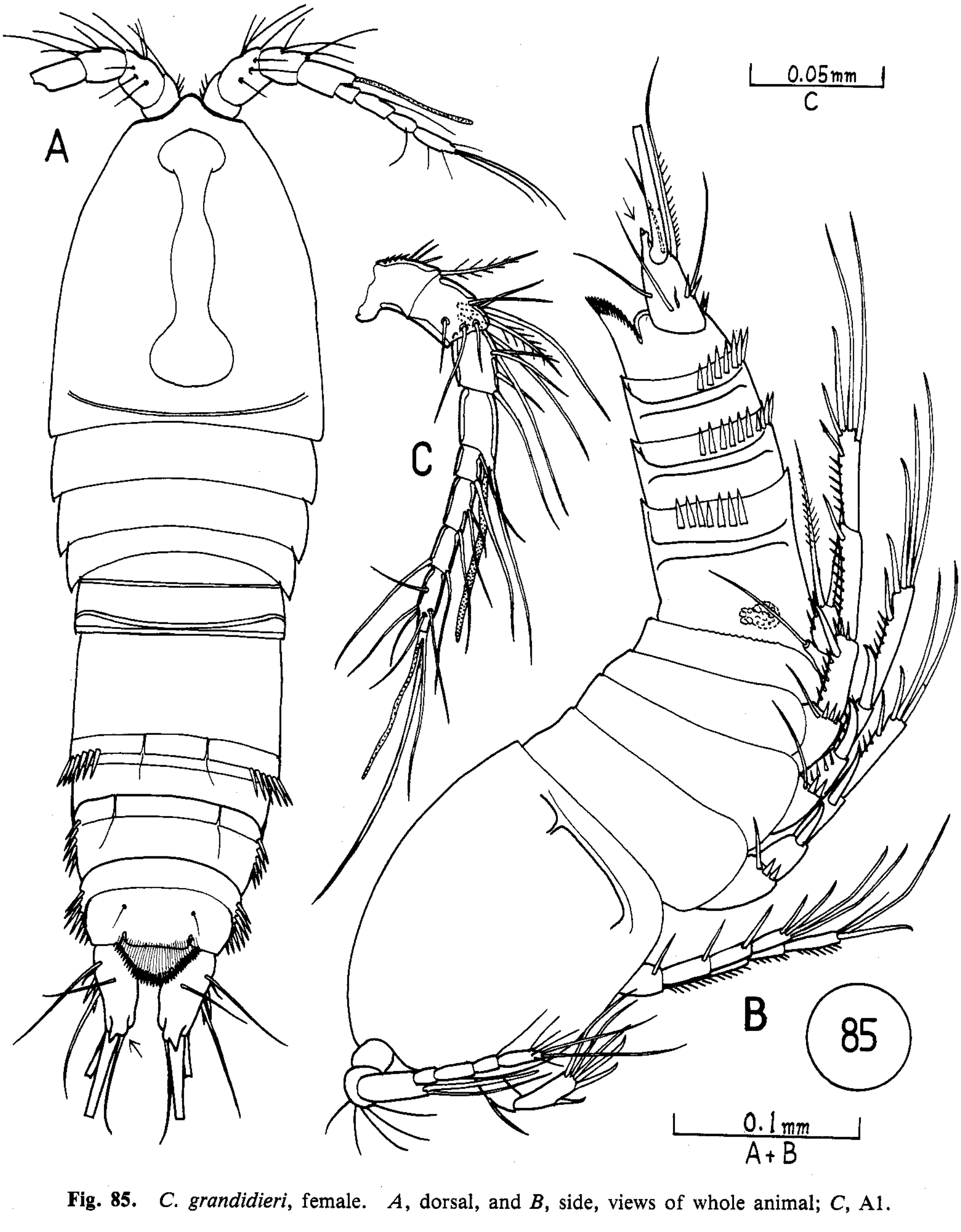


Fig. 85. *C. grandidieri*, female. *A*, dorsal, and *B*, side, views of whole animal; *C*, A1.

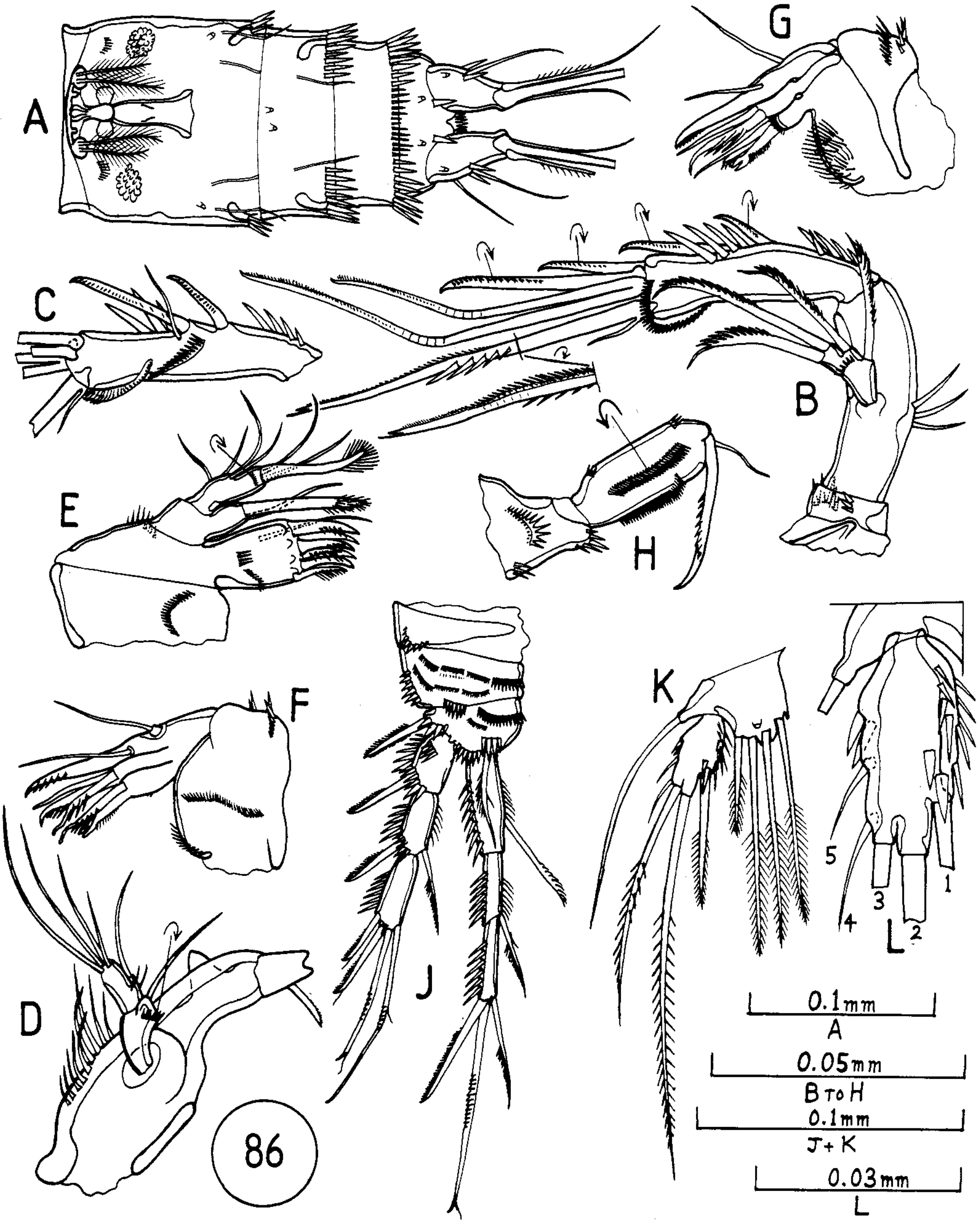


Fig. 86. *C. grandidieri*, female; *D* from the husk from Nardellos Lagoon, northern Queensland, the others from the female in Fig. 85. *A*, ventral view of Abd; *B*, exop view of A2; *C*, abexp view of A2enp (terminal spines and setae drawn as if cut off short); *D*, Md; *E*, Mx1; *F* and *G*, Mx2; *H*, Mxp; *J*, P1; *K*, P5; *L*, P5exp more highly magnified with its setae numbered 1–5. *D–L* in front view, except *F* and *H* which are in rear view.

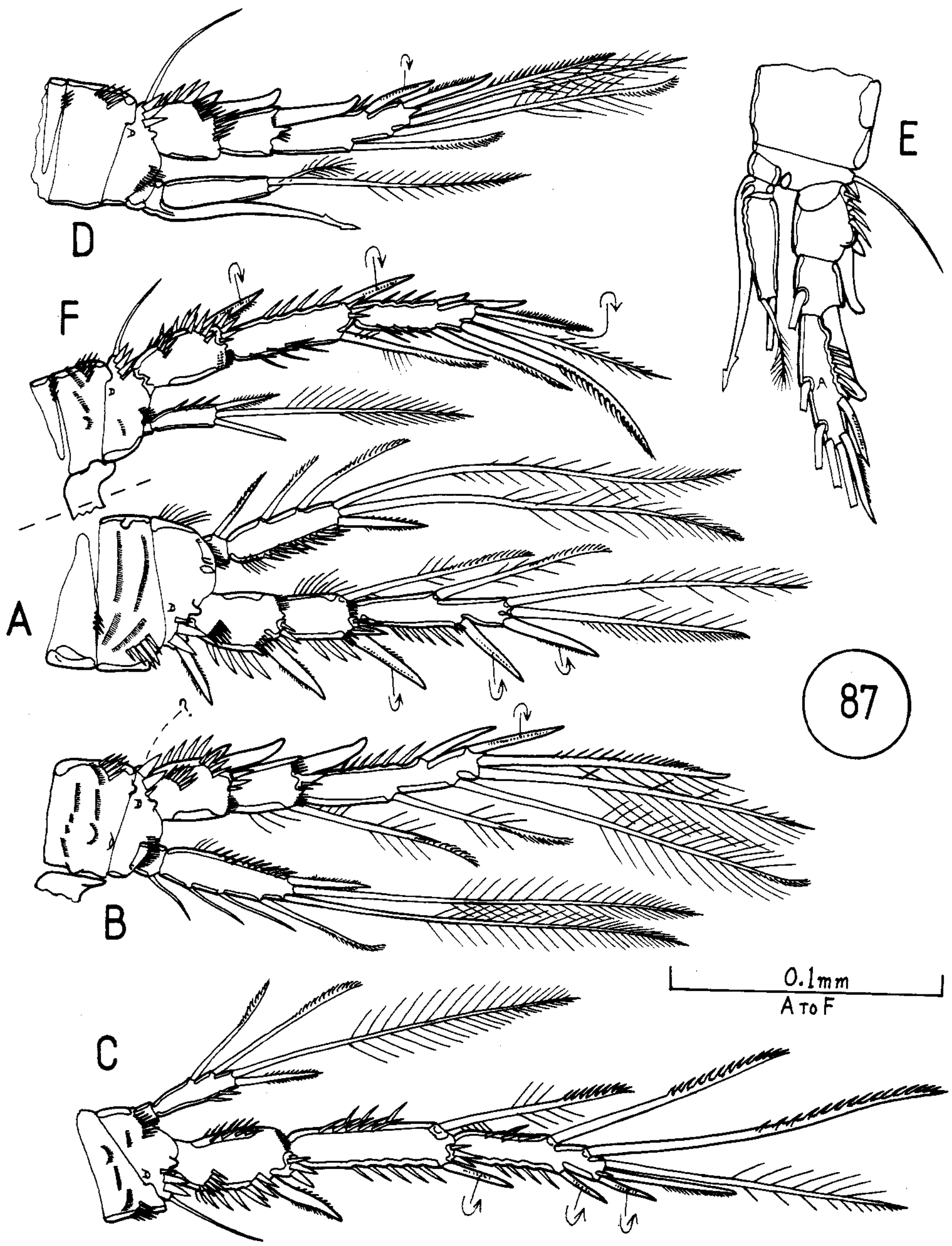


Fig. 87. *C. grandidieri*; *A–C*, female; *D–F*, male. *A*, P2; *B*, *D*, and *E*, P3; *C* and *F*, P4. *E* in rear view, all the others in front view.

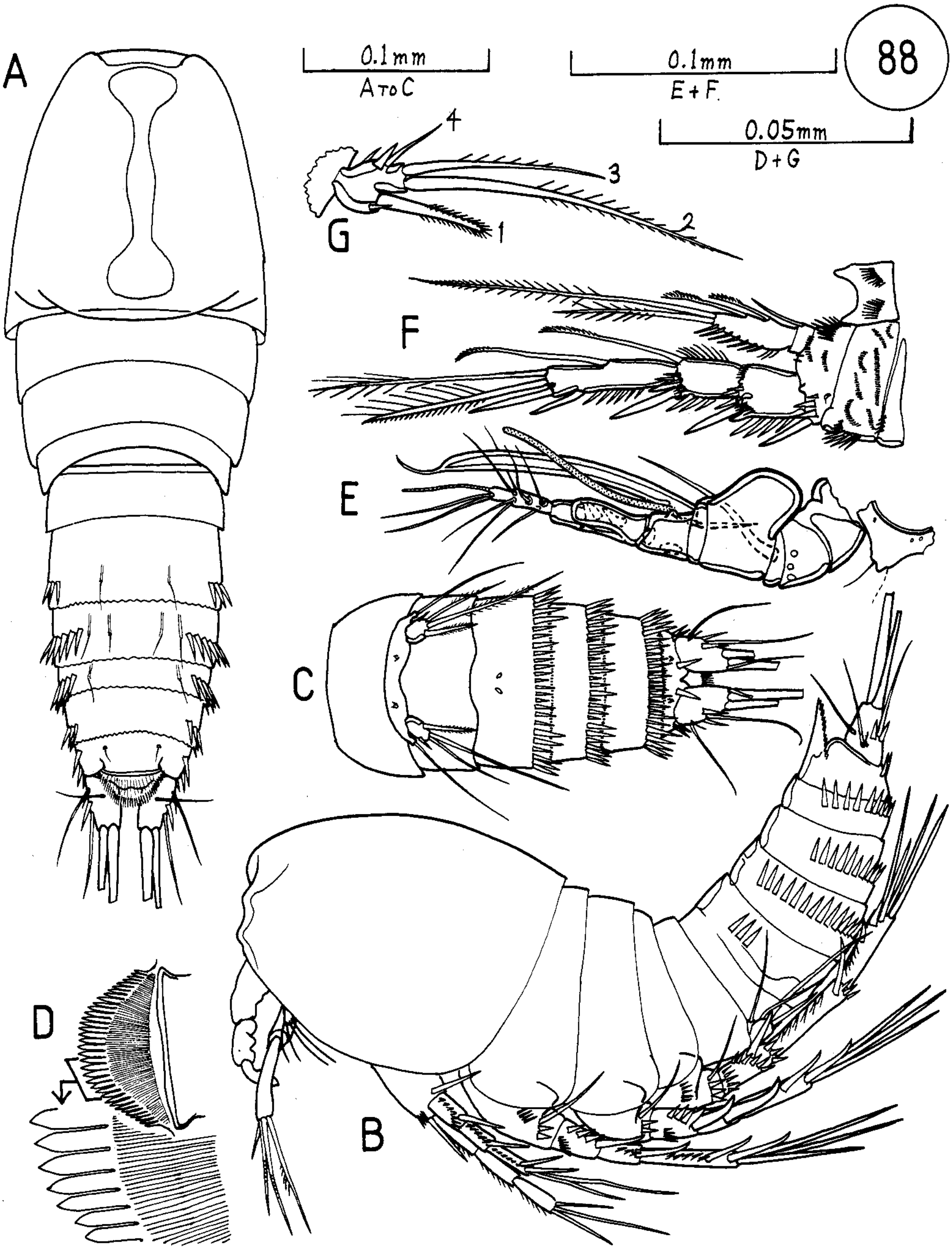


Fig. 88. *C. grandidieri*, male. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd with P5; *D*, dorsal view of op (inset to no exact scale, to show striations and form of teeth enlarged); *E*, A1; *F*, P2; *G*, P5 with its setae numbered 1–4 (seta5 present in female but not in male). For details of the integument see Fig. 74*G*, and for a subadult female see Fig. 74*F*.

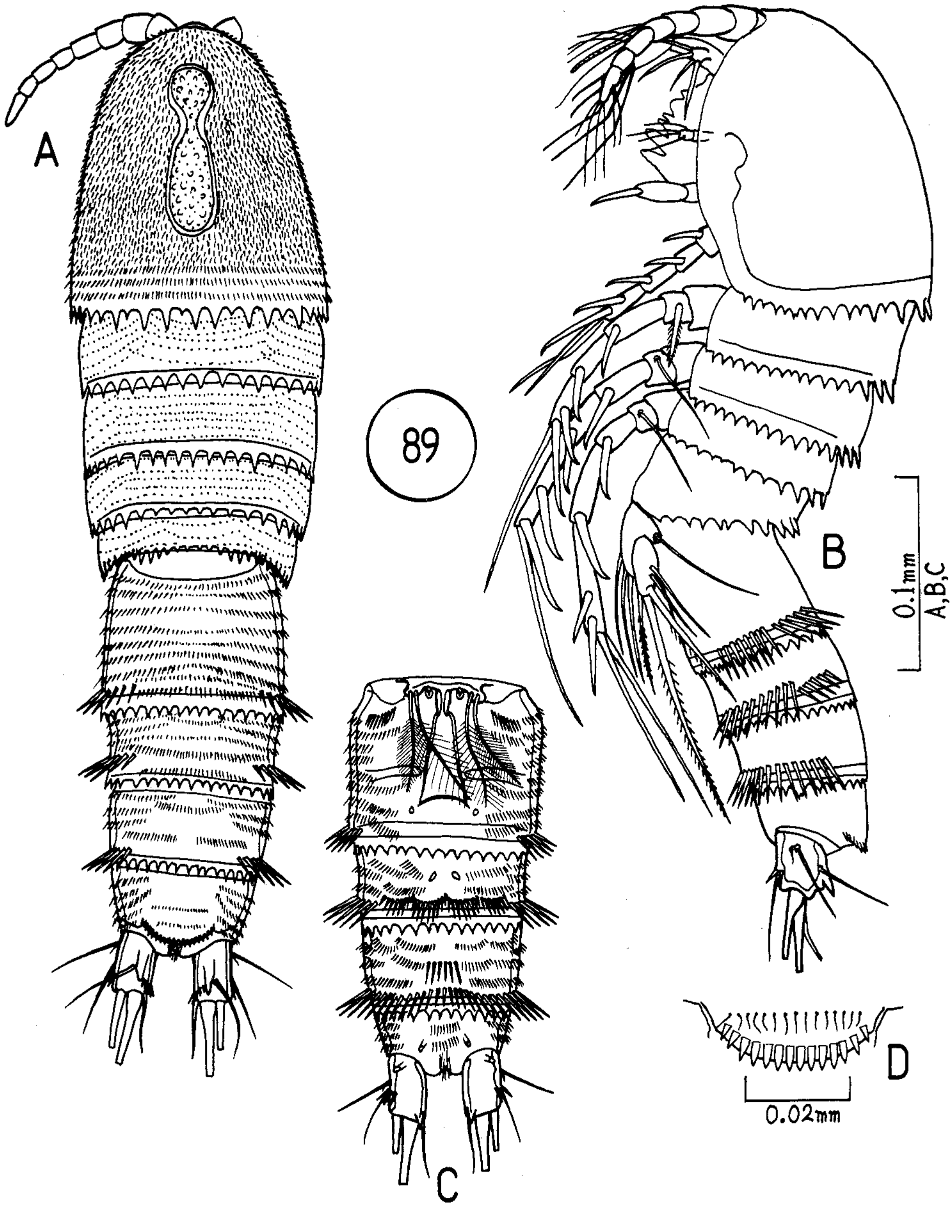


Fig. 89. *C. bidens*, female, from Holbrook, New South Wales (see text). *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd.

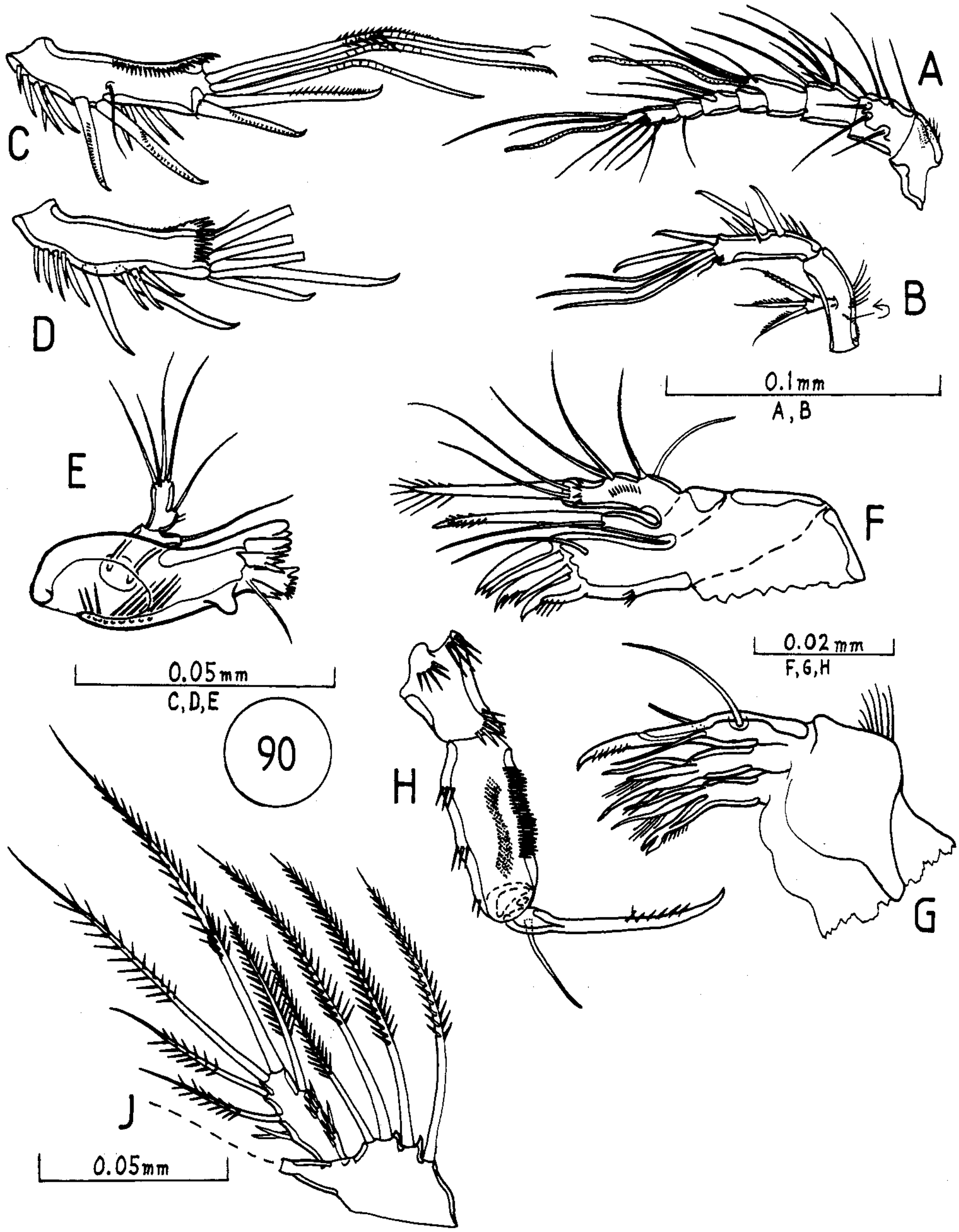


Fig. 90. *C. bidens*, as for Fig. 89. *A*, A1; *B*, abexp view of A2; *C*, abexp, and *D*, exop, views of A2enp; *E*, Md; *F*, Mx1; *G*, Mx2; *H*, Mxp; *J*, P5. *E–G* in rear view, *H* and *J* in front view.

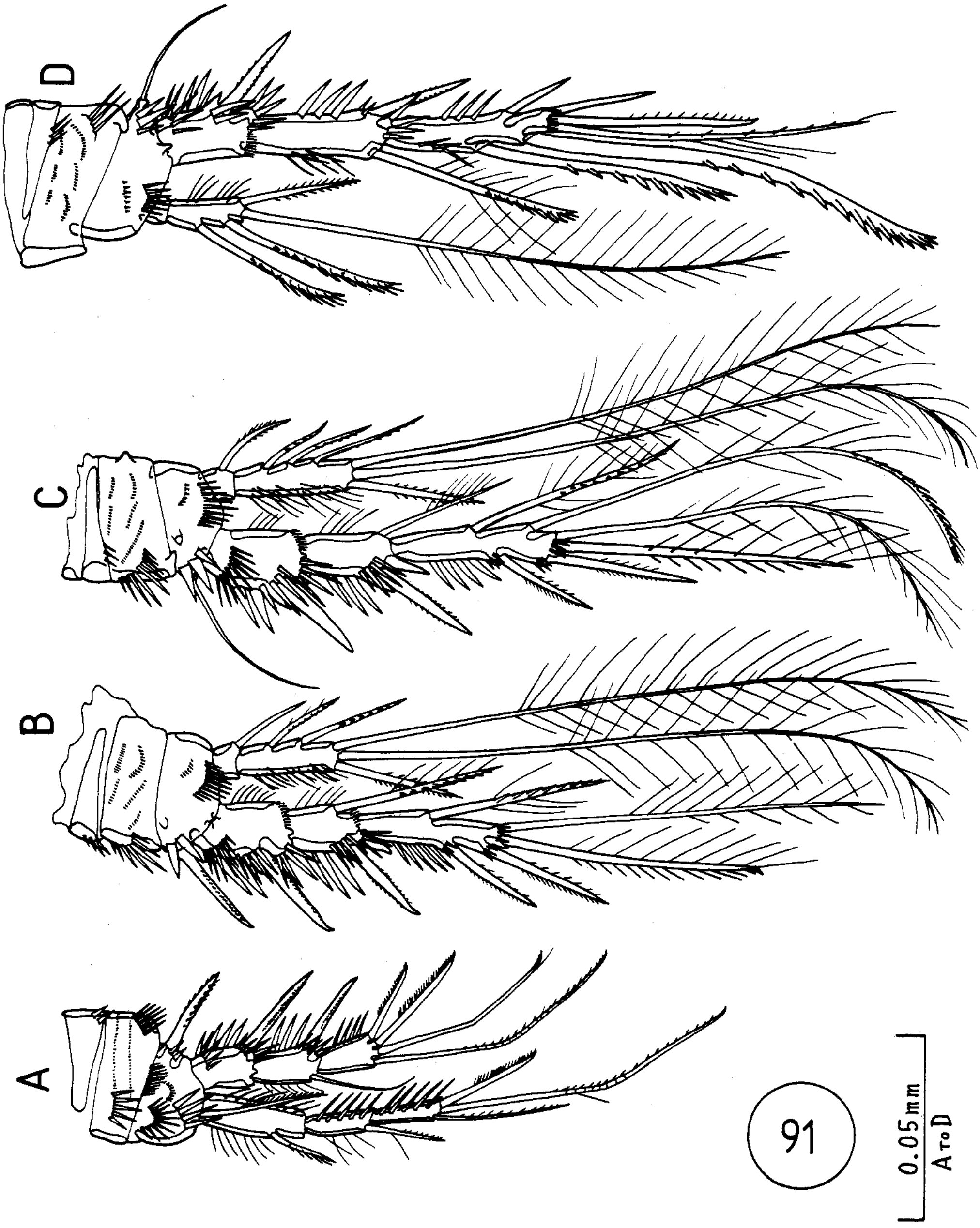


Fig. 91. *C. bidens*, as for Fig. 89. *A*, P1; *B*, P2; *C*, P3; *D*, P4.

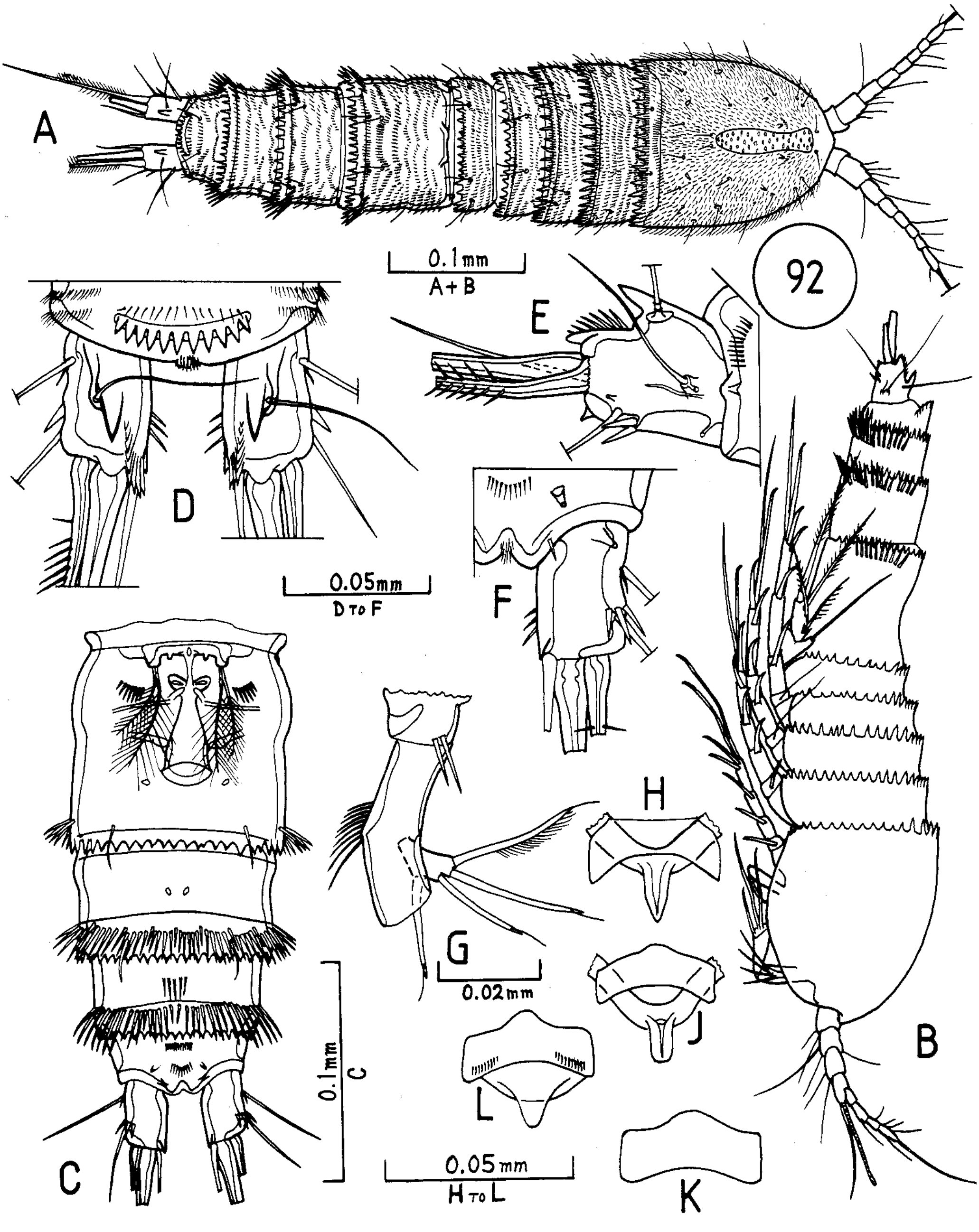


Fig. 92. *A–G*, *C. bidens*, female, from sample No. 17 (see Appendix 3). *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, dorsal, *E*, side, and *F*, ventral, views of FR; *G* (with own scale), abexp view of A2allobasis, with exp partly showing through it. *H–L*, *Fibulacamptus* spp., ICP of P1; *H*, *F. victorianus*, female holotype; *J*, *F. victorianus*, male allotype; *K*, female, and *L*, male, *F. tasmanicus* from sample 7R670 (see text).

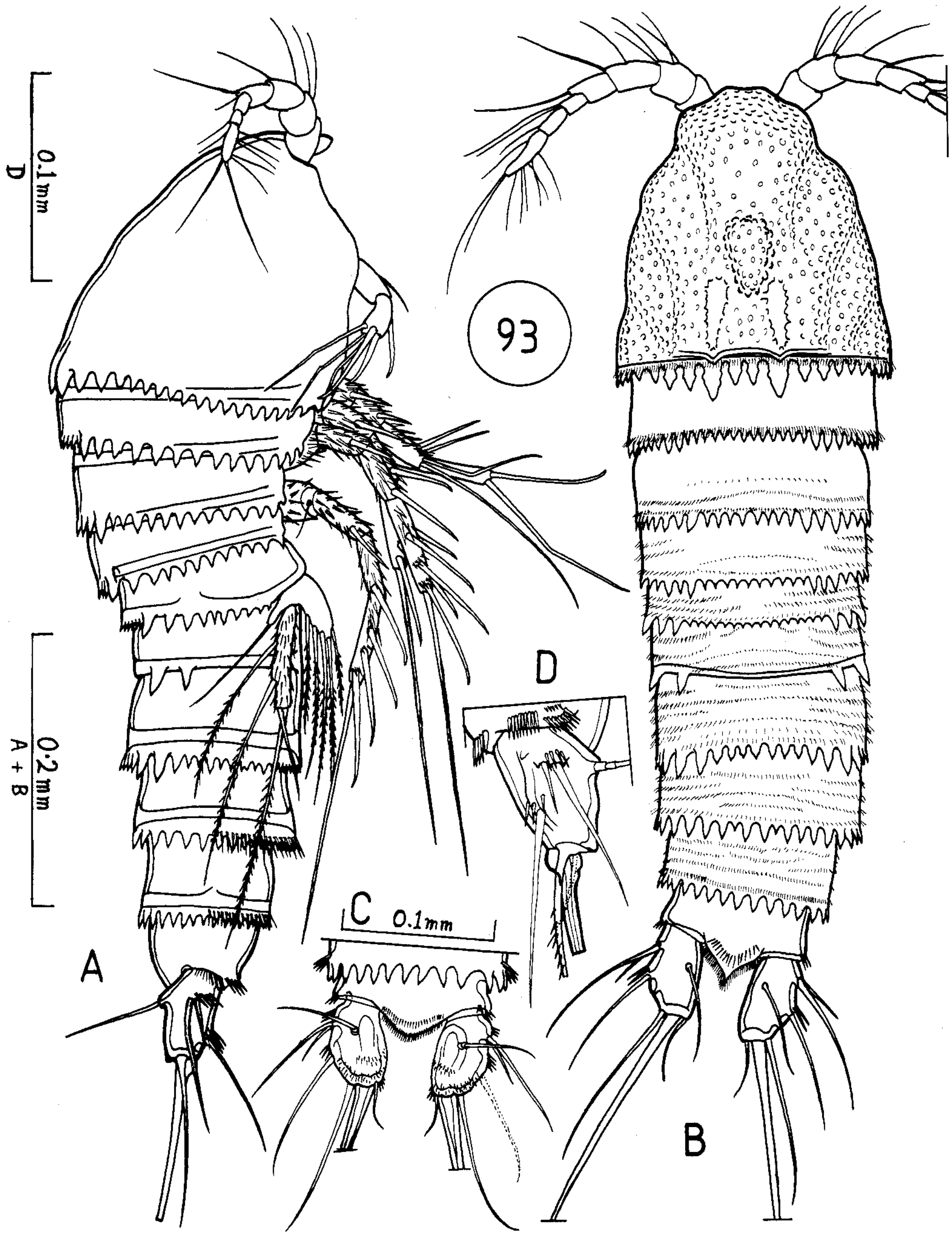


Fig. 93. *C. longiseta*, female. *A*, dorsal, and *B*, side, views of entire animal; *C*, dorsal view of op with FRs of a female with an abnormally short op (see text); *D*, FR (from left side) of another female from locality 28 in Map 6, to show details (see text).

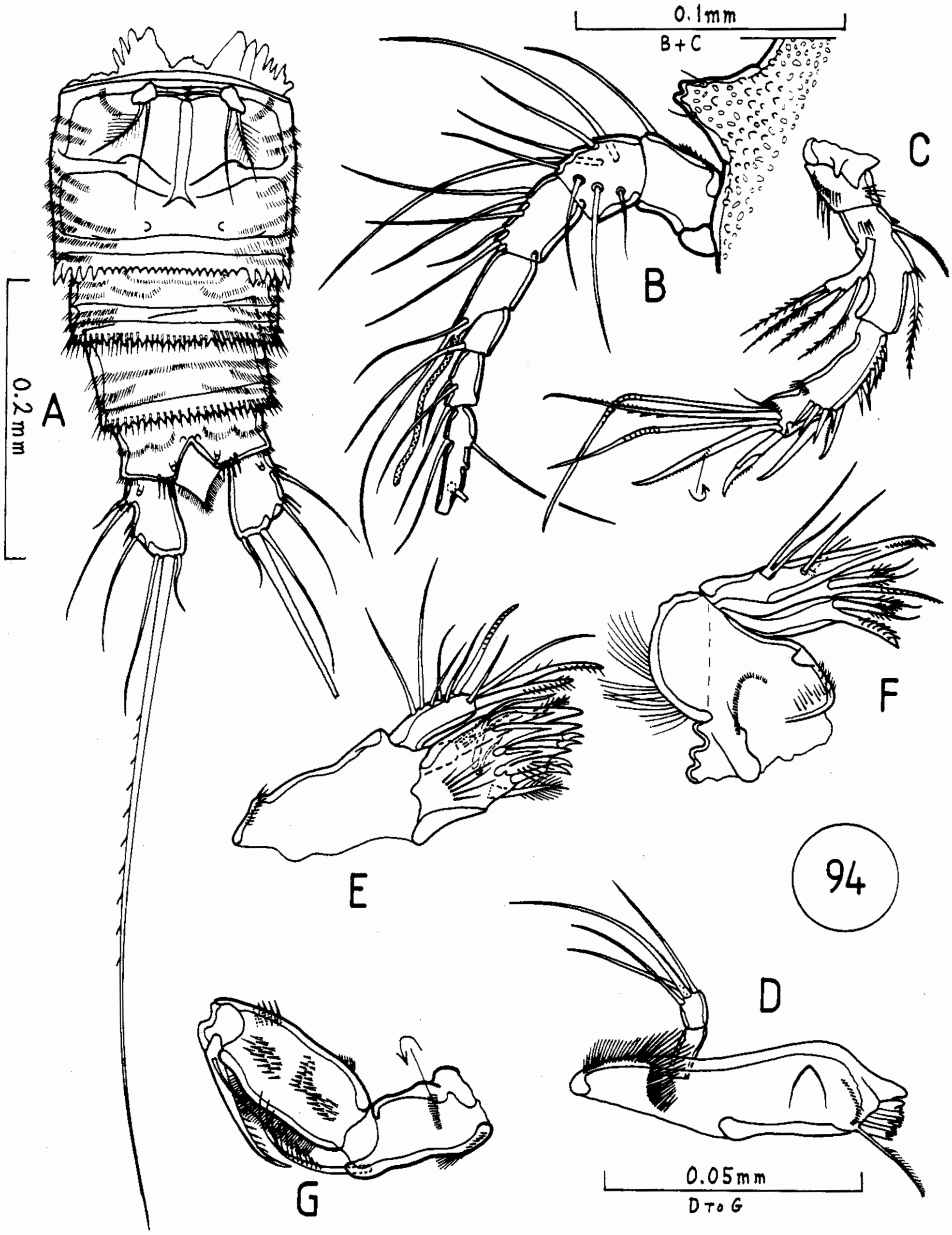


Fig. 94. *C. longiseta*, female. *A*, ventral view of Abd; *B*, R and A1; *C*, exop view of A2; *D*, Md; *E*, Mx1; *F*, Mx2; *G*, Mxp. *D* and *E* in front view, *F* and *G* in rear view.

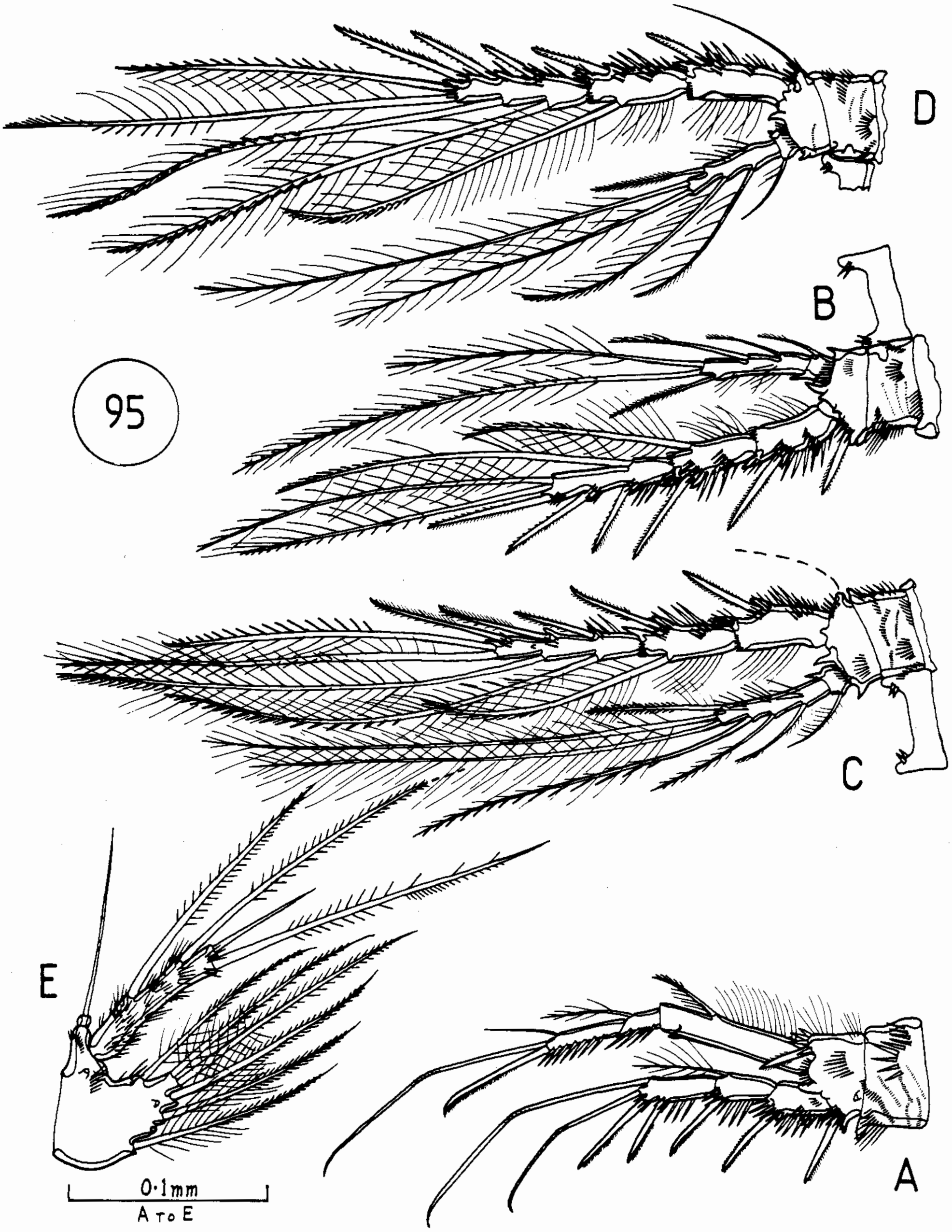


Fig. 95. *C. longiseta*, female. *A*, P1; *B*, P2; *C*, P3; *D*, P4; *E*, P5.

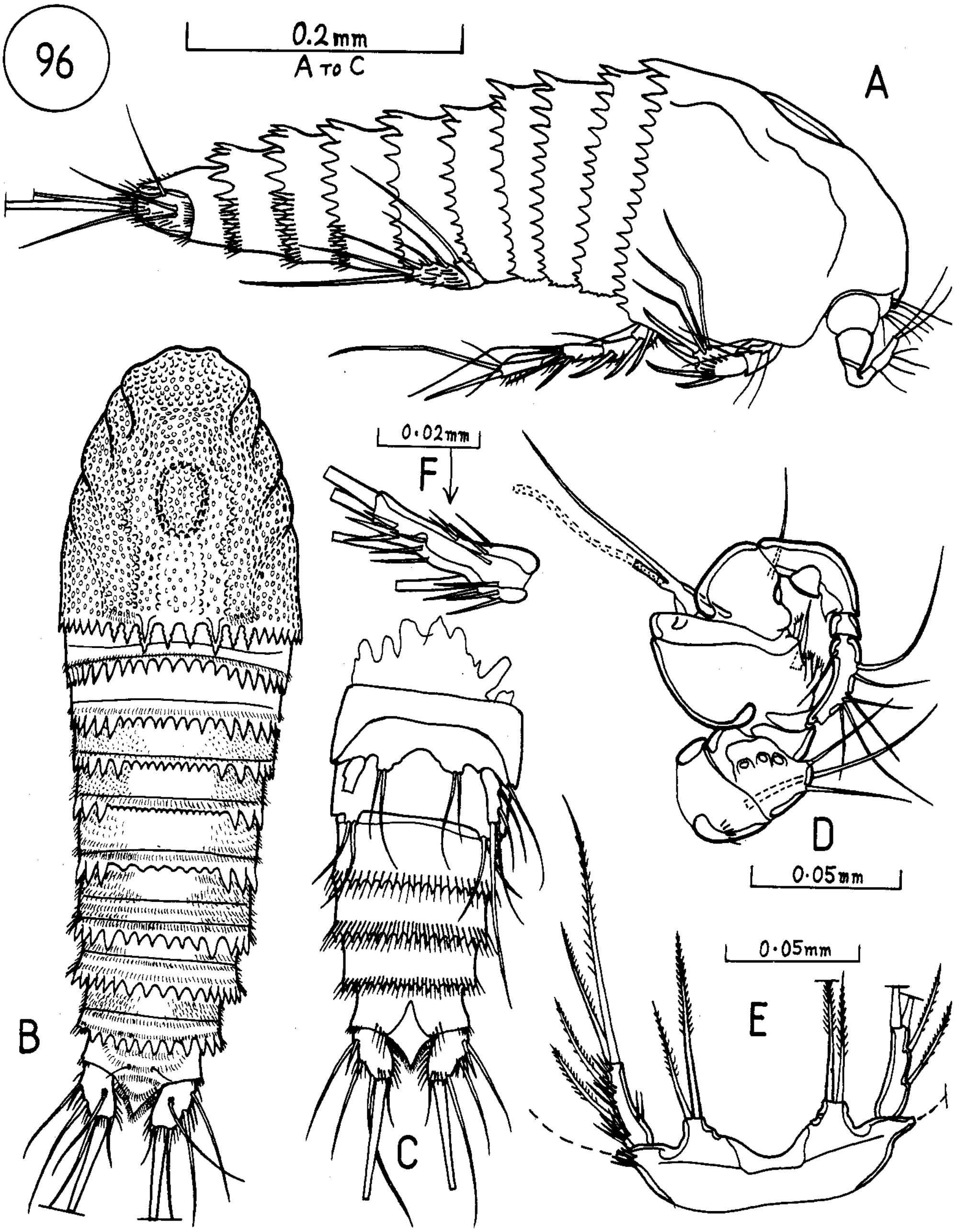


Fig. 96. *C. longiseta*, male. *A*, side, and *B*, dorsal, view of entire animal; *C*, ventral view of Abd; *D*, A1; *E*, P5; *F*, P5exp (with own scale).

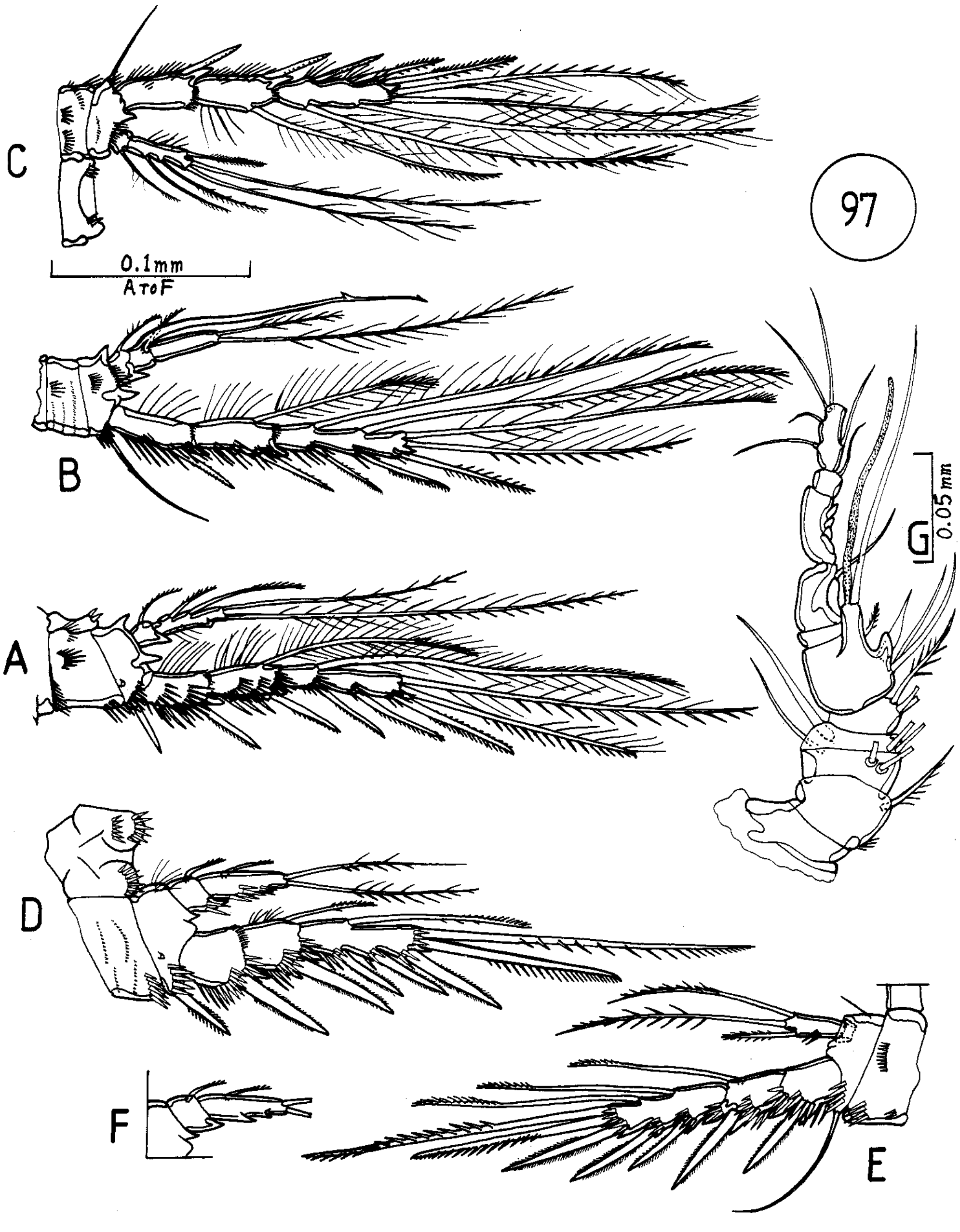


Fig. 97. *A–C*, *C. longiseta* male; *A*, P2; *B*, P3; *C*, P4. *D–F*, *C. mortoni* male; *D*, P2; *E*, P4; *F*, P2enp drawn without spinules or setae in order to show the thorns. *G*, *C. howardorum* male, ventral view of A1.

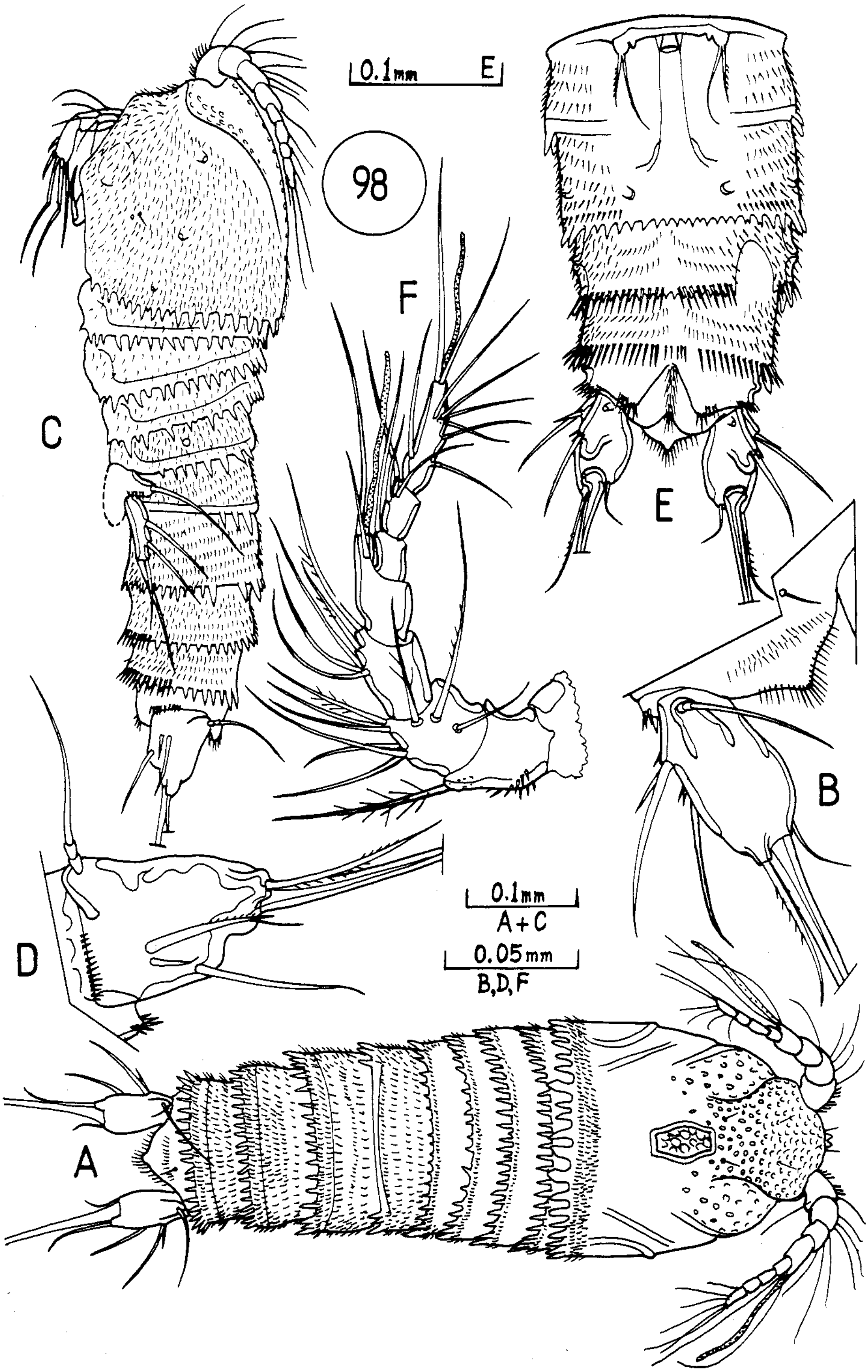


Fig. 98. *C. dumonti*, holotype female. *A*, dorsal view of entire animal; *B*, the same of op and FR; *C*, side view of whole animal (legs omitted save P5exp); *D*, side view of left FR; *E*, ventral view of Abd; *F*, dorsal view of A1.

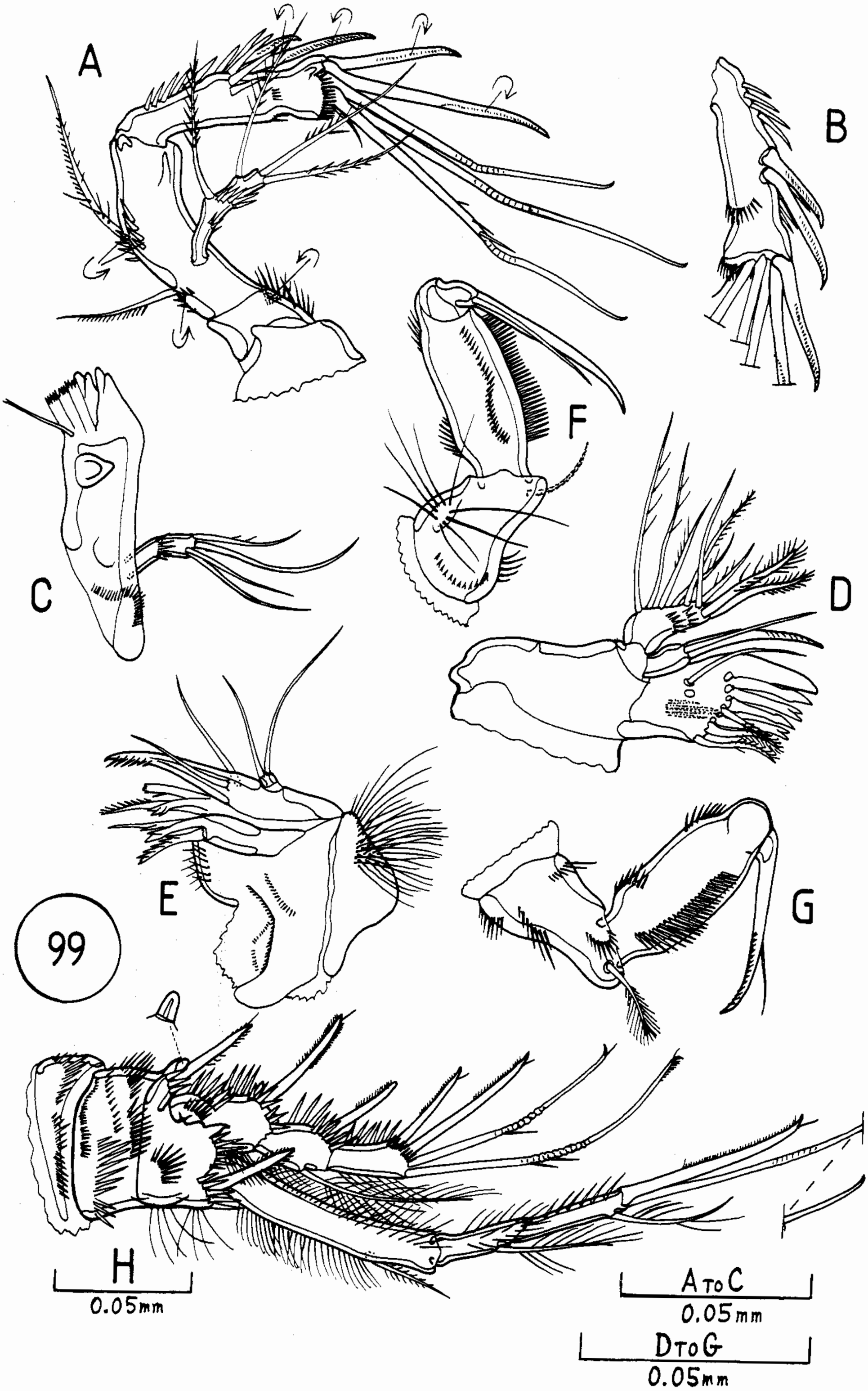


Fig. 99. *C. dumonti*, holotype female. *A*, exop view of A2; *B*, abexp view of A2enp; *C*, Md; *D*, Mx1; *E*, Mx2; *F* and *G*, Mxp; *H*, P1. *C–F* in rear view; *G* and *H* in front view.

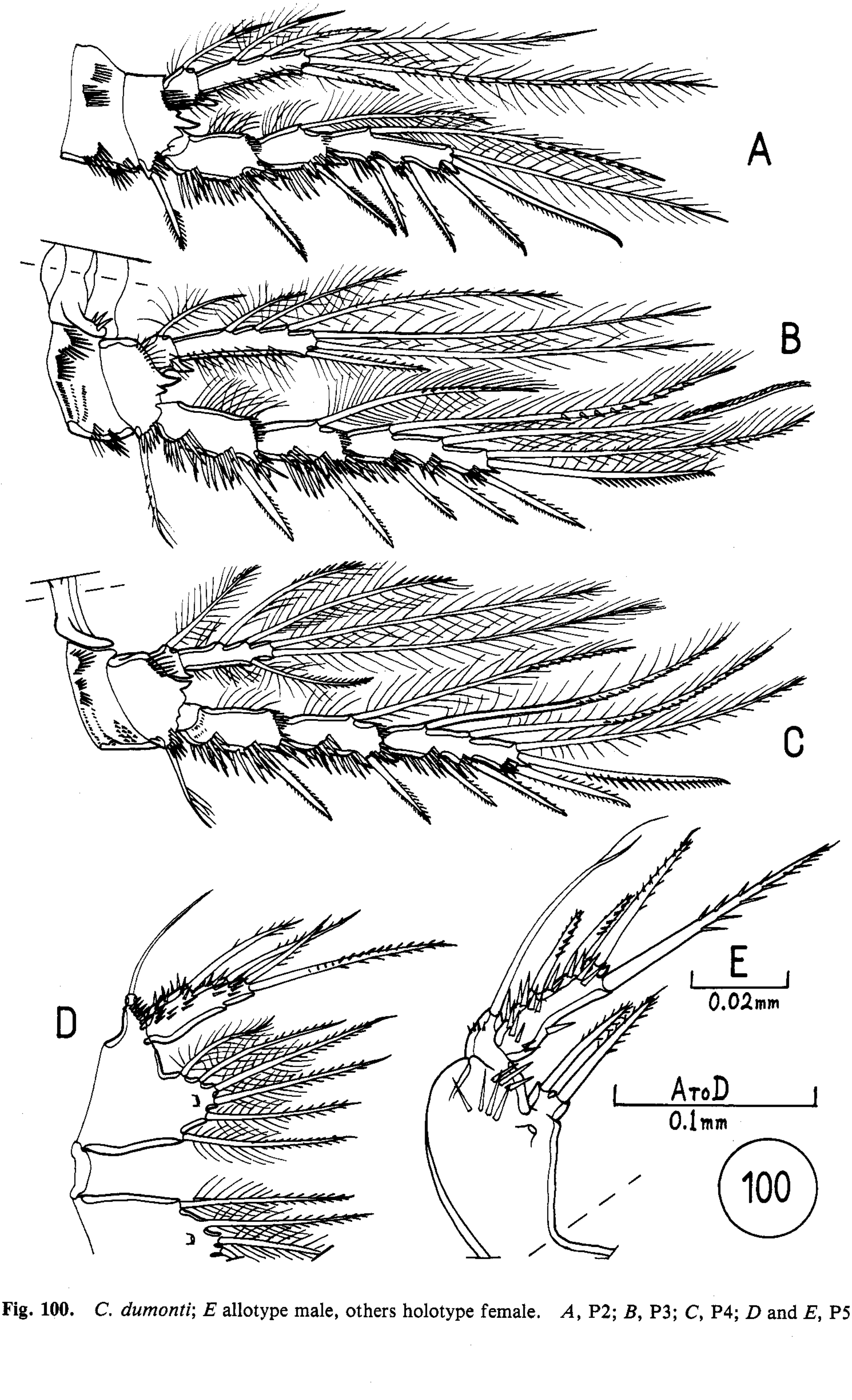


Fig. 100. *C. dumonti*; *E* allotype male, others holotype female. *A*, P2; *B*, P3; *C*, P4; *D* and *E*, P5.

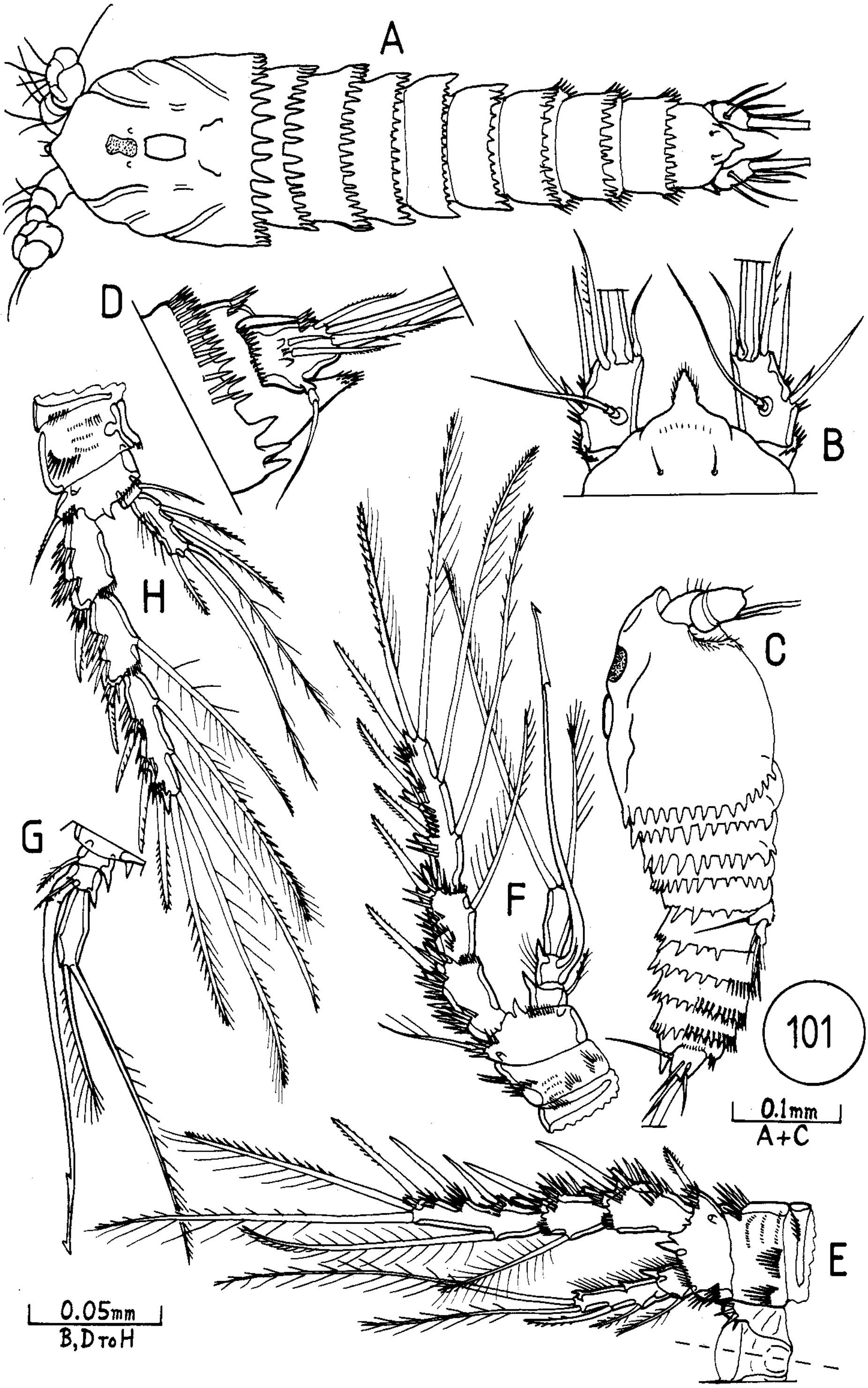


Fig. 101. *C. dumonti*, allotype male. *A*, whole animal, and *B*, op with FRs, both in dorsal view; *C*, side view of whole animal (contracted by drying, then restored by soaking); *D*, side view of right FR with op behind it; *E*, P2; *F*, P3; *G*, P3enp; *H*, P4. *E*, *F*, and *H* in front view, *G* in rear view.

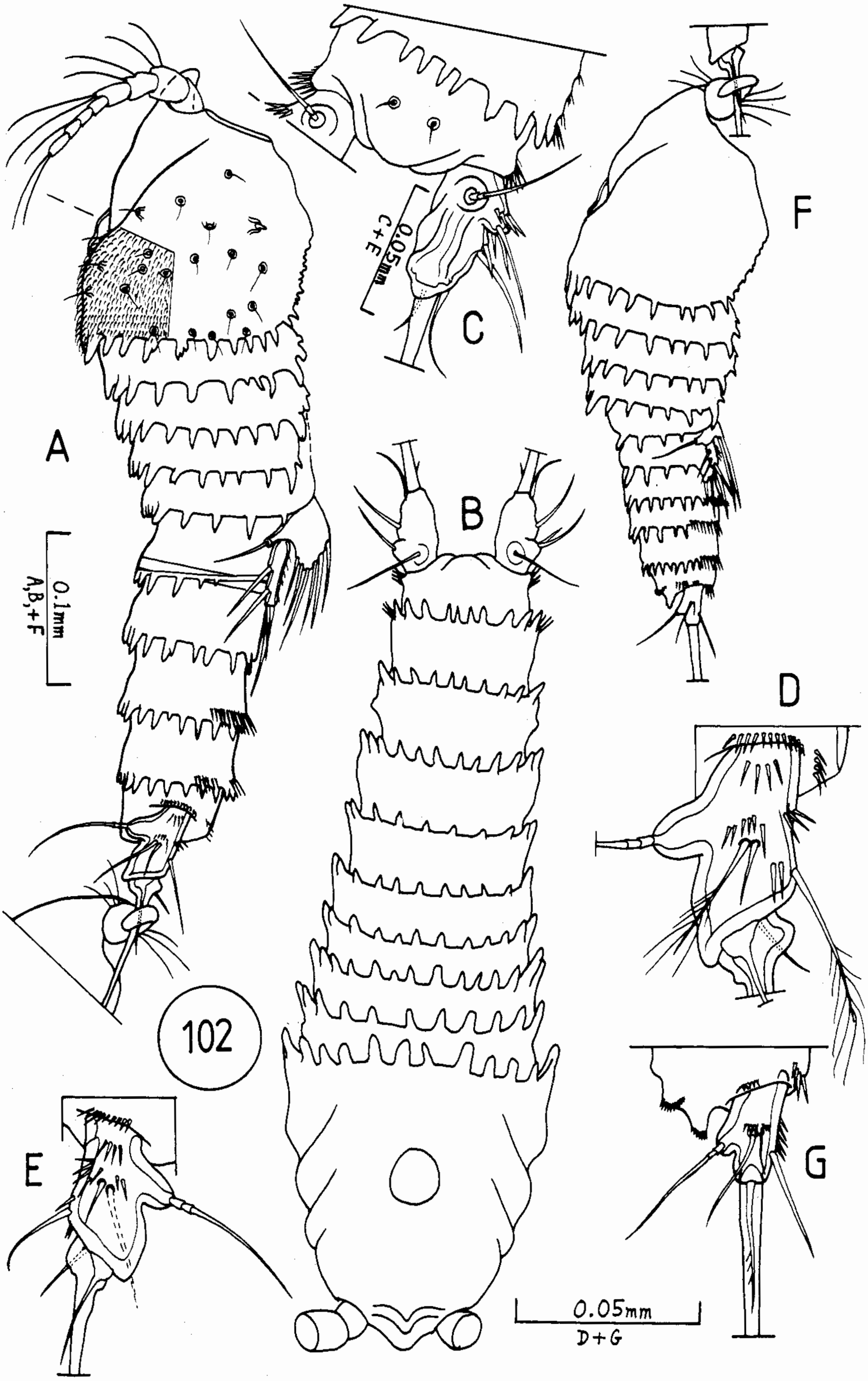


Fig. 102. *C. mammillifurca*. *A–D*, female holotype; *E*, paratype 2; *F* and *G*, male allotype. *A* and *F*, whole animal in side view; *B*, whole animal in dorsal view; *C*, op and FRs in dorsal view; *D*, *E*, and *G*, FR in side view. In *D* and *E*, seta7 is shown partly dotted because of being behind setae 5 and 6, whereas in *E* seta1 is dotted because of being lost.

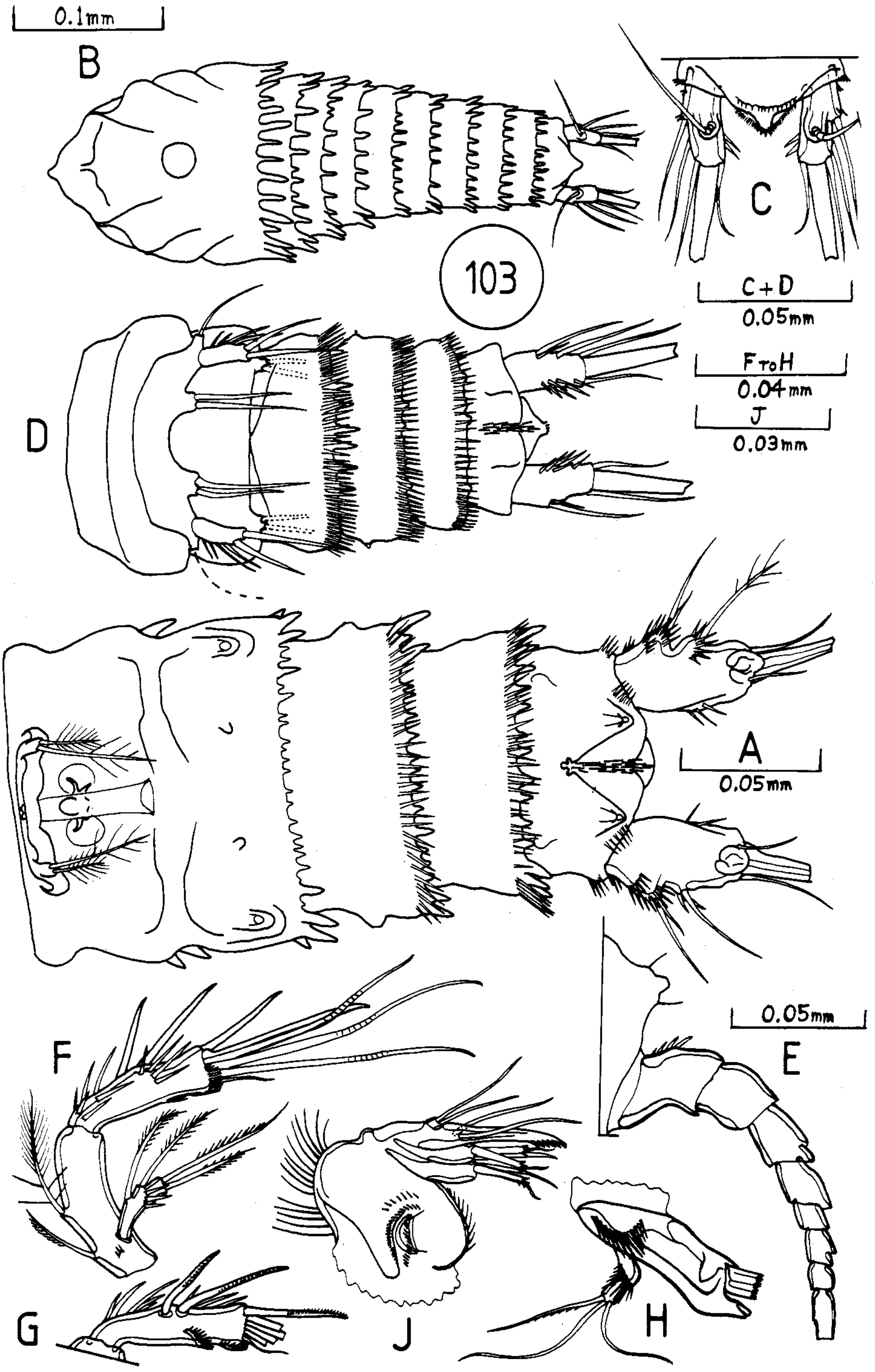


Fig. 103. *C. mammillifurca*. *A*, *E–G*, and *J*, holotype; *H*, paratype 2; *B–D*, allotype. *A* and *D*, Abd in ventral view (*D* with P5 and P6, the setae of P6 dotted because lost); *B*, whole animal in dorsal view; *C*, op with FRs in dorsal view; *E*, A1; *F*, exop view of A2; *G*, abexp view of A2enp; *H*, Md in rear view; *J*, Mx2 in rear view. *A*, *B* and *E*, each with own scale.

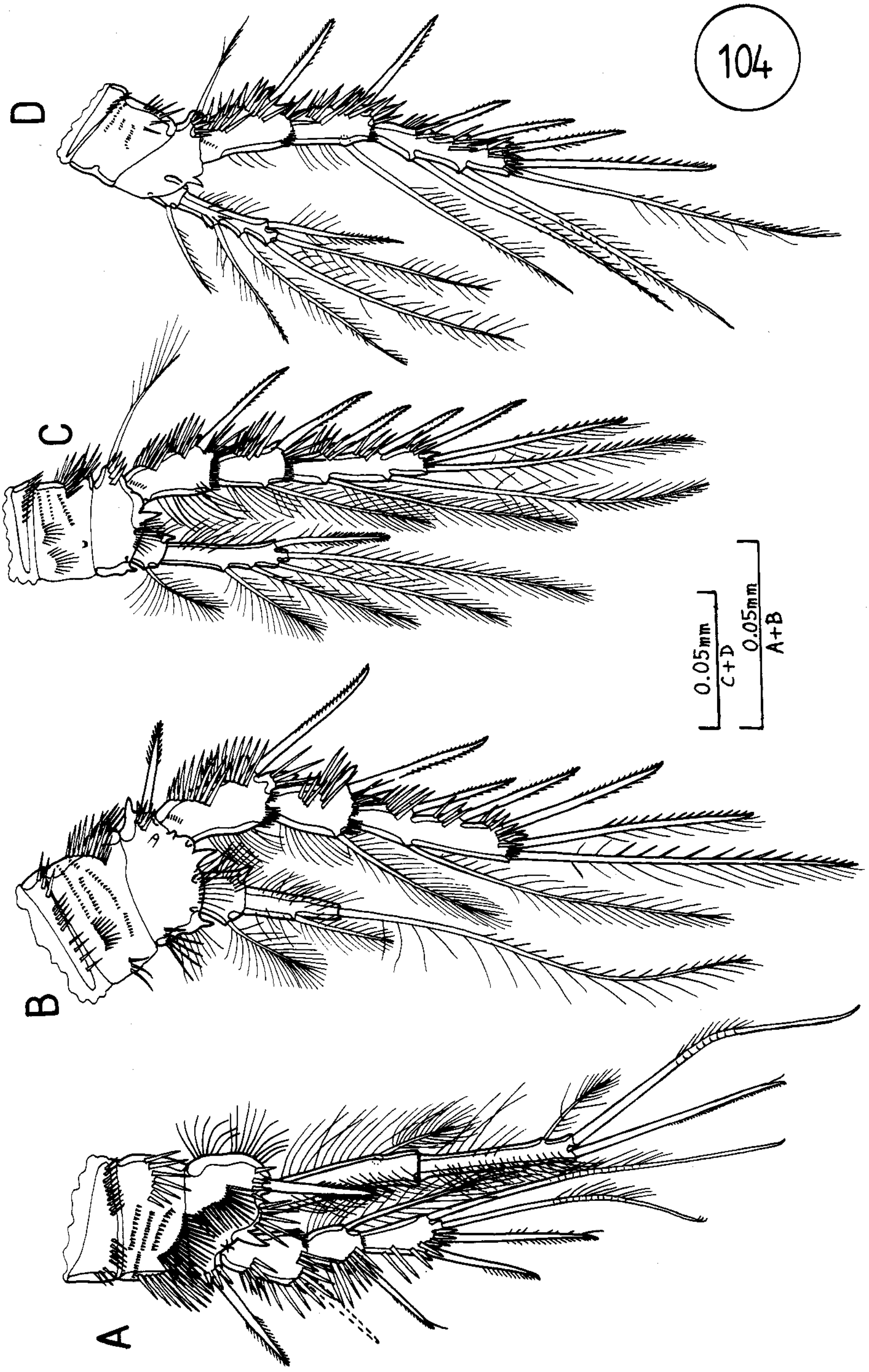


Fig. 104. *C. mammillifurca*, female; *A–C*, holotype; *D*, paratype 2. *A*, P1; *B*, P2; *C*, P3; *D*, P4.

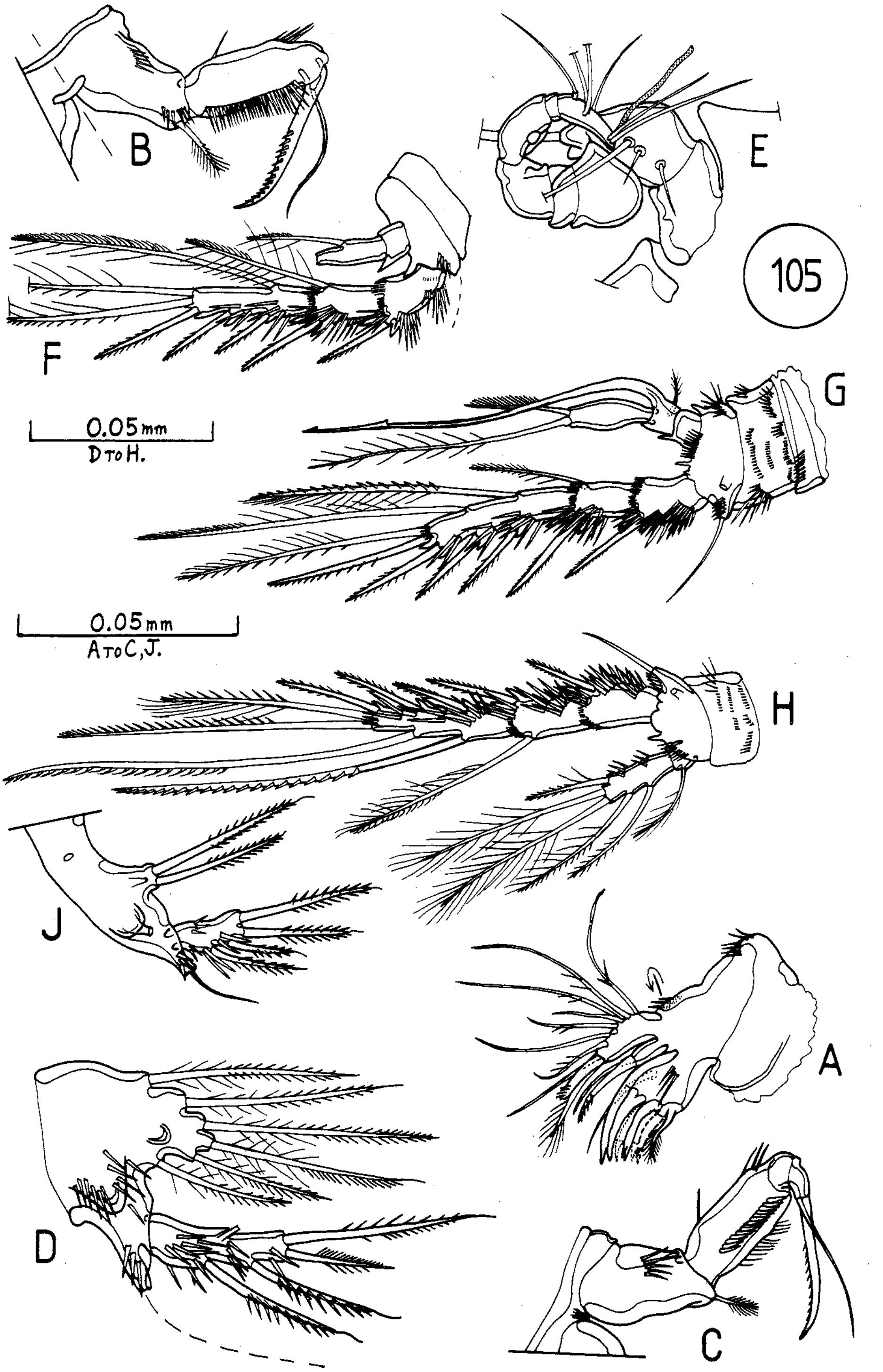


Fig. 105. *C. mammillifurca.* *A–C*, paratype 2; *D*, holotype; *E–J*, allotype. *A*, front view of Mx1; *B*, front, and *C*, rear, views of Mxp; *D* and *J*, P5; *E*, A1; *F*, P2; *G*, P3; *H*, P4.

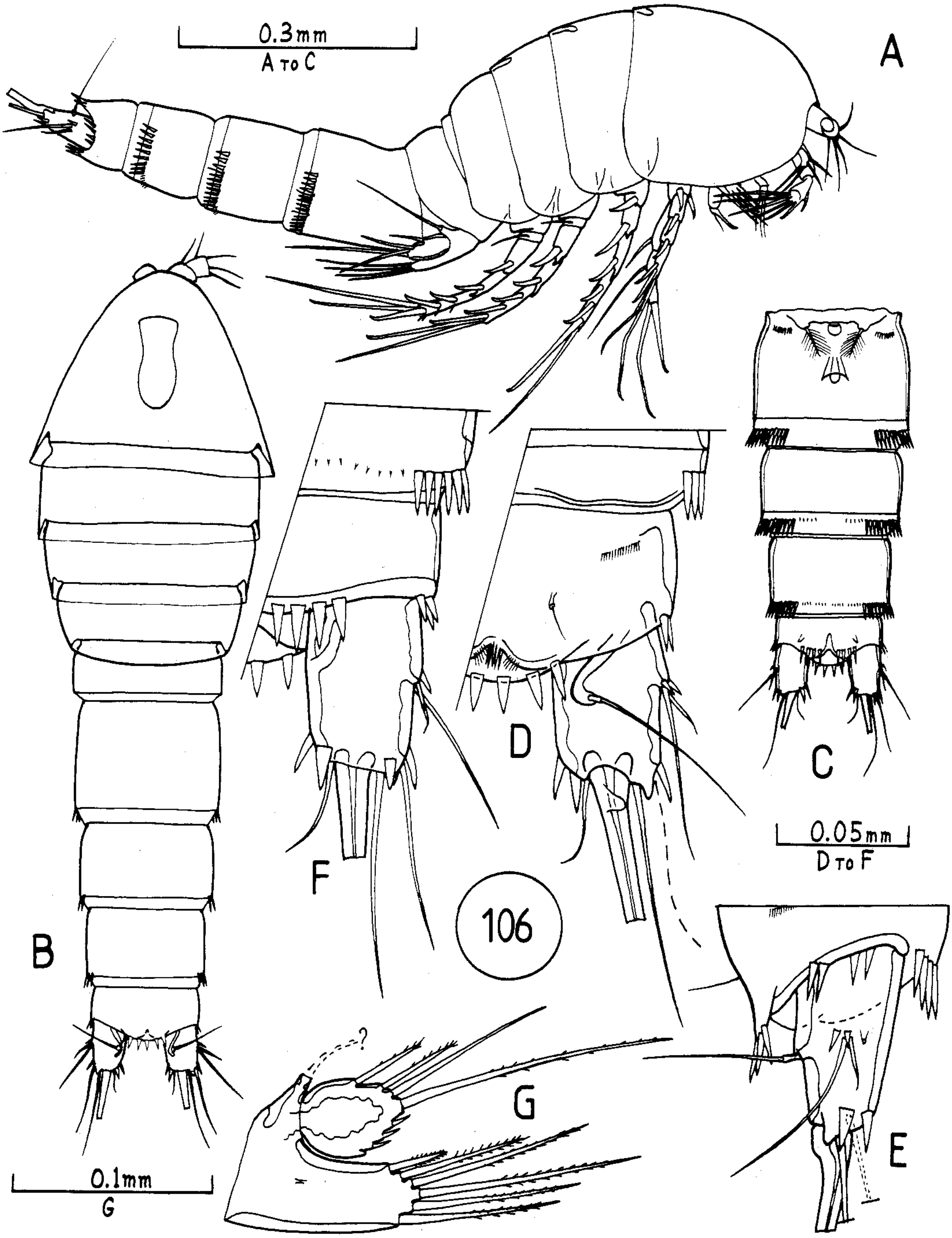


Fig. 106. *C. howardorum*, female holotype. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd; *D*, dorsal, *E*, side, and *F*, ventral, views of one FR and adjacent structures; *G*, P5 (OBS shown dashed because lost).

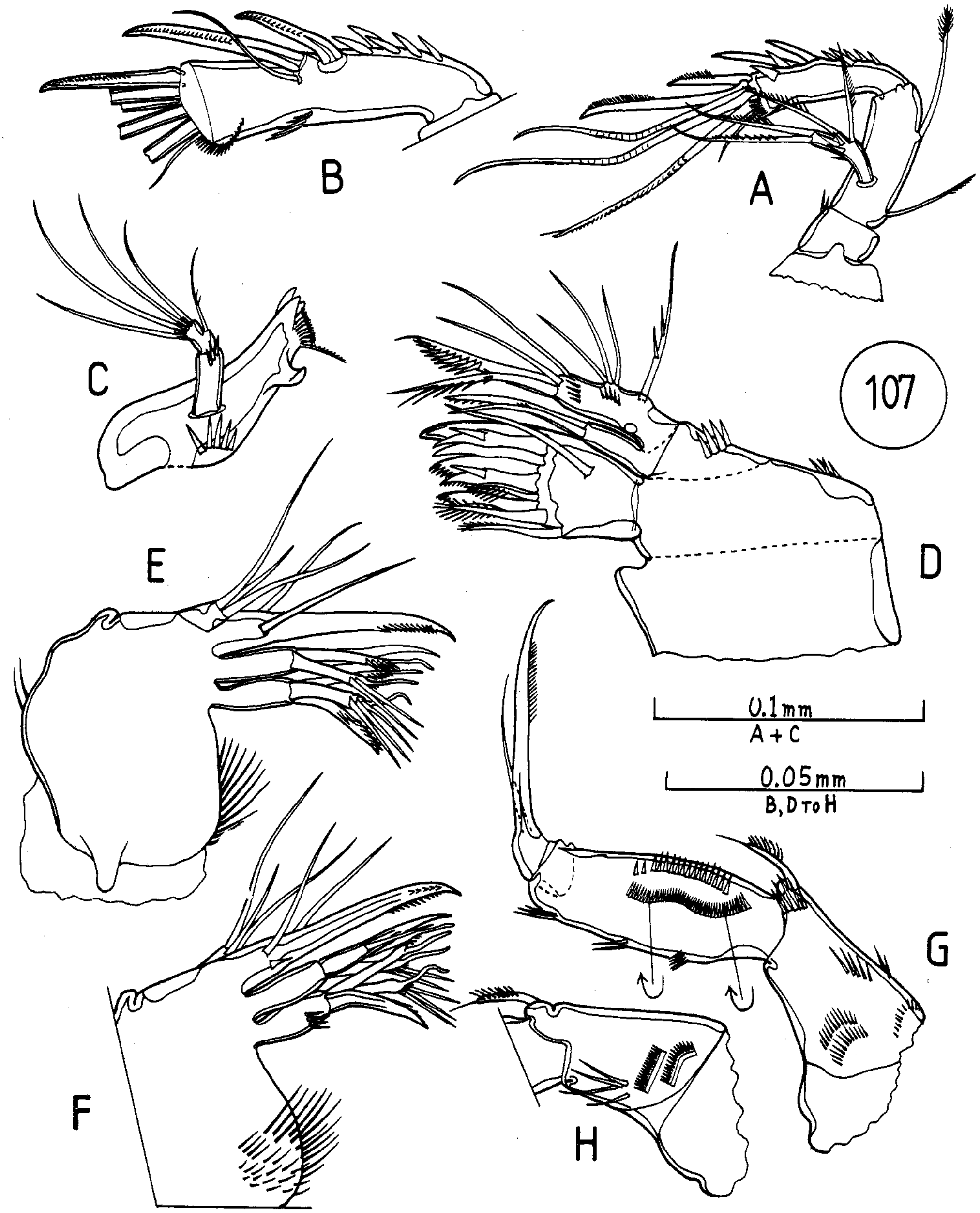


Fig. 107. *C. howardorum*, female to holotype. *A*, exop view of entire A2; *B*, abexp view of A2enp; *C*, Md; *D*, Mxl; *E* and *F*, Mx2; *G*, entire Mxp; *H*, Mxp forearm. *C*, *F*, and *G*, front views; *D*, *E*, and *H* in rear view.

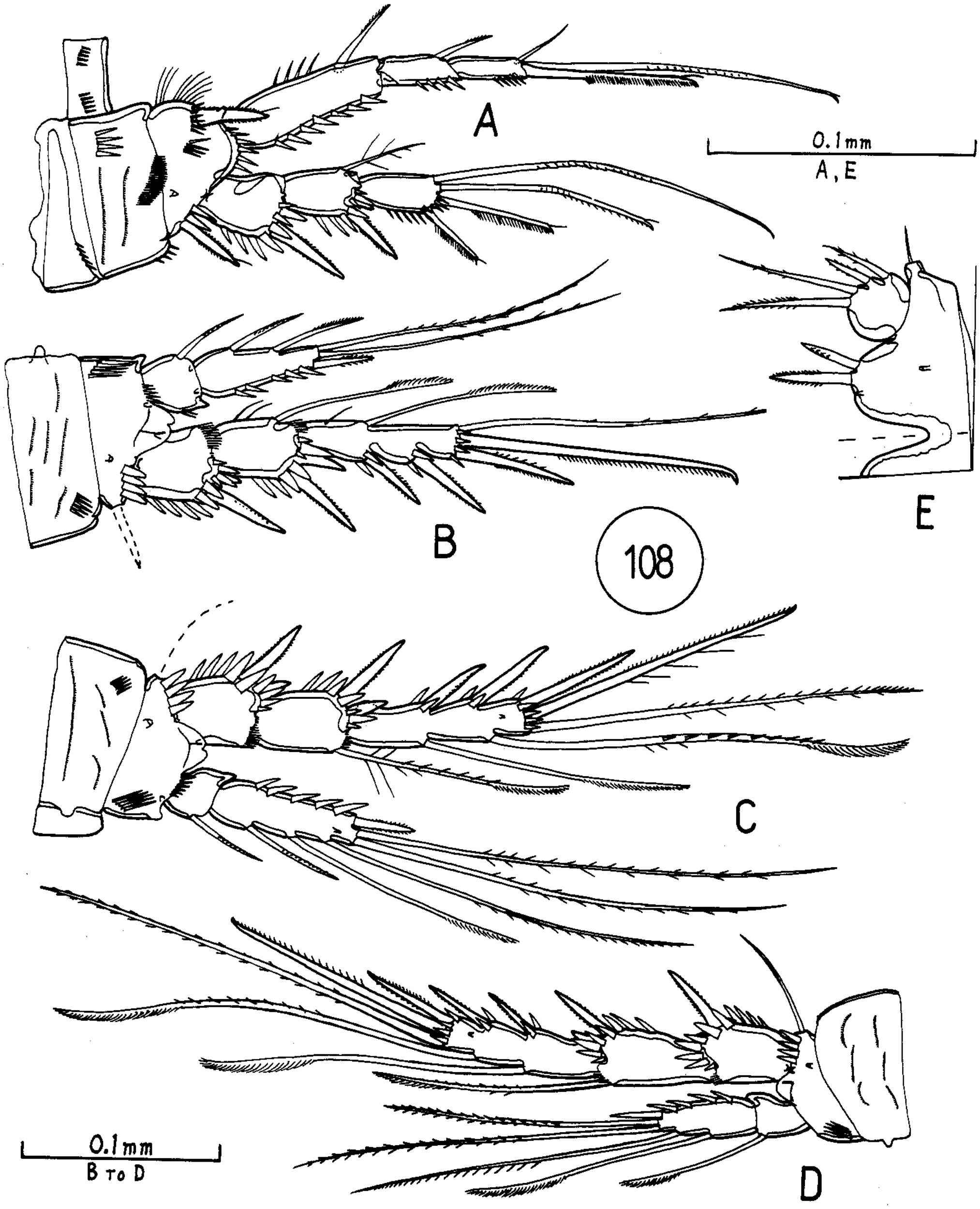


Fig. 108. *C. howardorum*; *A* and *E*, male allotype; others from the female holotype. *A*, P1; *B*, P2; *C*, P3; *D*, P4; *E*, P5.

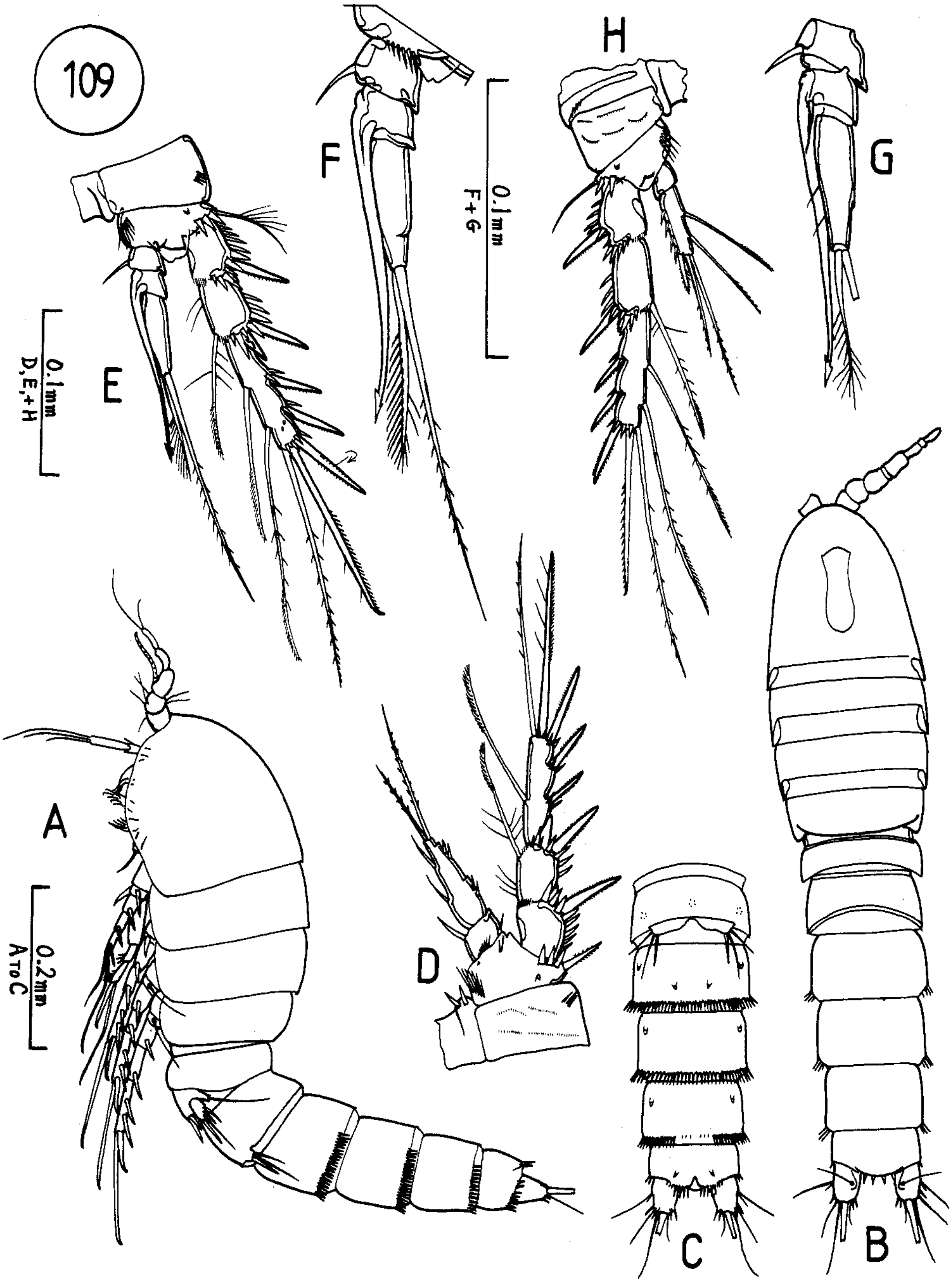


Fig. 109. *C. howardorum*, male allotype. *A*, side, and *B*, dorsal, views of whole animal; *C*, ventral view of Abd with P6; *D*, P2; *E*, P3; *F*, front, and *G*, rear, views of P3enp; *H*, P4. See Fig. 97*G* for male A1.

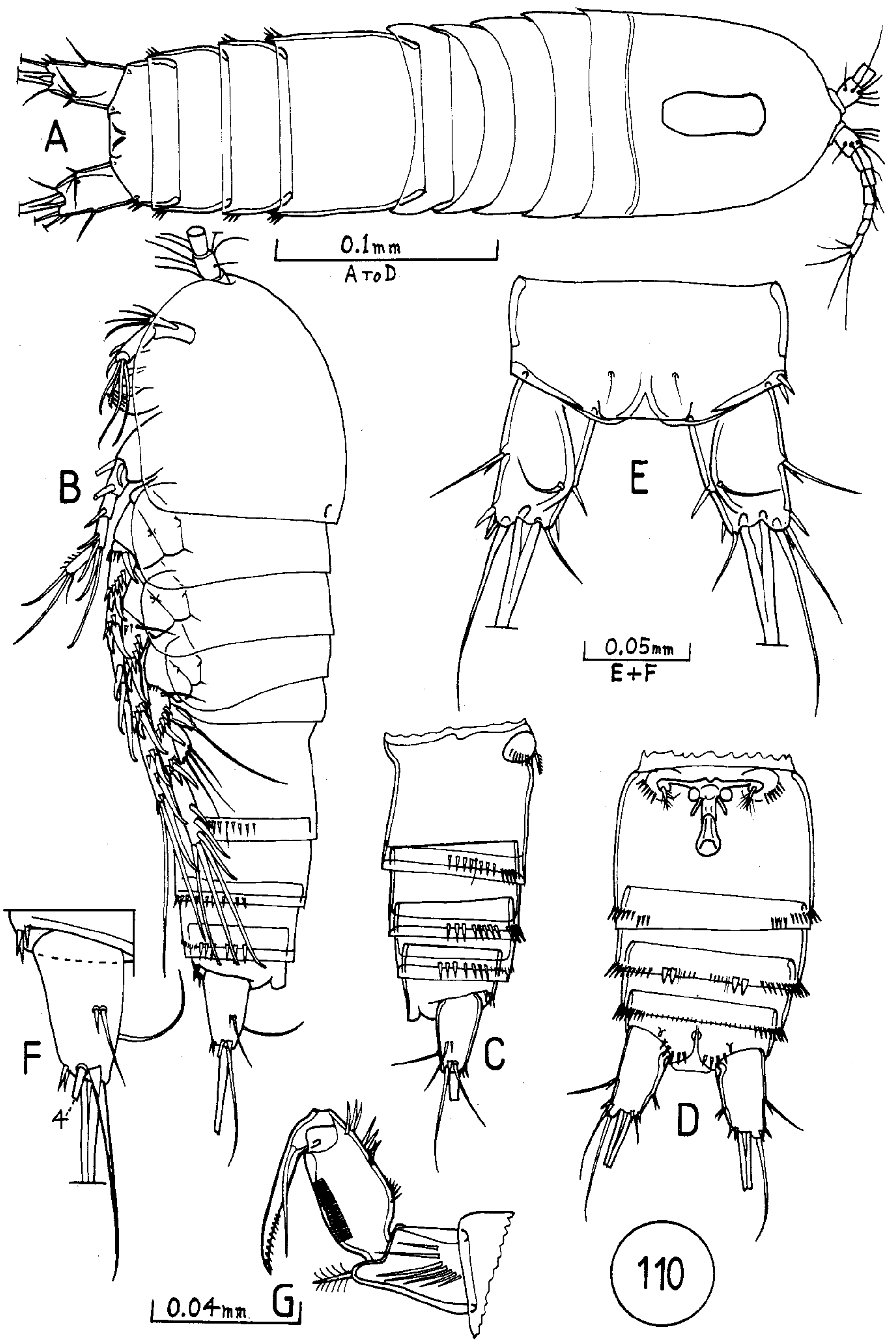


Fig. 110. *C. sublaevis*, holotype female. *A*, dorsal, and *B*, side, views of whole animal; *C*, Abd from other side to show spinulation partly masked by legs in *B*; *D*, Abd in ventral view; *E*, Abd5 with op and FRs in dorsal view; *F*, left-side view of FR, with the stump of seta4 numbered; *G*, rear view of Mxp.

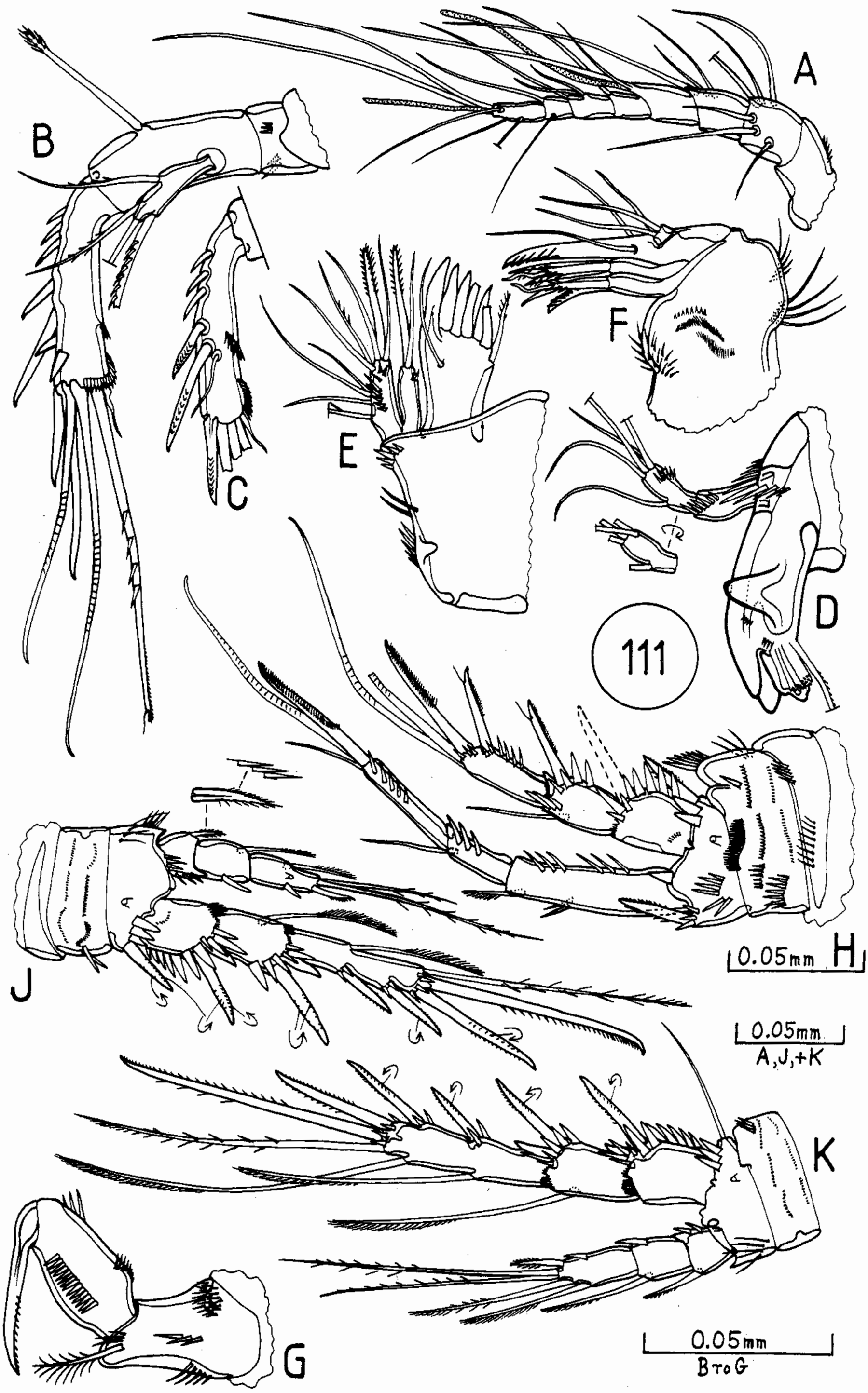


Fig. 111. *C. sublaevis*, holotype female. *A*, A1; *B*, exop view of A2; *C*, abexp view of A2enp; *D*, Md; *E*, Mx1; *F*, Mx2; *G*, Mxp; *H*, P1; *J*, P2; *K*, P3. *D–F* in rear, *G* in front, view.

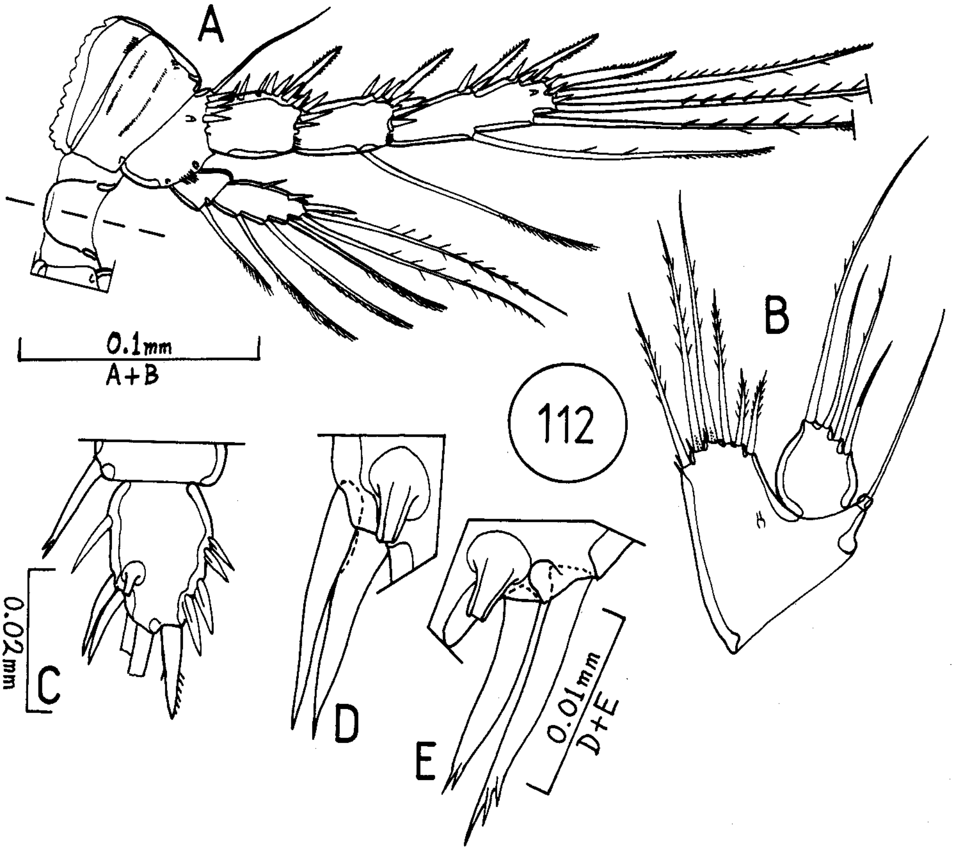


Fig. 112. *A* and *B*, *C. sublaevis*, holotype female. *A*, P4; *B*, P5. *C–E*, *F. victorianus*, holotype female. *C*, entire P3enp2; *D* and *E*, the inner setae of enp2 together with the tube-pore (see text). *C–E* in rear view.

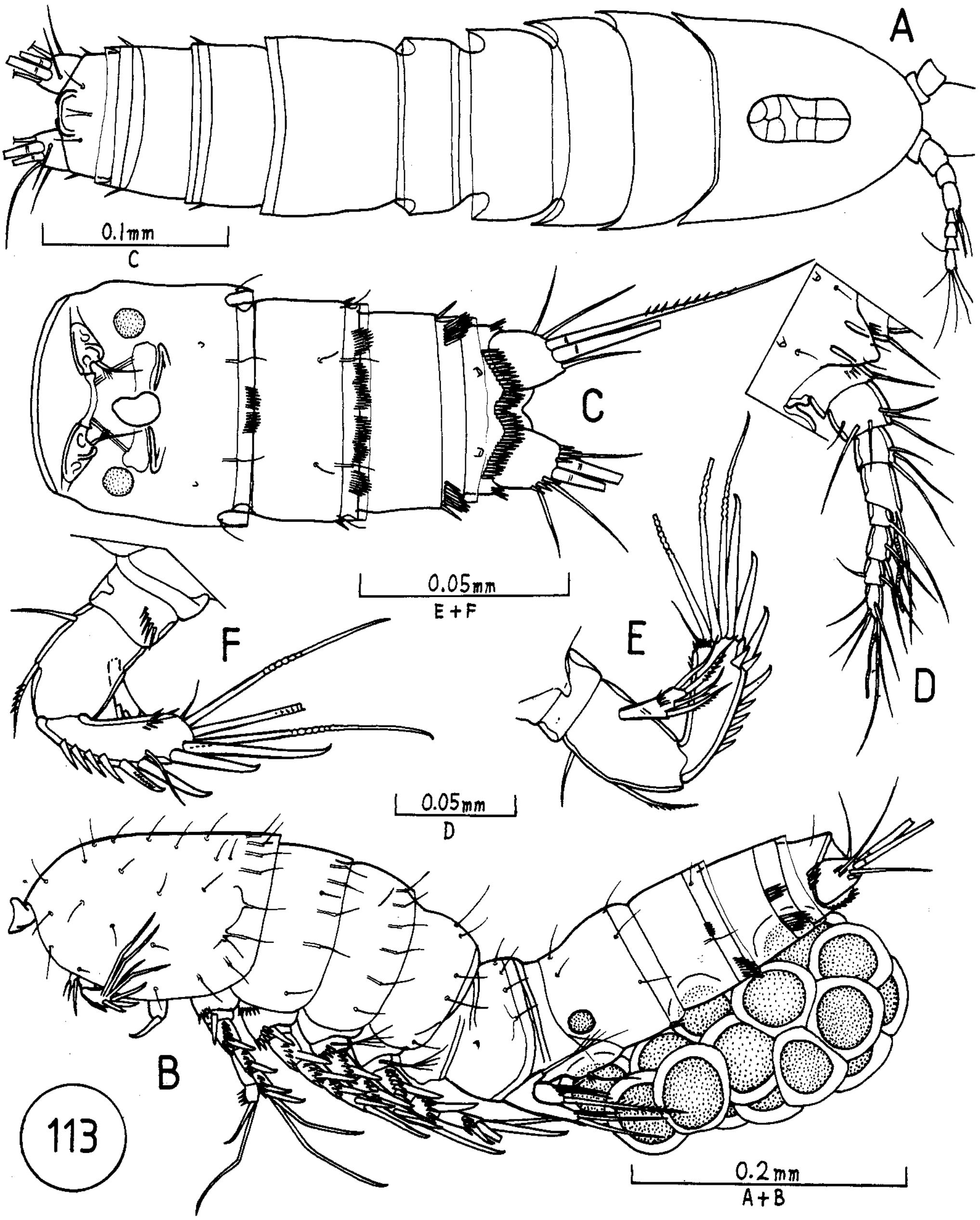


Fig. 113. *F. victorianus*, female holotype. *A*, dorsal, and *B*, side, views of entire animal with eggs; *C*, ventral view of Abd; *D*, R and A1; *E*, exop, and *F*, abexp, views of A2.

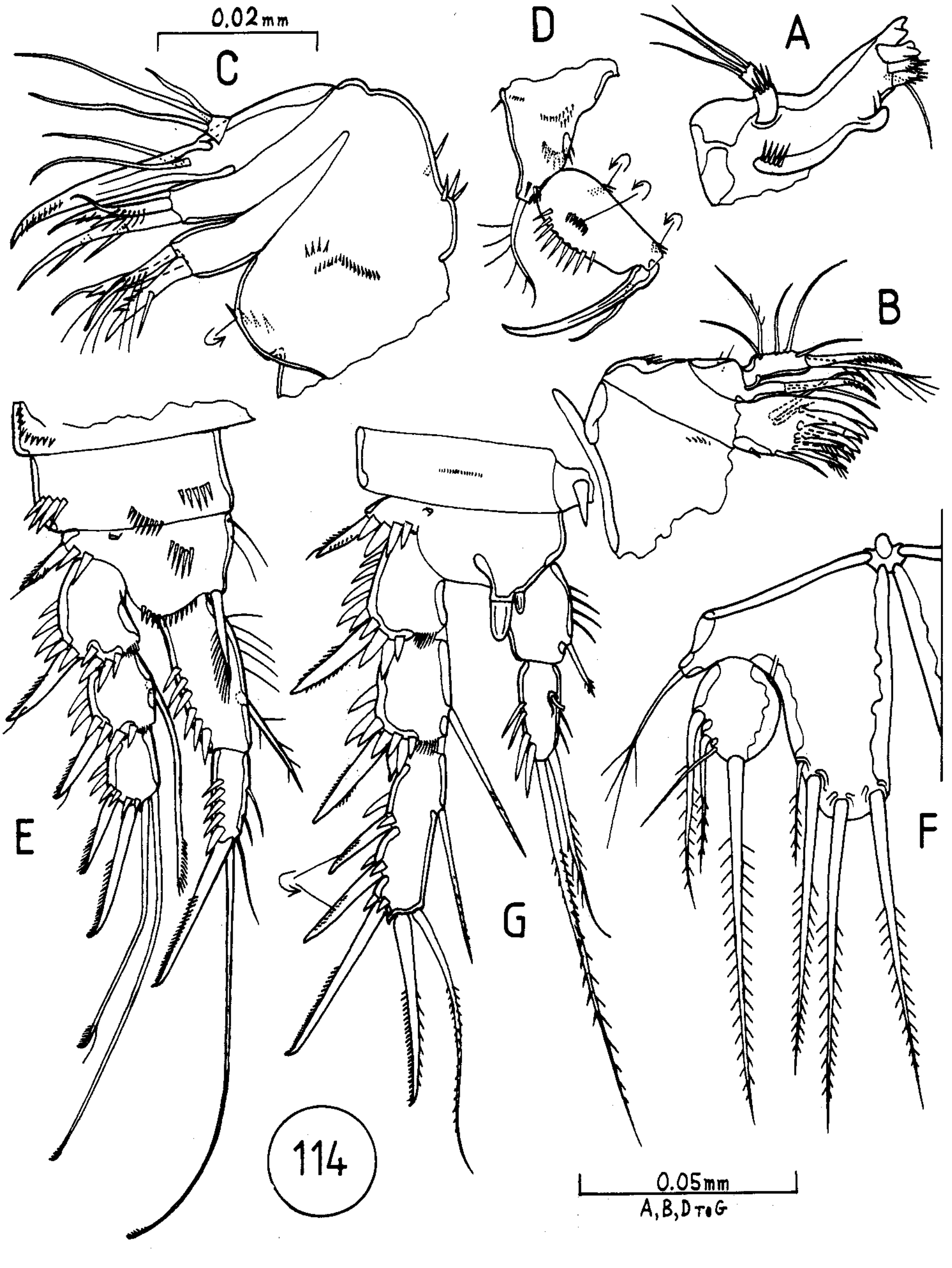


Fig. 114. *F. victorianus*; *G* from the male allotype, the others from the female holotype. *A*, Md; *B*, Mx1; *C*, Mx2; *D*, Mxp; *E*, P1; *F*, P5; *G*, P2. *A* and *C* in rear view, the others in front view.

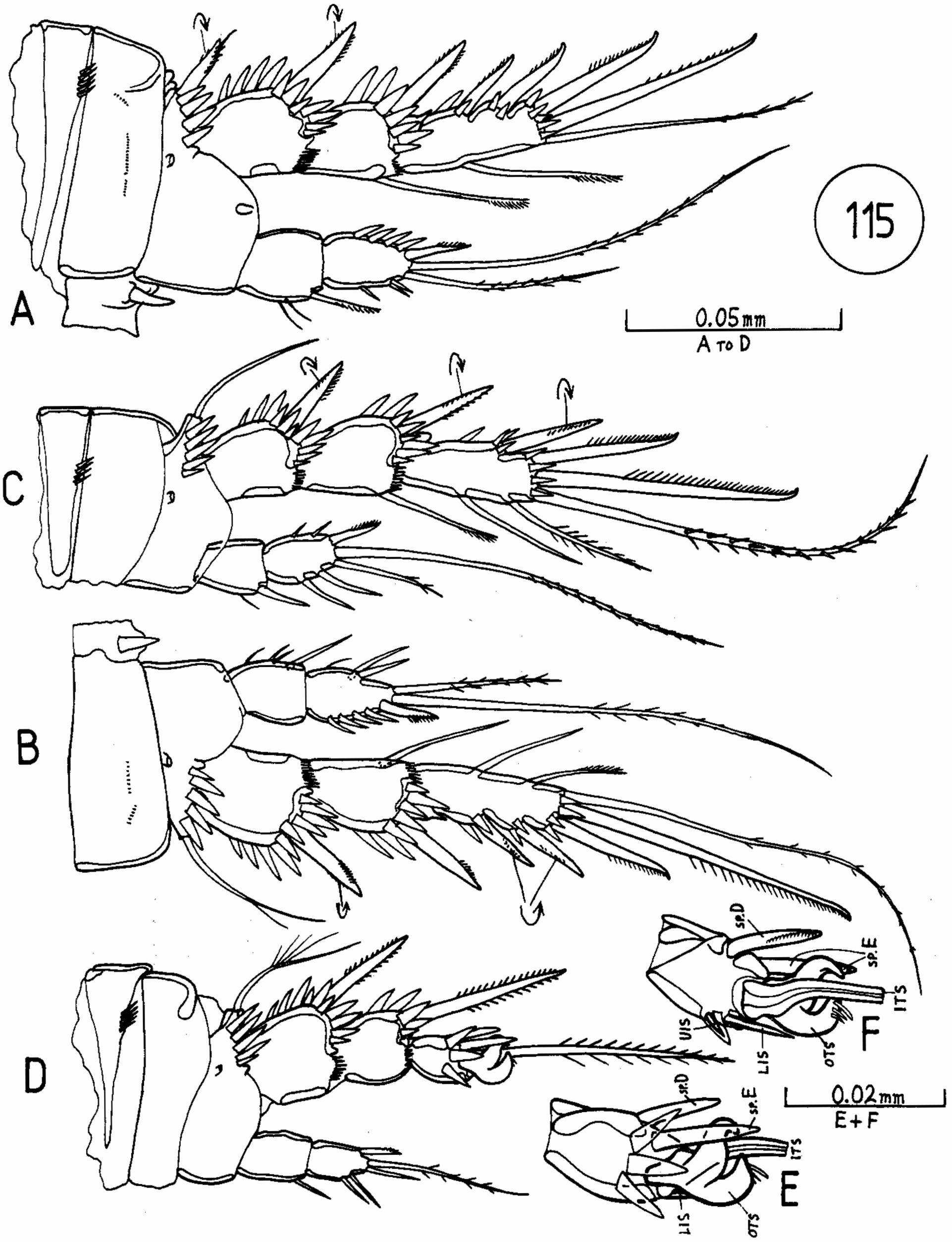


Fig. 115. *F. victorianus*; *A–C*, female holotype; *D–F*, male allotype. *A*, P2; *B*, P3; *C* and *D*, P4; *E*, front, and *F*, rear, views of male P4exp3 whose spines and setae are labelled as follows: sp. D and sp. E, exopod spines D and E; ITS and OTS, inner and outer terminal setae, the latter being modified to form a grapnel; UIS and LIS, upper and lower inner setae. Note that UIS in *F* lies exactly behind a spinule which conceals it in *E*.

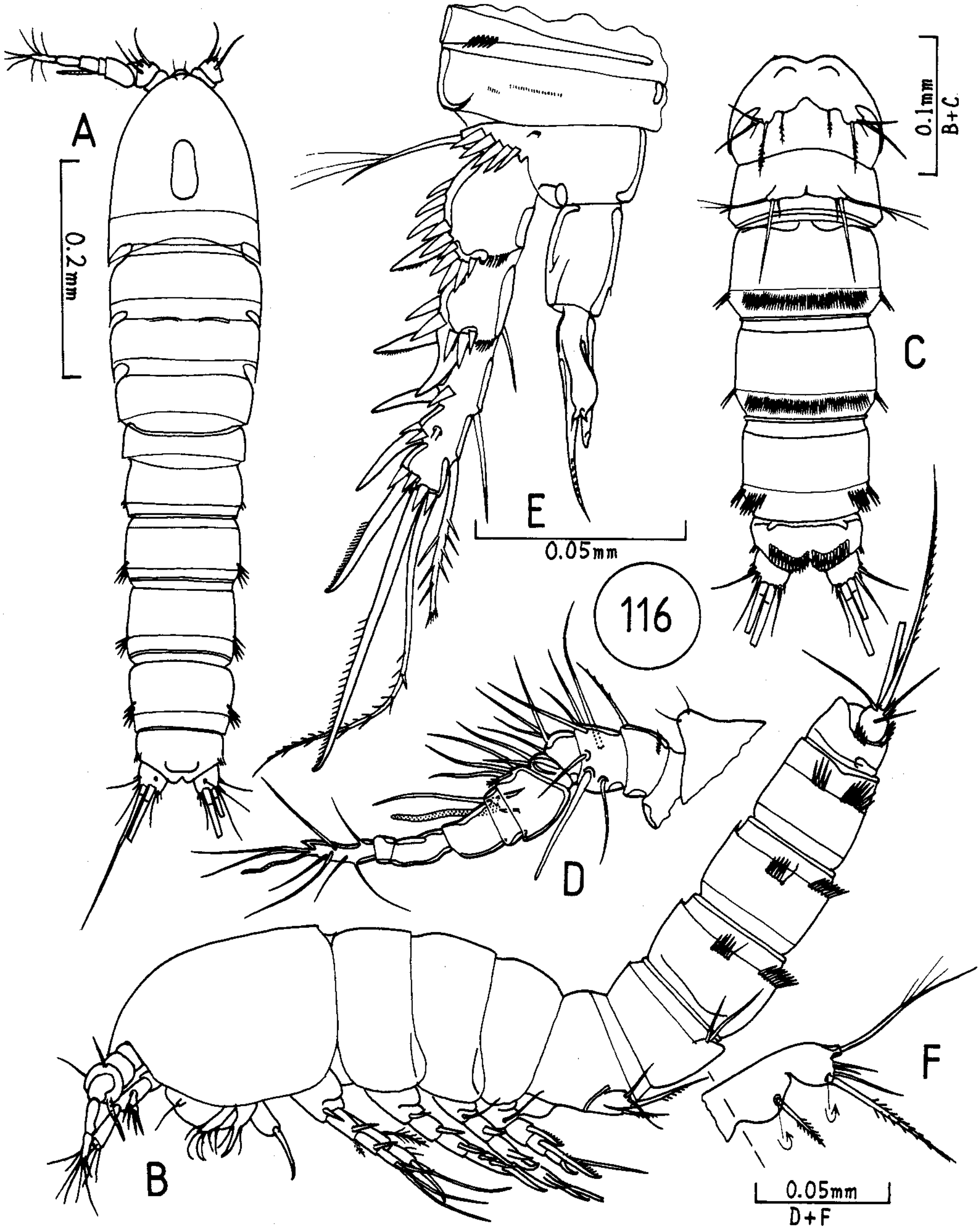


Fig. 116. *F. victorianus*, male allotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd with P5 and P6; *D*, R and A1; *E*, P3; *F*, P5.

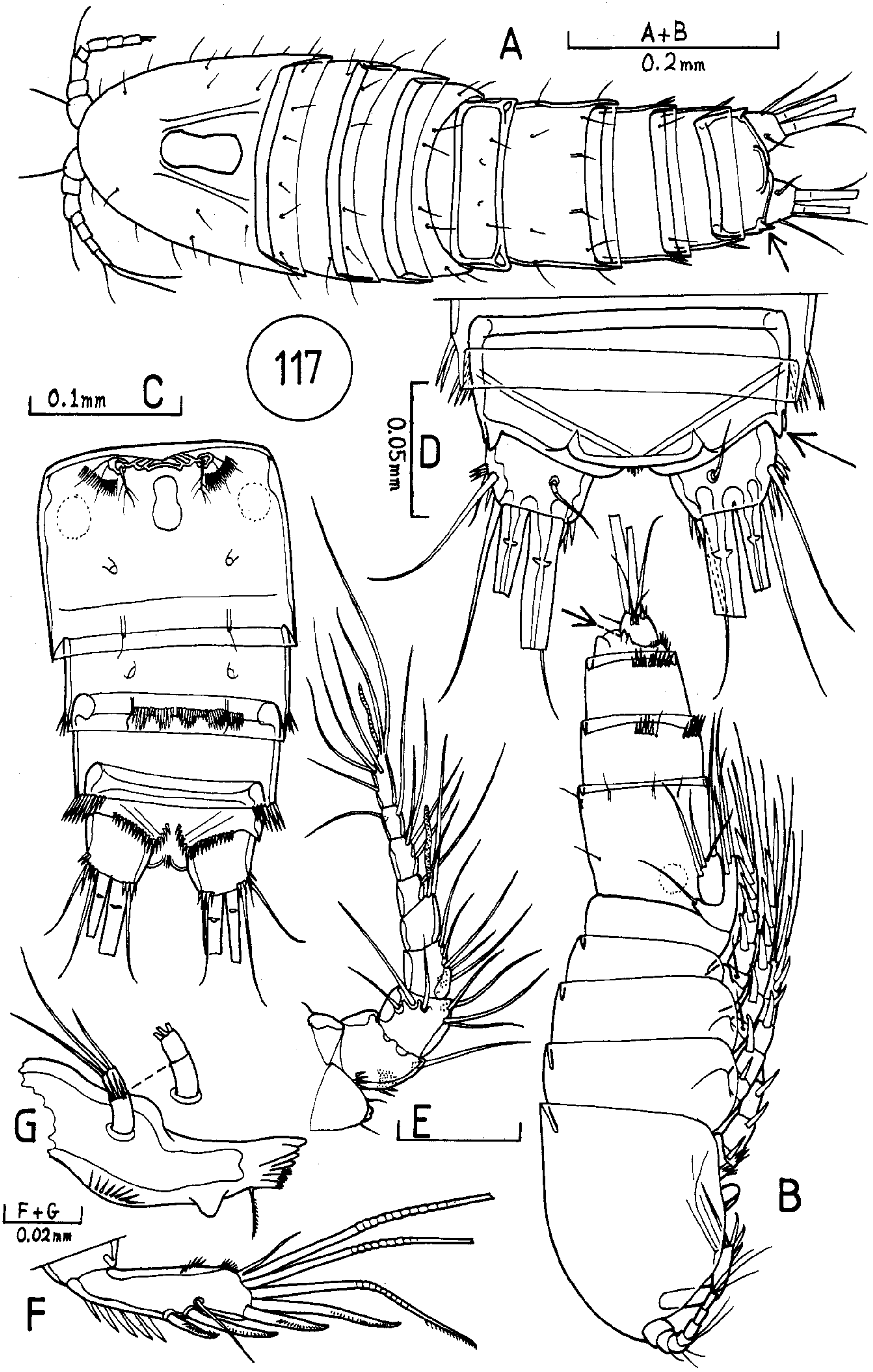


Fig. 117. *F. tasmanicus*, female holotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, dorsal view of op with FRs; *E*, R and A1; *F*, abexp view of A2enp; *G*, front view of Md, with (inset) palp as if denuded of spinules so as to reveal suture between CXB and enp. *C*, *D*, and *E* have own scales.

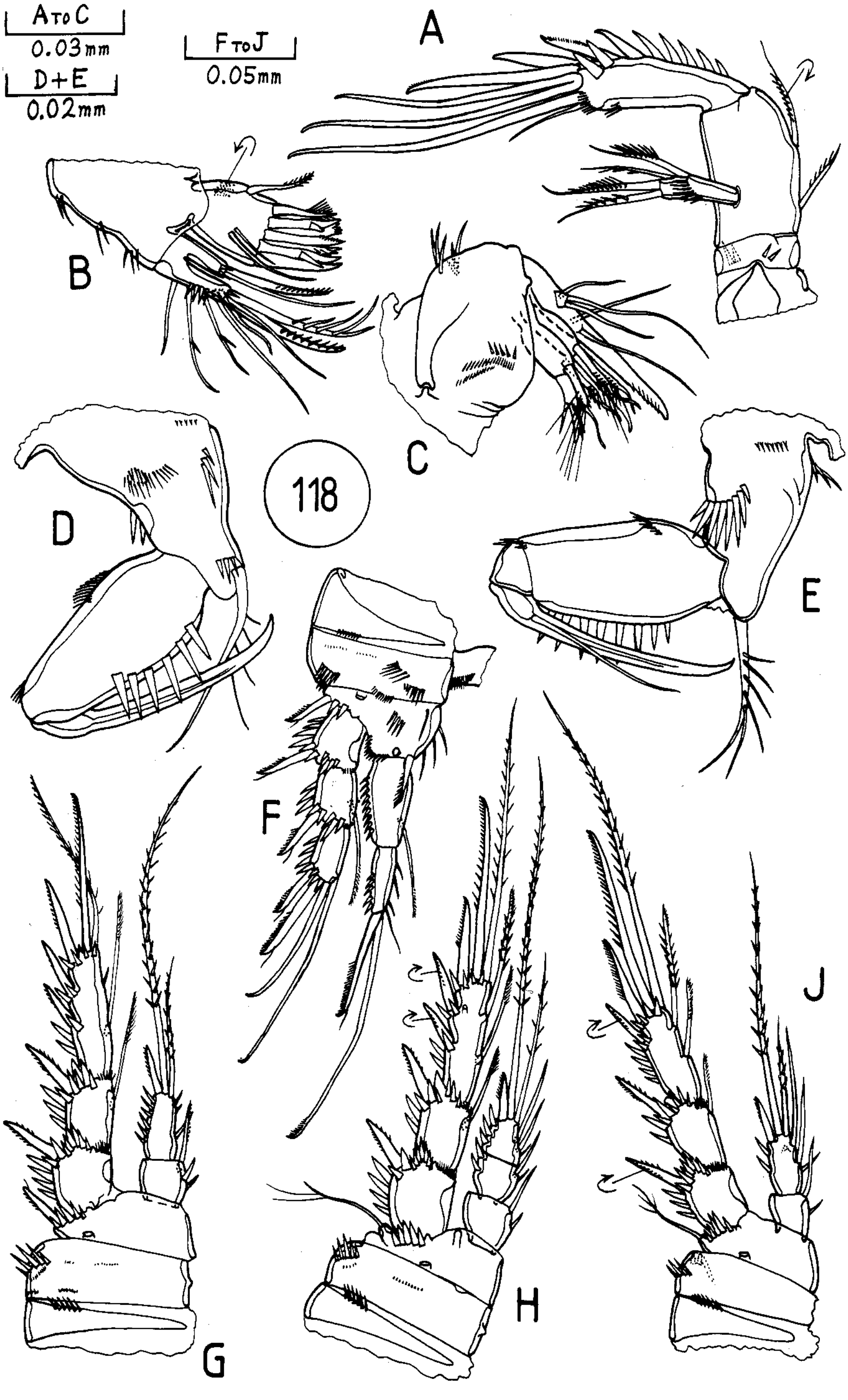


Fig. 118. *F. tasmanicus*, female holotype. *A*, exop view of A2; *B*, Mx1; *C*, Mx2; *D* and *E*, Mxp; *F–J*, P1–P4 in that order. *B*, *C*, and *E* in rear view; *D* and *F–J* in front view.

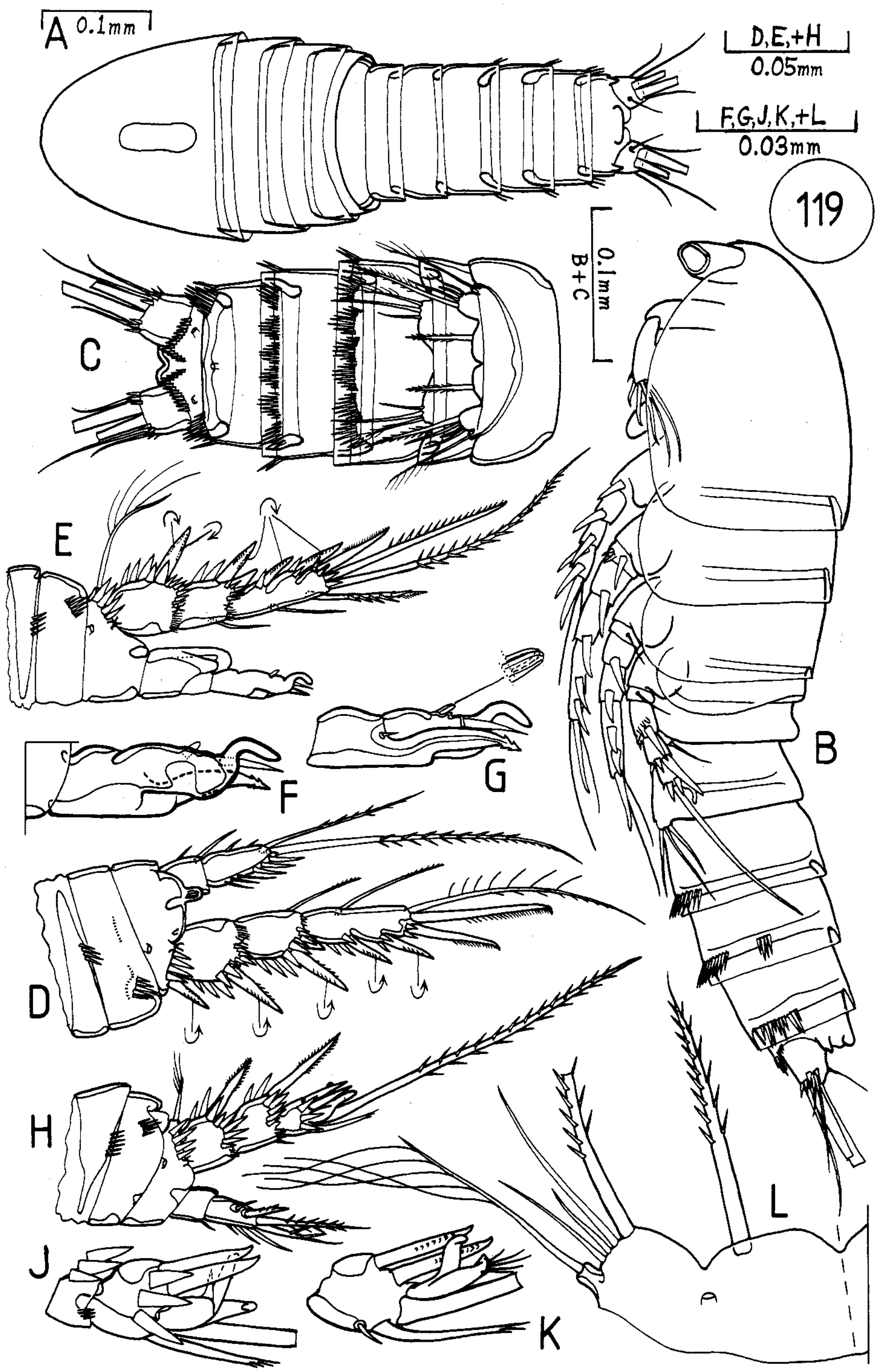


Fig. 119. *F. tasmanicus*, male allotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd with P5 and P6; *D*, P2; *E*, P3; *F* and *G*, P3enp2 (next to *G*, with a connecting line, the double nature of the papilla is shown); *H*, P4; *J* and *K*, P4exp3 to show grapnel; *L*, P5. *D–L* in front view, except *G* and *K* which are in rear view.

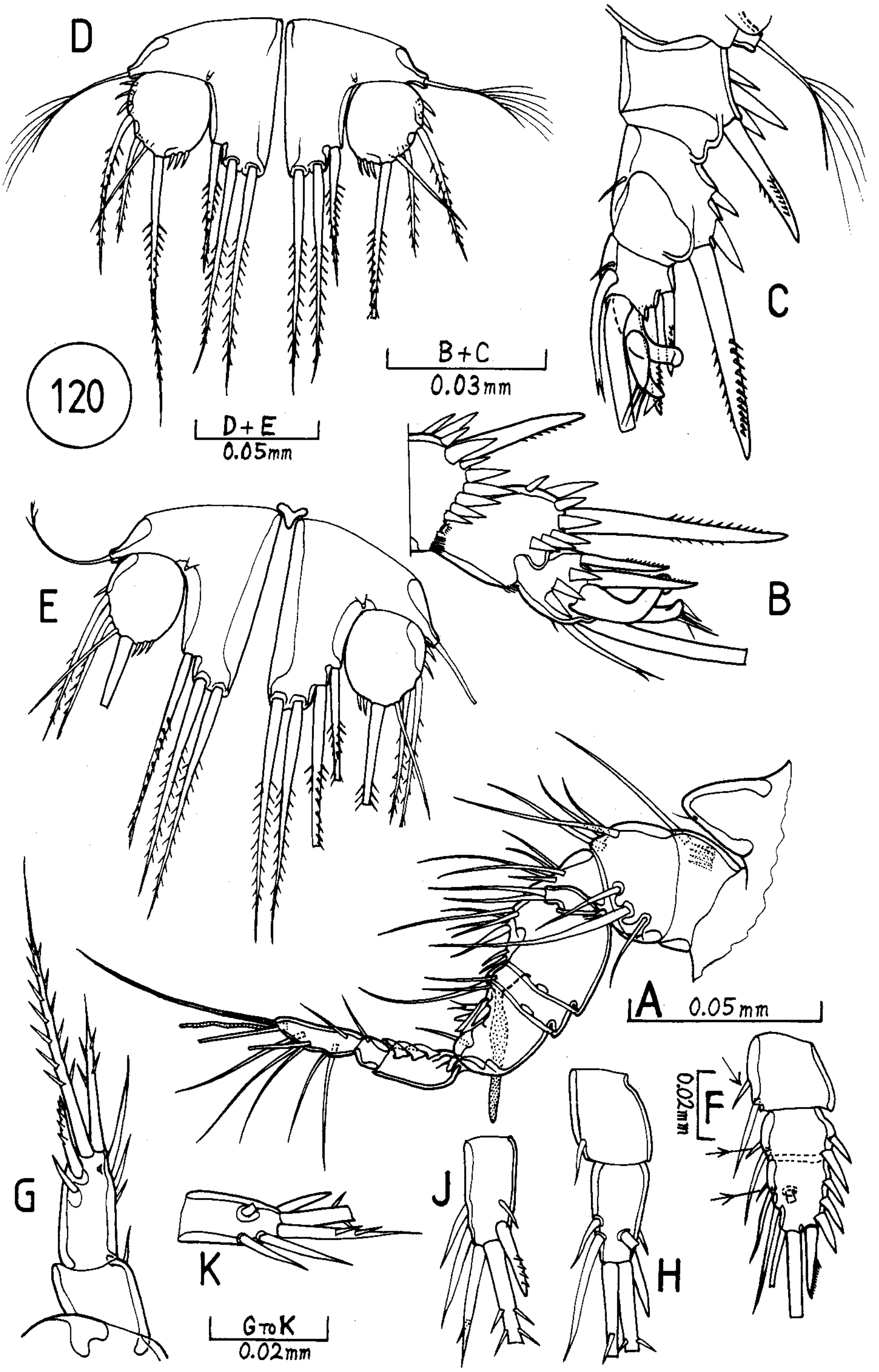


Fig. 120. *F. tasmanicus*; *D–F* female, the rest male; *E* from the female holotype, *G* and *H* from the male allotype, the others from sample 7R670; *A* in dorsal view, *C*, *H*, and *K* in rear view, the others in front view. *A*, R and A1; *B* and *C*, P4exp; *D* and *E*, paired P5s; *F*, P3enp (see text); *G–K*, setation of P4enp2 (and of enp1 where shown).

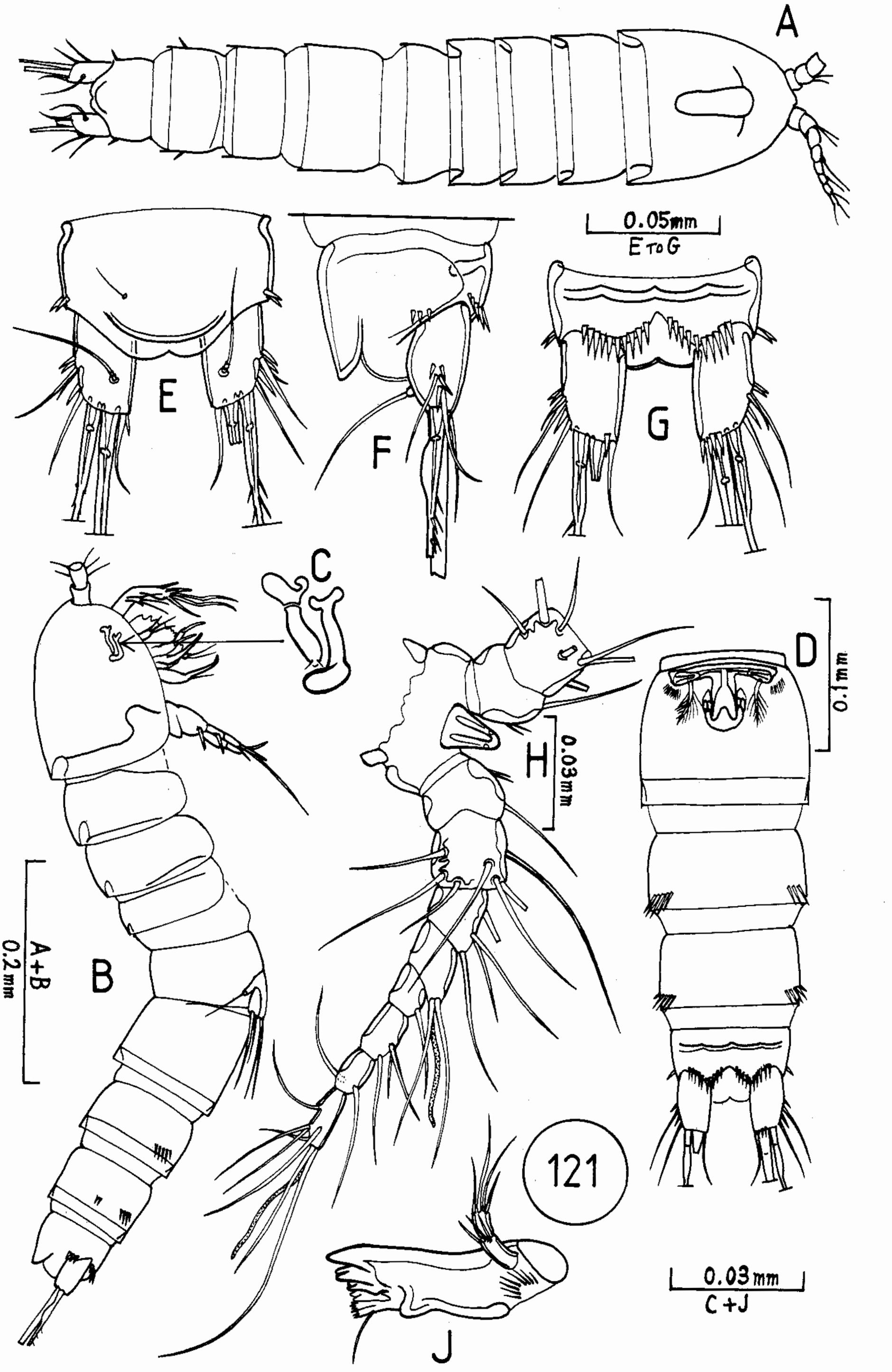


Fig. 121. *F. gracilior*, female; *J* from paratype 1, *A–H* from the holotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, sclerites (much enlarged) which appear to support the Md; *D*, ventral view of Abd; *E*, dorsal, *F*, right, and *G*, ventral, views of op with FRs; *H*, dorsal view of R with A1; *J*, front view of Md.

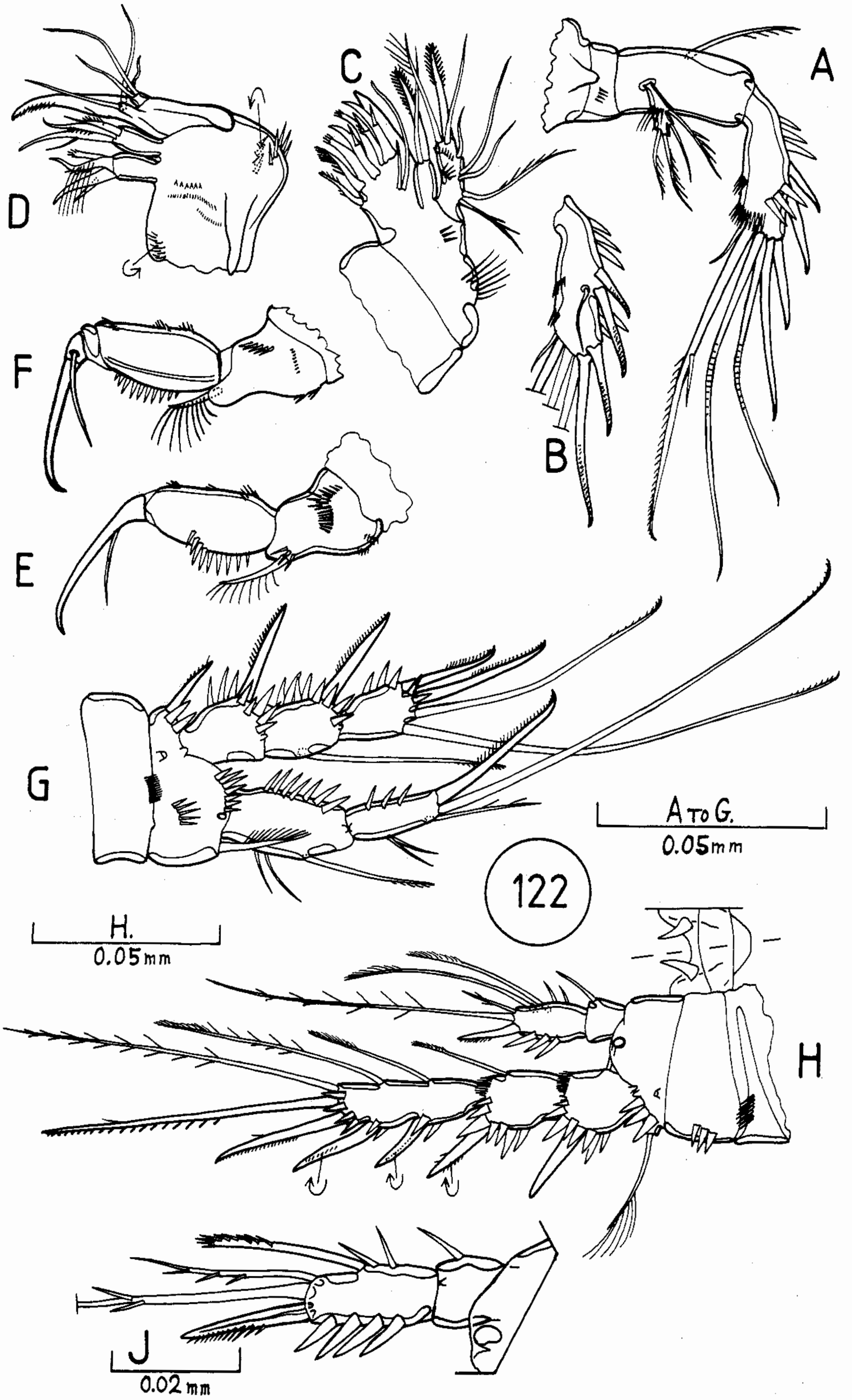


Fig. 122. *F. gracilior*, female; *A*, *B*, and *H* from paratype 1, the others from the holotype. *A*, exop view of A2; *B*, abexp view of A2enp; *C*, Mx1; *D*, Mx2; *E* and *F*, Mxp; *G*, P1; *H*, P3; *J*, P2enp1 (see text). *E*, *G*, *H*, and *J* in front view; *C*, *D*, and *F* in rear view. *H* and *J* have own scales.

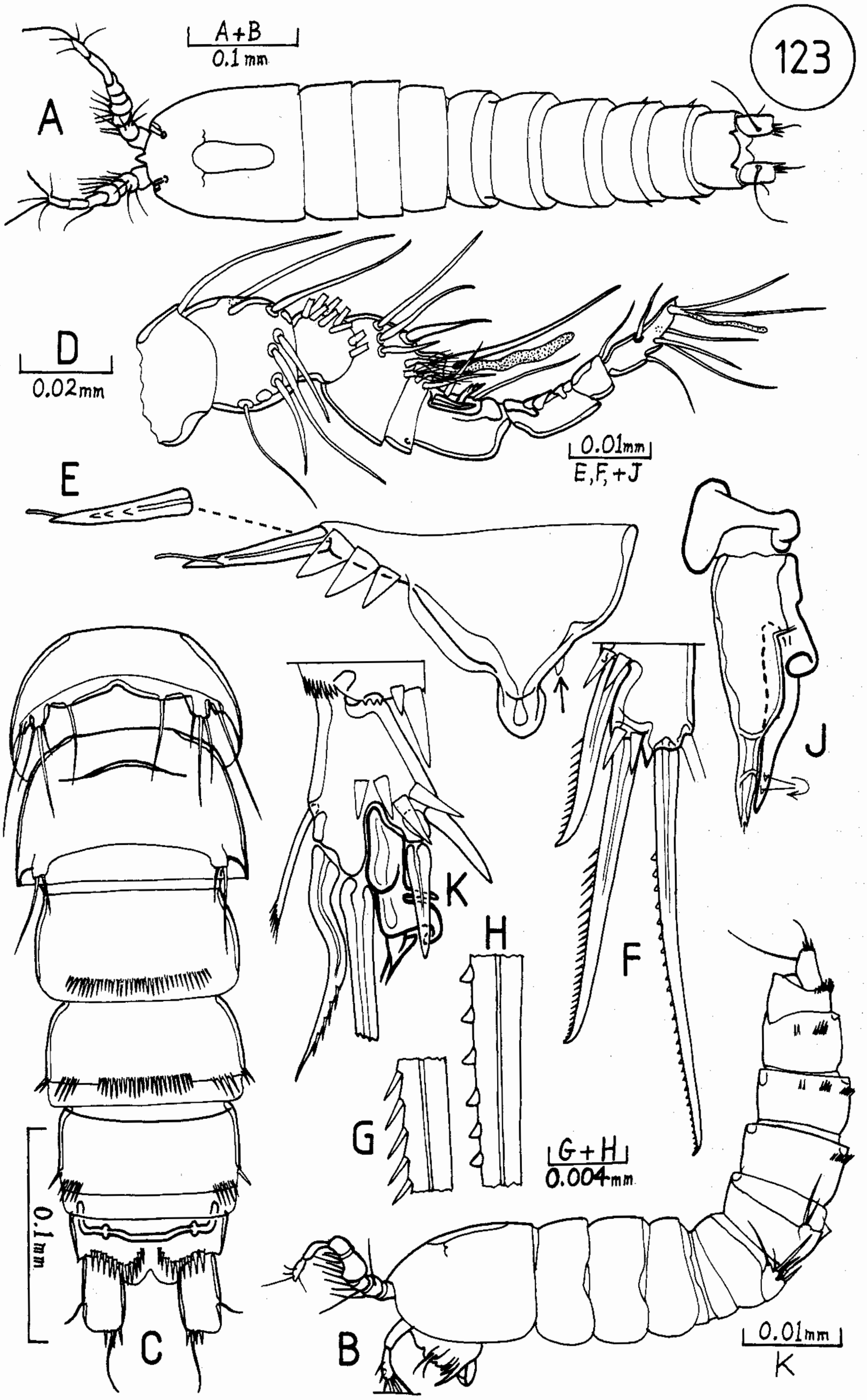


Fig. 123. *F. gracilior*, male allotype. *A*, dorsal, and *B*, side, views of whole animal; *C*, ventral view of Abd; *D*, dorsal view of A1; *E–H*, P2; *E*, basis showing distal knob, and (inset) the rear face of the OBS to show denticulations; *F*, end of exp3 with exp-spines D and E, and the outer terminal seta, to show ornamentation; *G*, part of exp-spine *E*, and *H*, part of the outer terminal seta, to show ornamentation enlarged; *J*, P3enp; *K*, P4exp3 showing grapnel-seta heavily outlined. *E–K* in front view except for the inset to *E*. *C*, *D*, and *K*, each have own scale.

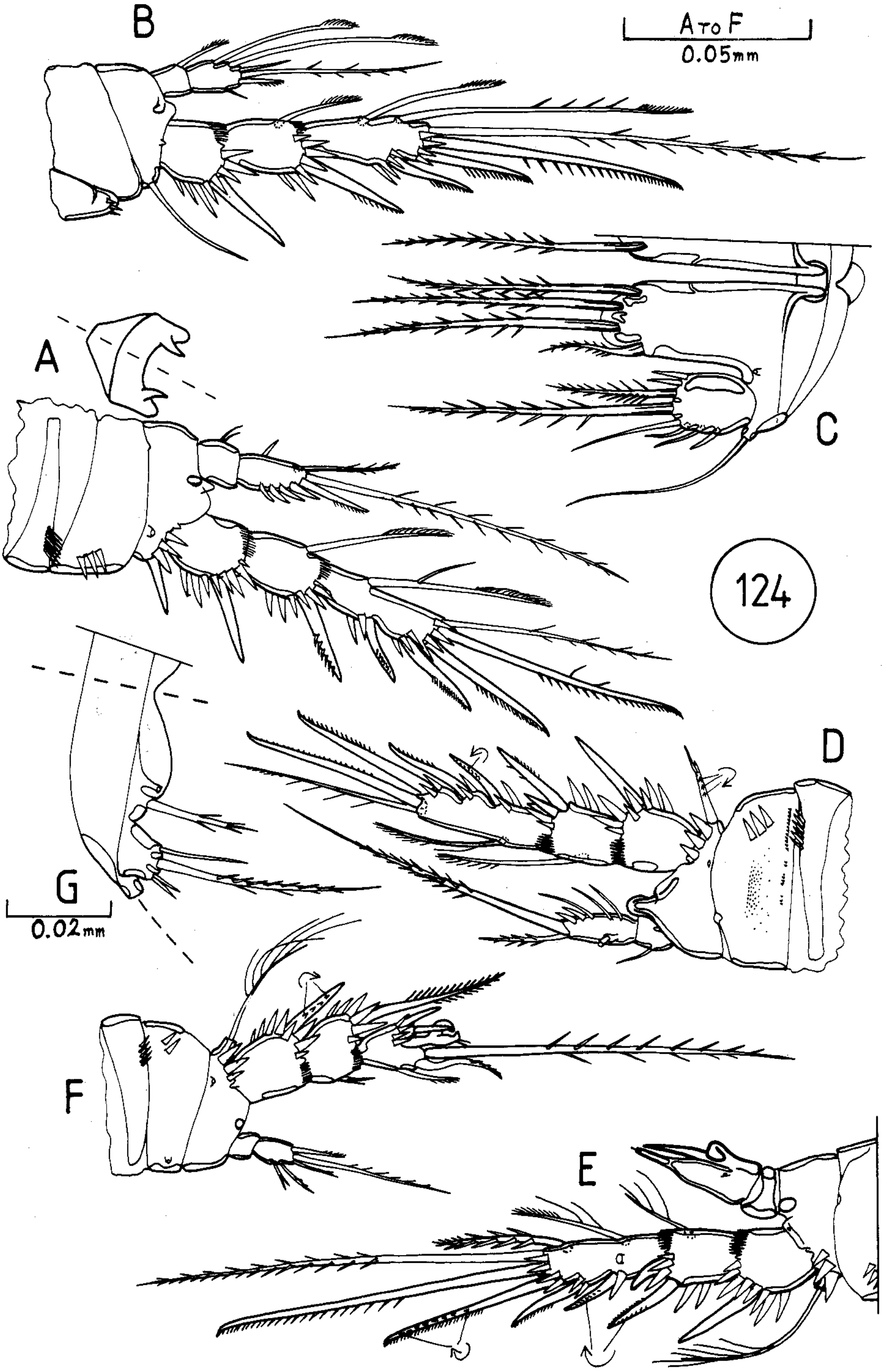


Fig. 124. *F. gracilior*, legs; *A–C*, female (*A* from paratype 1, *B* and *C* from holotype); *D–G*, male allotype. *A* and *D*, P2; *B* and *F*, P4; *C* and *G*, P5; *E*, P3.

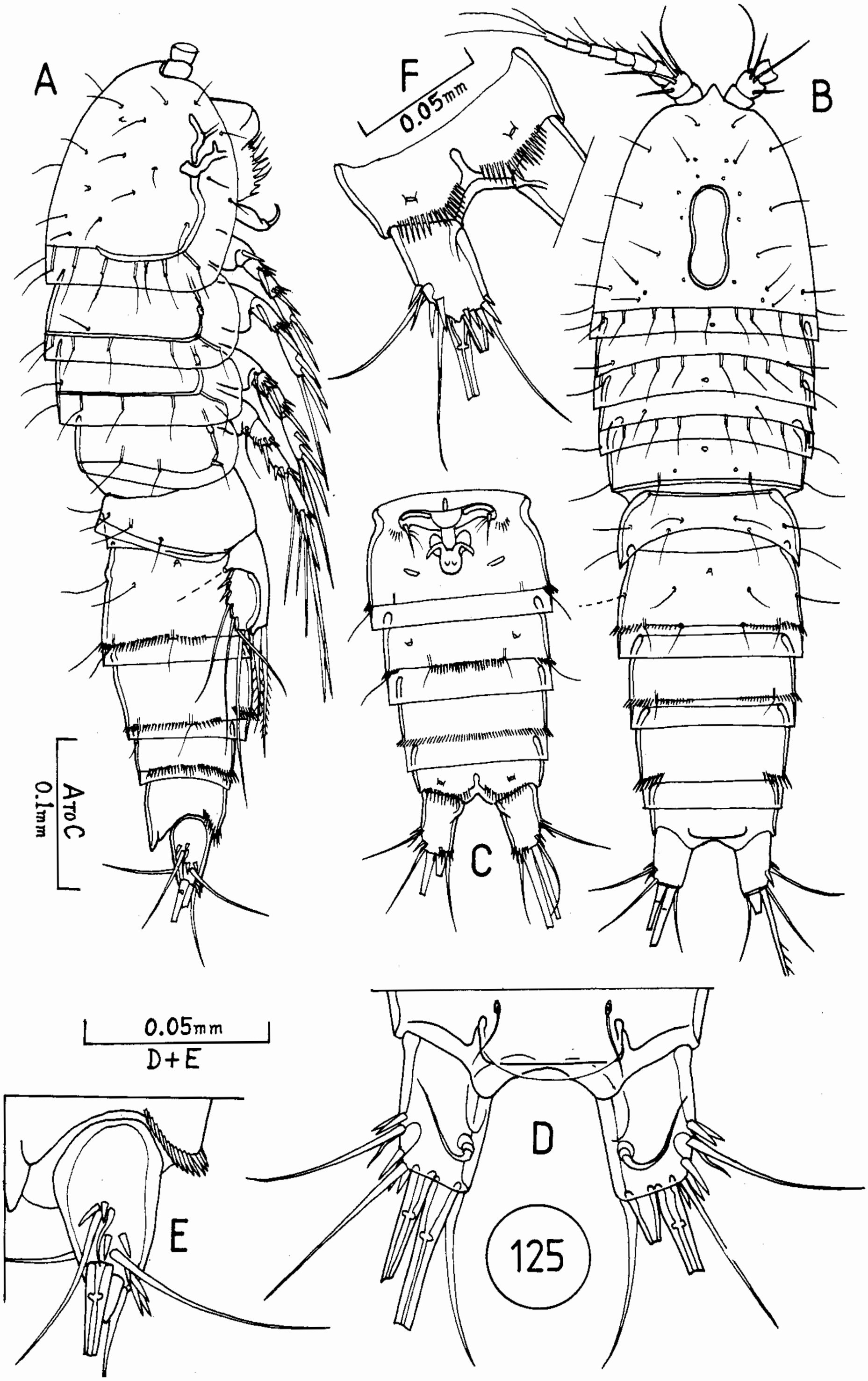


Fig. 125. *F. bisetosus*, holotype female. *A* and *B*, whole animal; *C*, Abd; *D–F*, FRs (with op in *D*). *A* and *E* from the right side, *B* and *D* in dorsal view, *C* and *F* in ventral view.

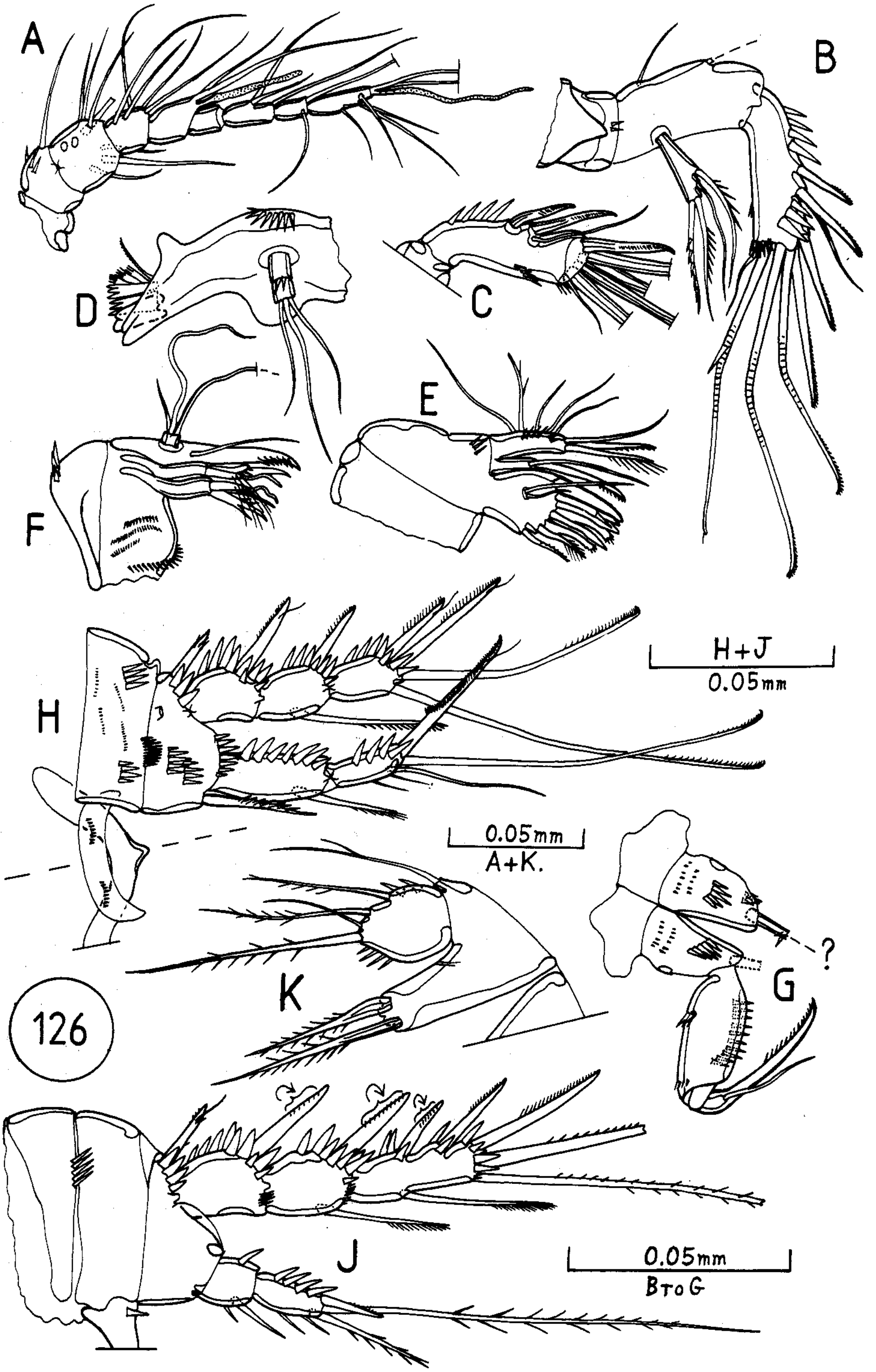


Fig. 126. *F. bisetosus*, holotype female. *A*, A1; *B*, A2; *C*, abexp view of A2enp; *D*, Md; *E*, Mx1; *F*, Mx2; *G*, Mxp; *H*, P1; *J*, P2; *K*, P5. Distal allobase seta lost in *B* (? injury). *D* and *H–K* in front view; *E–G* in rear view.

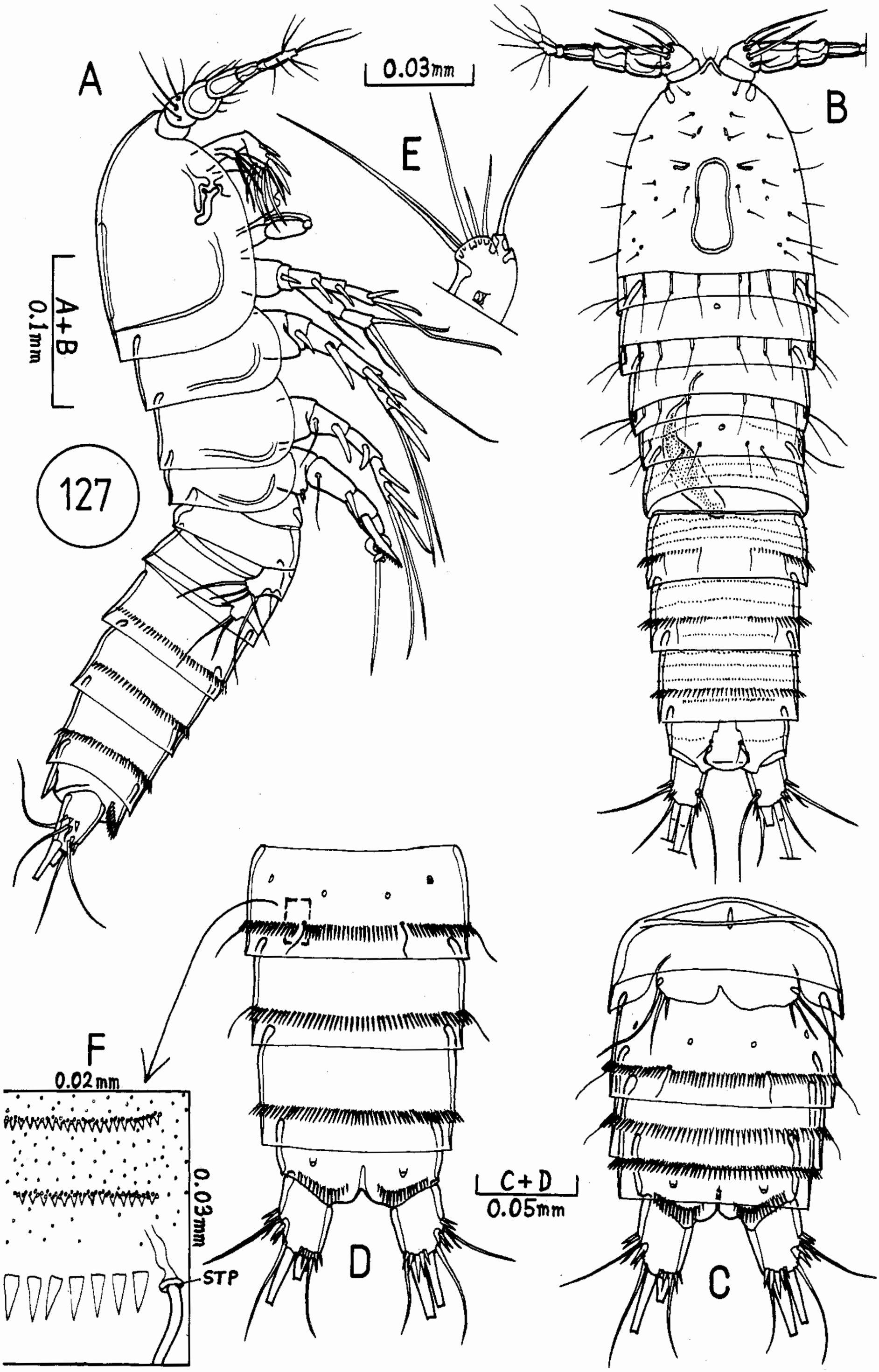


Fig. 127. *F. bisetosus*, allotype male. *A*, side, and *B*, dorsal, views of entire animal; *C*, ventral view of Abd (severely telescoped), including Abd1 to show P6; *D*, Abd redrawn from *C* as if re-extended, omitting Abd1; *E*, P5; *F*, the arrowed part of the dorsal surface in *D* (viewed by transparency) enlarged to show details explained in the text (STP, sensillary tunnel-pore).

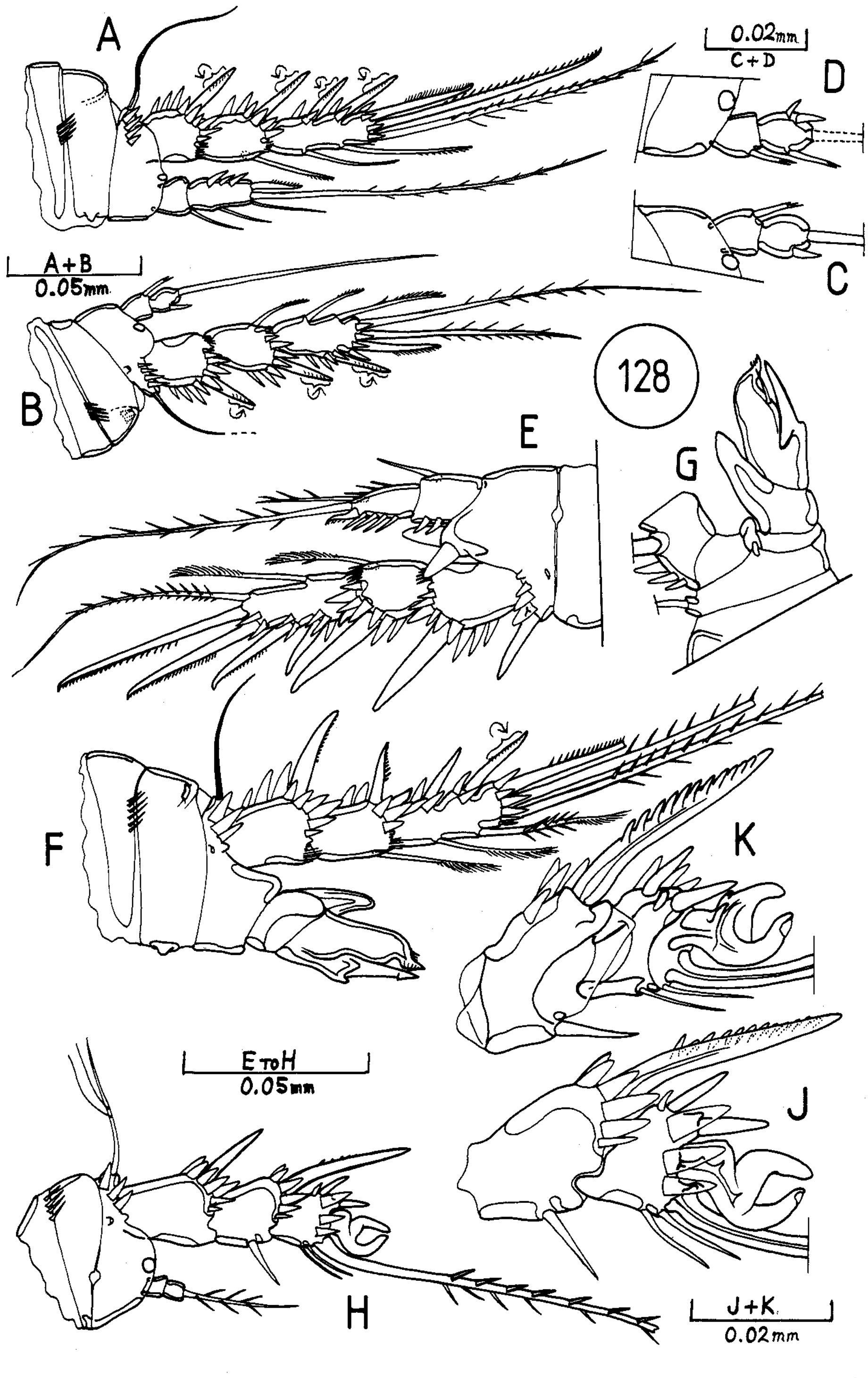


Fig. 128. *F. bisetosus. A–D*, holotype female; *E–K*, allotype male. *A* and *F*, P3; *E*, P2; *G*, P3enp; *B* and *H*, P4; *C* and *D*, the two P4enps of the holotype; *J* and *K*, the two P4exps of the allotype. *G* and *K* in rear view, the others in front view.

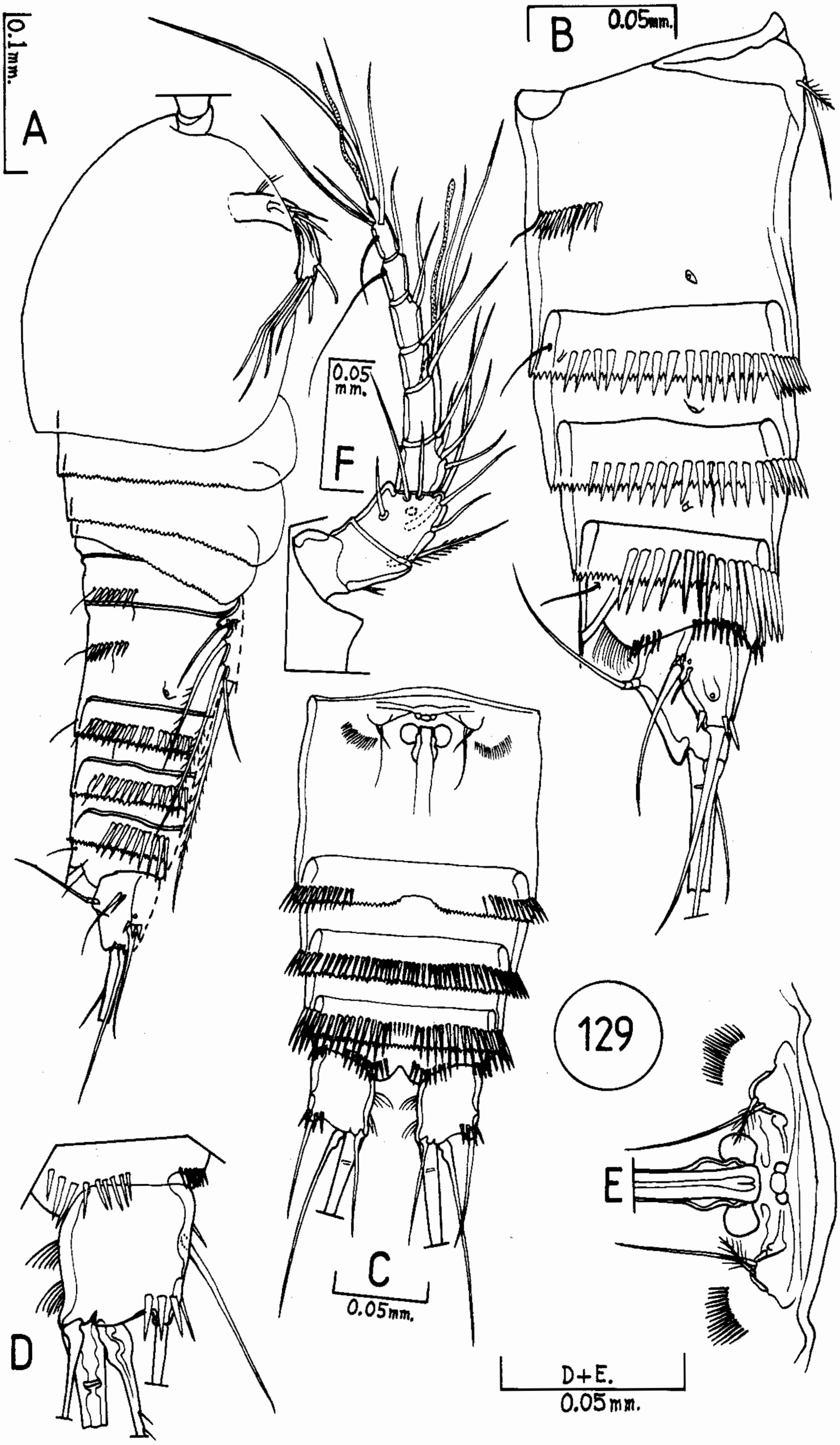


Fig. 129. *C. ablatifurcatus*, holotype female. *A*, side view of whole animal; *B*, side, and *C*, ventral, views of Abd; *D*, ventral view of FR; *E*, genital field.

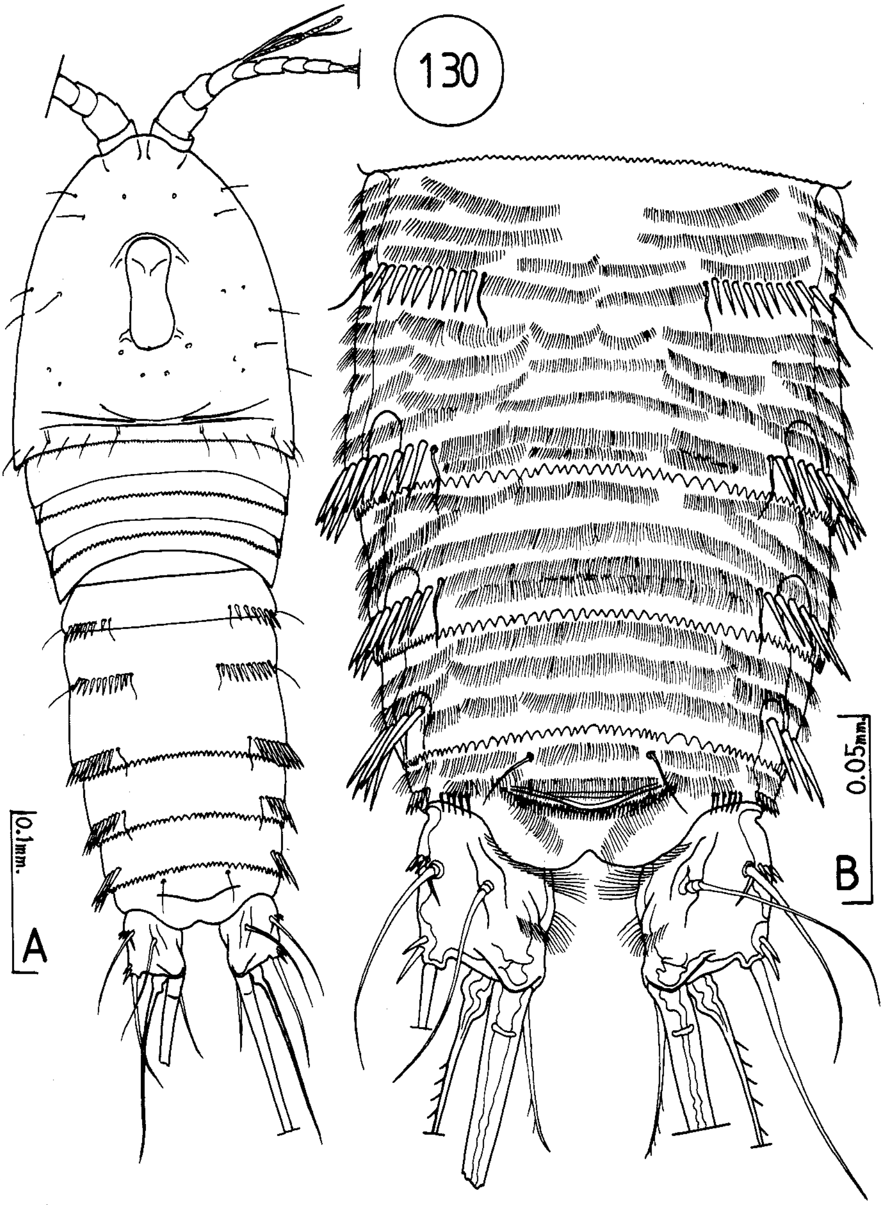


Fig. 130. *C. ablatifurcatus*, holotype female. *A*, dorsal view of whole animal; *B*, dorsal view of Abd showing combs of microsetules.

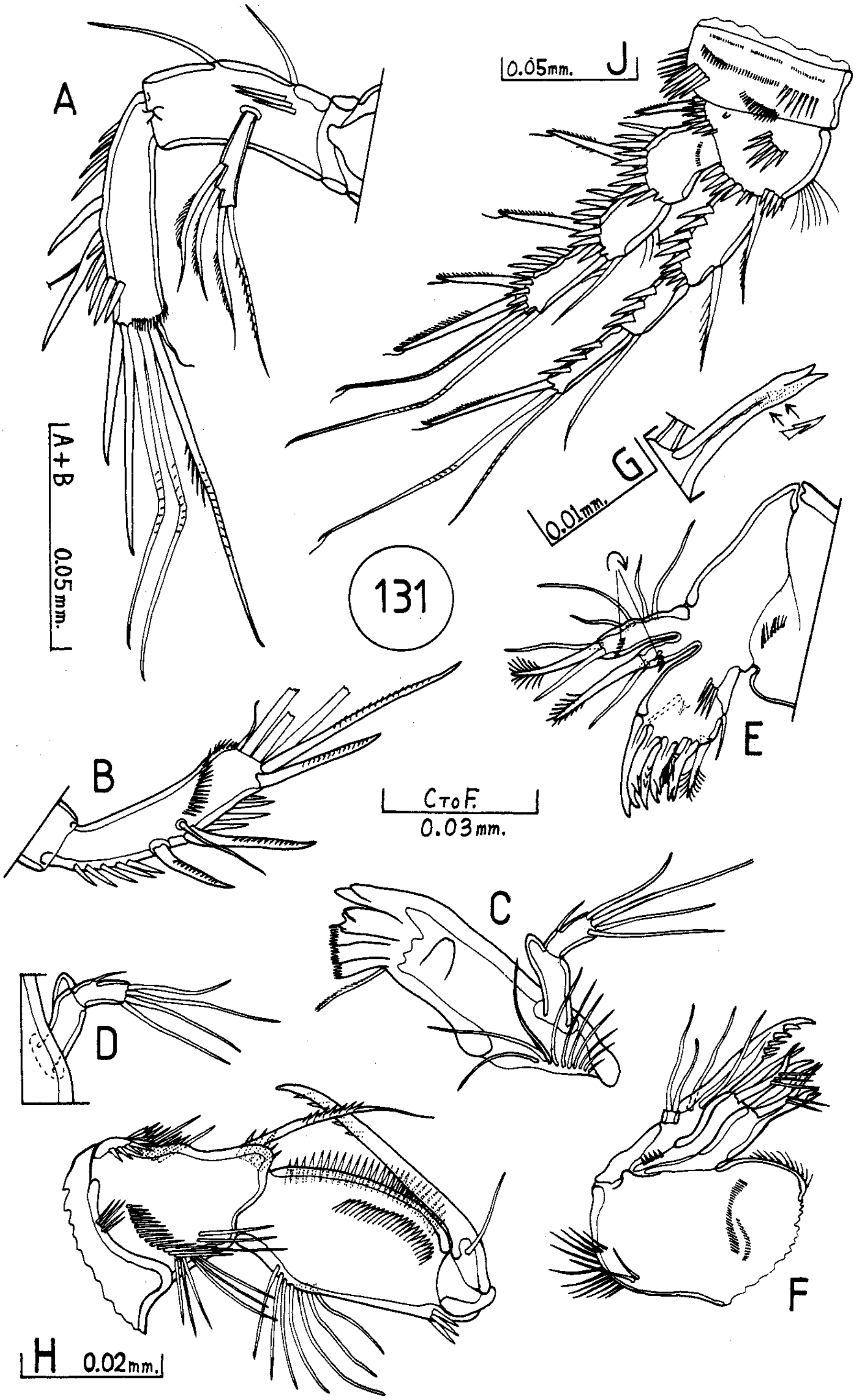


Fig. 131. *C. ablatifurcatus*, holotype female. *A*, exop view of entire A2; *B*, abexp view of A2enp; *C*, front view of Md; *D*, rear view of Md palp; *E*, front view of Mx1; *F*, rear view of Mx2; *G*, Mx2 proximal endite, proximal seta enlarged to show forked end, and far-side spinules; *H*, rear view of Mxp. *G*, *H*, and *J*, each have own scale.

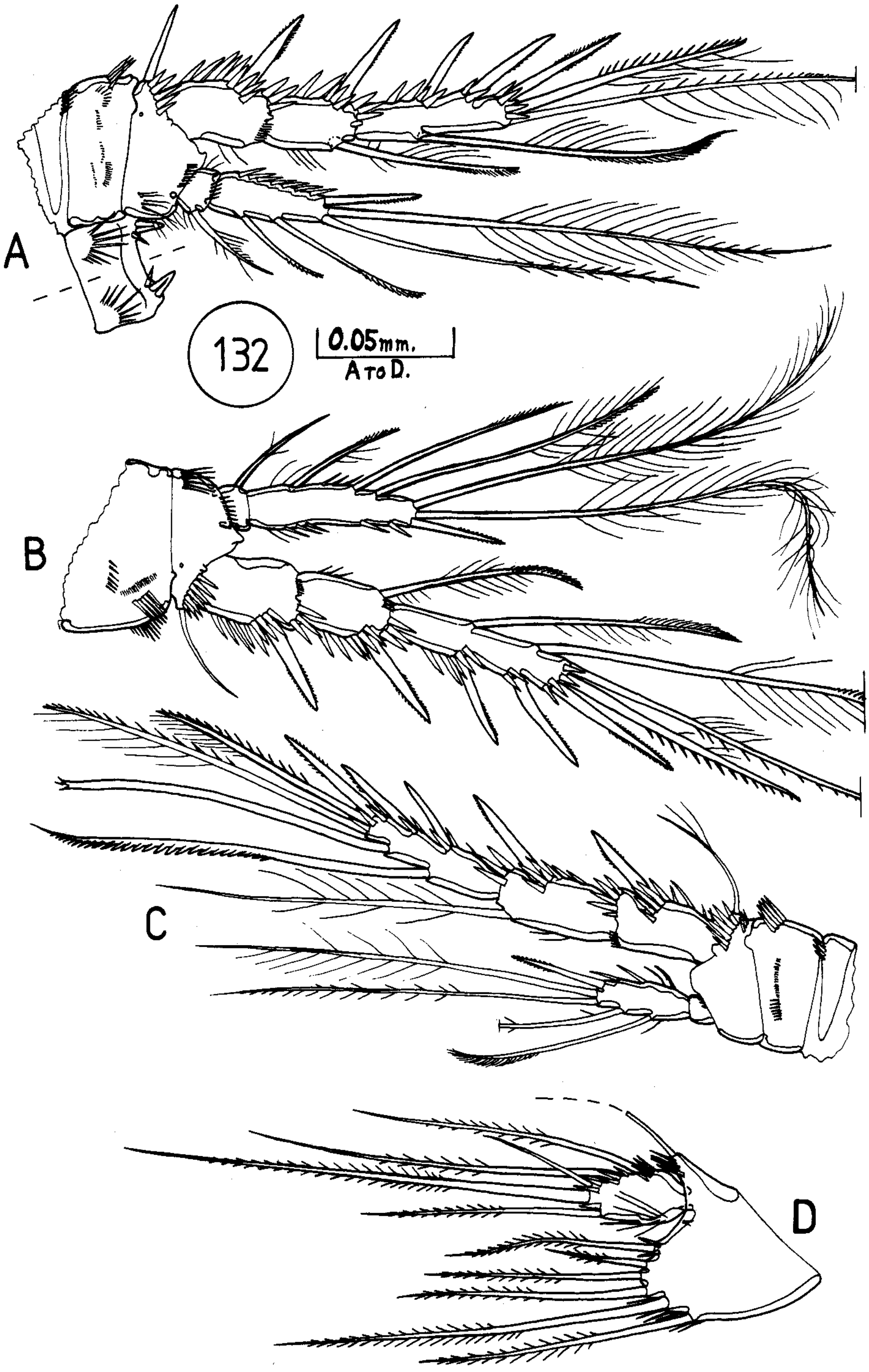


Fig. 132. *C. ablatifurcatus*, holotype female. *A*, P2; *B*, P3; *C*, P4; *D*, P5.

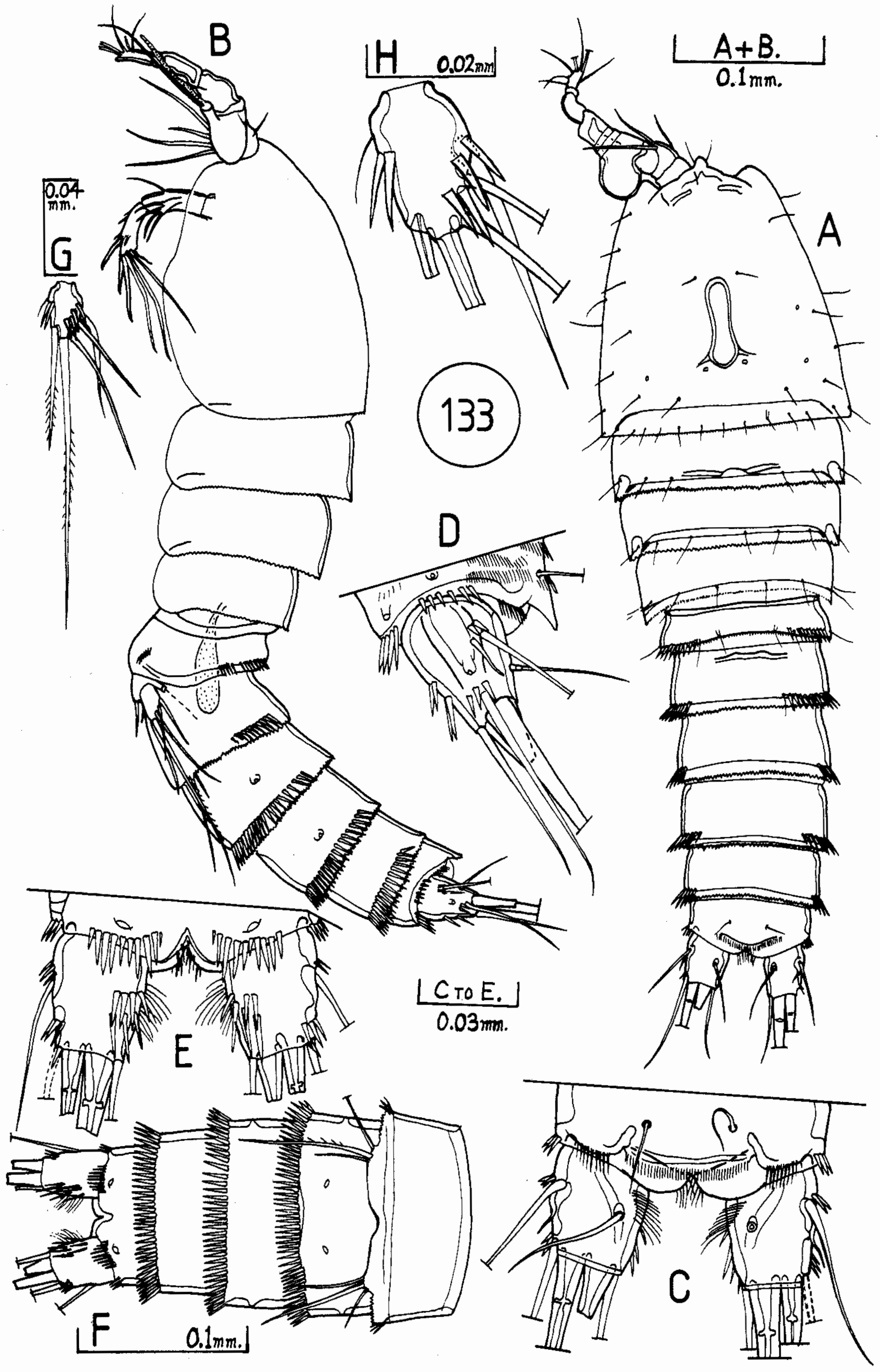


Fig. 133. *C. ablatifurcatus*, allotype male. *A*, dorsal, and *B*, side, views of whole animal; *C*, dorsal, *D*, side, and *E*, ventral views of operculum with FRs; *F*, ventral view of Abd; *G*, entire P5exp; *H*, P5exp magnified, and with setae 1–4 cut short. *F*, *G*, and *H*, each have own scale.

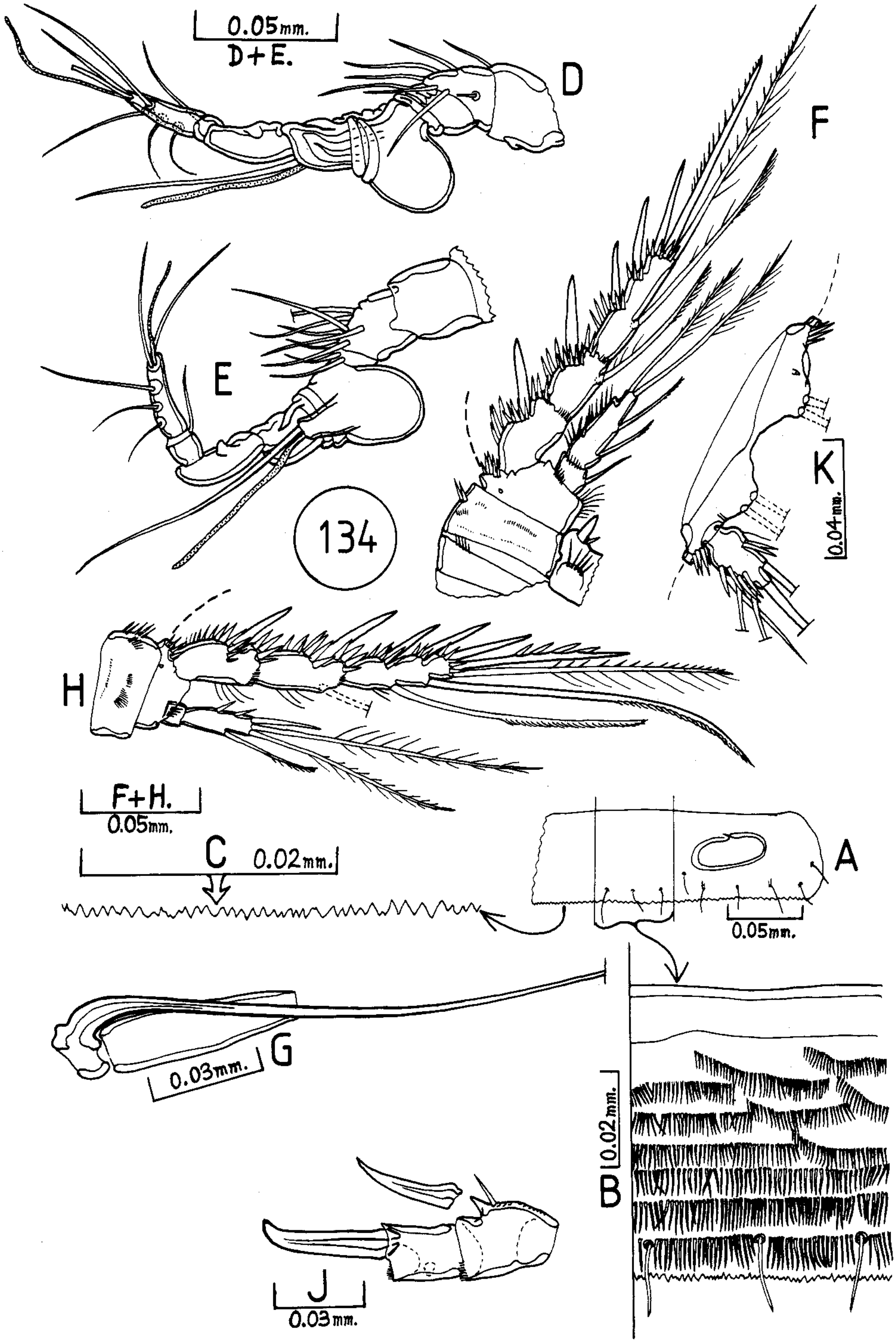
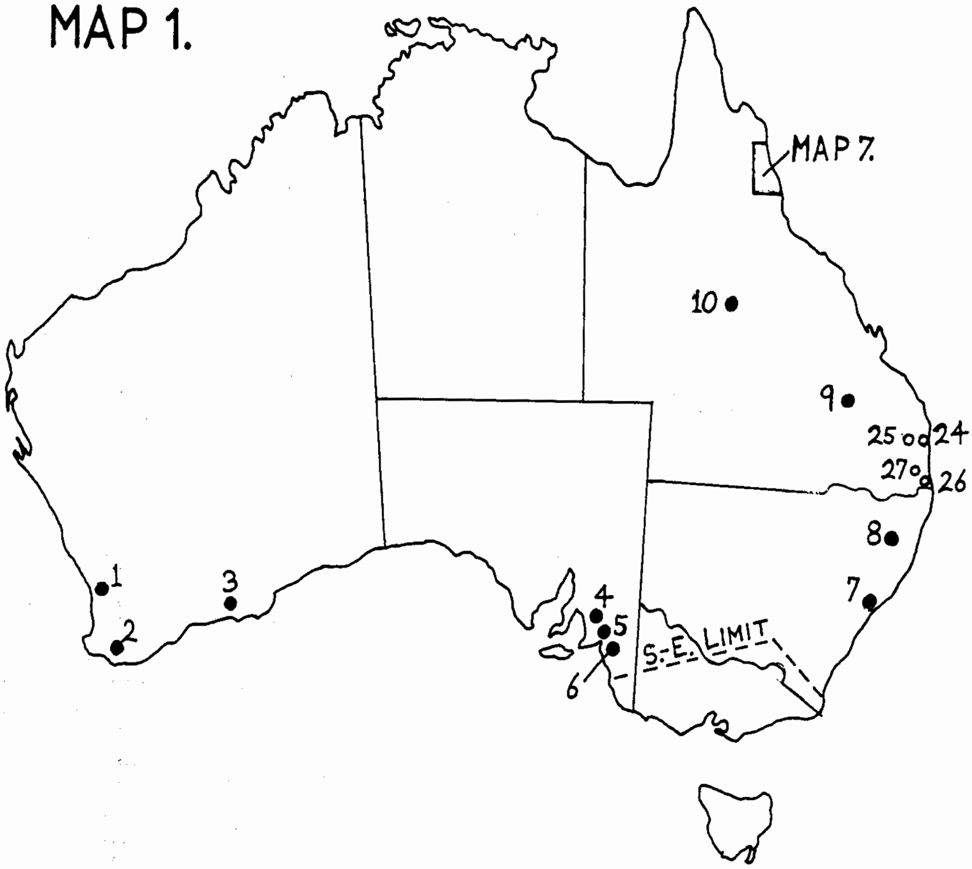


Fig. 134. *C. ablatifurcatus*, allotype male. *A*, PLT2 laid flat to show lateral organ (the long oval with a thickened rim); *B*, the part indicated in *A* enlarged to show combs of microsetules, 3 sensillary pores each with its sensillum, and the denticulate SRE; *C*, the denticulate SRE in *A* at extreme magnification; *D*, dorsal, and *E*, ventral, views of A1; *F*; P2; *G*, the remains of P3enp (the rest of P3 largely destroyed by the sliding of the coverslip after it had been put on); *H*, P4; *J*, the remains of P3exps 1 and 2 with spine B and the presumed (detached but still adjacent) spine A; *K*, P5benp with 1 exp conjecturally fitted to it and both benp-setae conjecturally shown by dashes (after being lost, as above).

MAP 1.



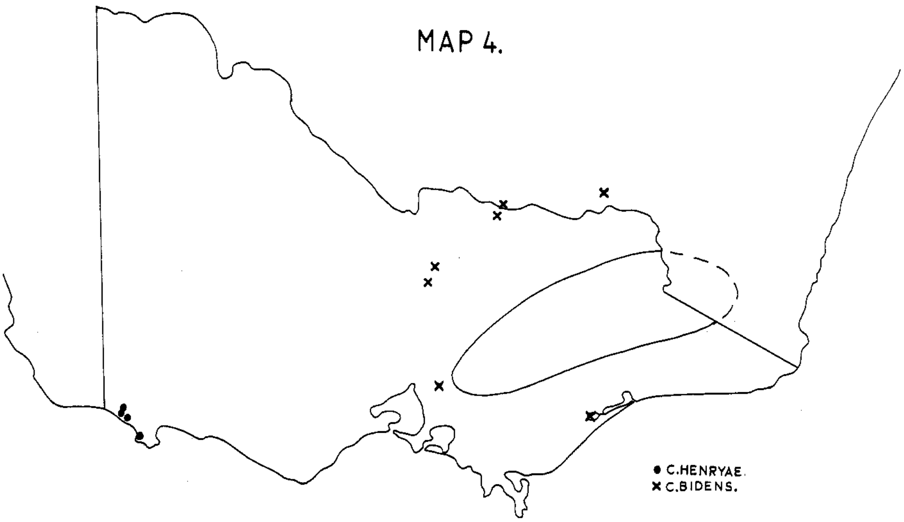
Map 1. Australian mainland finds of *C. australicus* (localities 1, 7 and 8 and, doubtfully, 4), *C. longiseta* (localities 3, 8 and, doubtfully, 4), *C. henryae* (locality 6), *C. bidens* (locality 5) and *F. bisetosus* (locality 2) which lie outside the south-eastern limit (for which see Maps 2 and 3) and the area of north-eastern Queensland delineated in Map 7. Further details of records of the first three species are given in Appendix 1. The numbers 24–27 refer to samples 24–27 (in which no harpacticoids were found) of Appendix 3. For localities 9 and 10 see Note Added in Proof on p. 1097. See also text descriptions of the species for further comments.

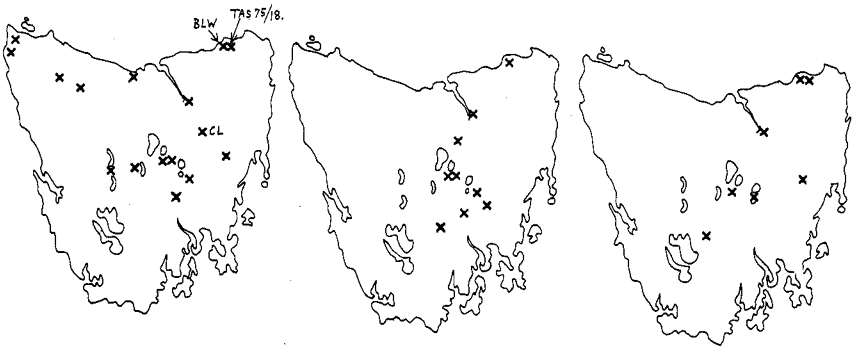
MAP 2.

MAP 3.

Maps 2–5. Distribution of the commonest *Canthocamptus* species, as explained in the text descriptions. Localities are listed in Appendix 1.

MAP 4.



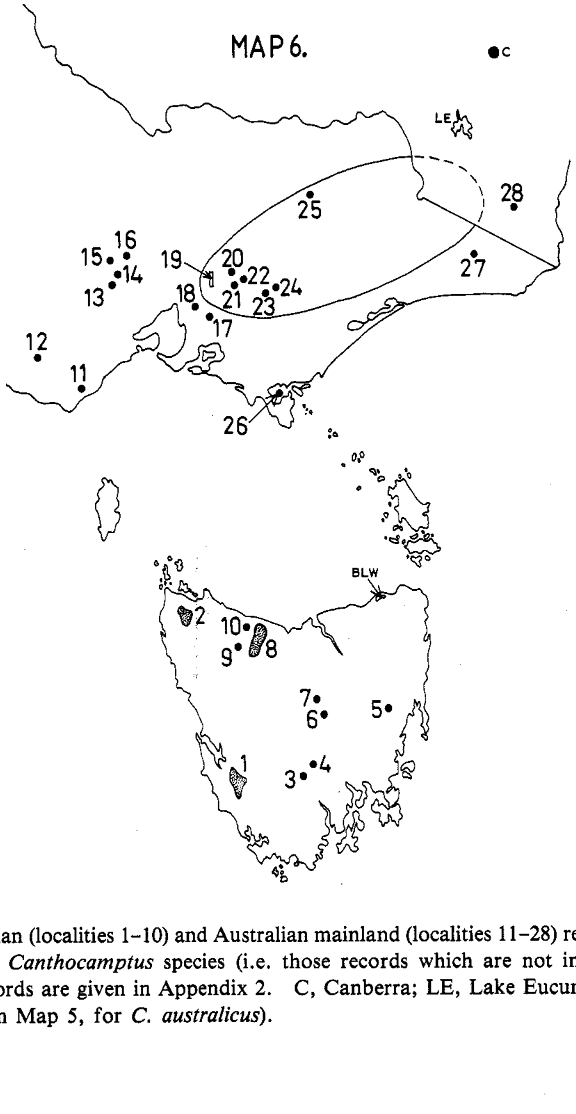


C.AUSTRALICUS.

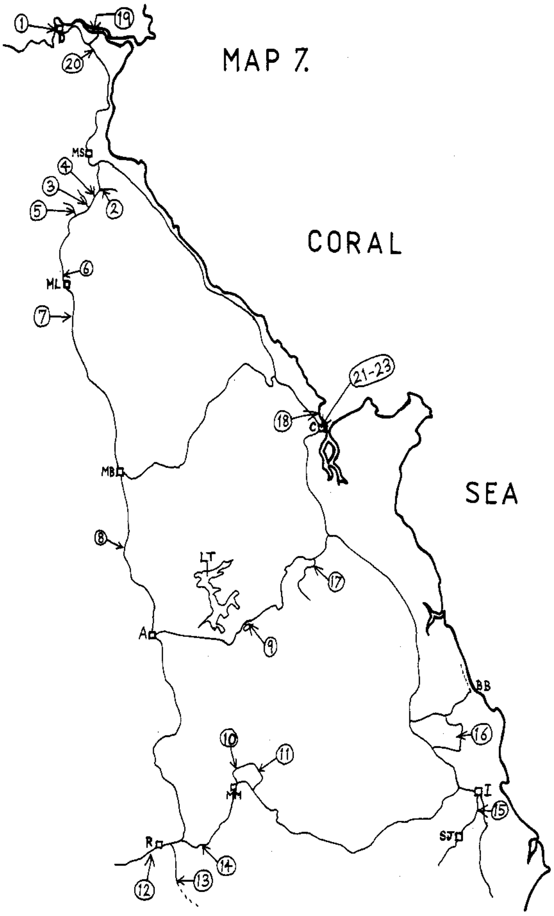
C.LONGISETA.

C.HENRYAE.

MAP 5.



Map 6. Tasmanian (localities 1–10) and Australian mainland (localities 11–28) records of *Fibulacamptus* species and rarer *Canthocamptus* species (i.e. those records which are not in Appendix 1). Further details of the records are given in Appendix 2. C, Canberra; LE, Lake Eucumbene; BLW, Big Lake Waterhouse (as in Map 5, for *C. australicus*).



Map 7. Area of north-eastern Queensland (inset in Map 1) searched by the author for harpacticoids in June 1981. Numbers 1–23 (and also numbers 24–27 on Map 1) indicate where samples were taken. Further details are given in Appendix 3 and show how scarce harpacticoids of all kinds were in these samples, except in more or less saline waters; in non-saline waters, either *C. bidens* or *C. grandidieri* or both were found in samples 2, 8, 11, 12, 15 and 17, but the only other harpacticoids were the damaged canthocamptids in sample 23. The relevant towns (☐) and major natural features (connected only by the principal roads, except that samples 2 and 17 were down small side roads) are as follows, from north to south: D, Daintree; MS, Mossman; ML, Mount Molloy; C, Cairns; MB, Mareeba; LT, Lake Tinaroo; A, Atherton; BB, Bramston Beach; and (at the southern edge, from west to east) R, Ravenshoe; MM, Millaa Millaa; SJ, South Johnstone; and I, Innisfail.

Index of names and synonyms used in this paper, other than in Section 3

(N) denotes taxa mentioned by name only, and not described elsewhere in this paper.

Postscript. The Lit-from-within Method

This technique, apparently undescribed, is extremely useful for observing, in a whole specimen, details which are difficult to see either because they are small (e.g. all the mouthparts together *in situ*) or subtly refractive but lacking a sharp outline (e.g. the pleats mentioned on p. 1073), and which in either case are normally visible only on the dissected parts of the animal mounted in a gum-arabic-type medium, using phase-contrast or Nomarski. It requires no special skills, and no out-of-the-way microscopical components, except that the ×40 objective used (dry or water-immersion, but oil-immersions of this power have not yet been tried) should have a numerical aperture above 0·7 and preferably above 0·8, and should if possible be an apochromat or semi-apochromat rather than an achromat (unless the latter be an exceptionally good one). Likewise, the condenser should be highly corrected (aplanatic, whether or not it is achromatic too) in preference to the simpler types such as an Abbe. The worker is advised to try the method with as wide a variety of objectives and condensers as can be obtained, in order to understand the above.

The specimen should be mounted in water on a conventional plain microscope slide, with (normally) one fragment of coverslip on either side of it as a wall, and a third fragment as a roof over the specimen and both walls. This forms a sandwich slide, all of whose components (including the specimen) must be free of airbubbles (at least, near the specimen) and as clean as possible. If a preparation with one wall-fragment on each side (as above) be written 1 + 1, then a very thick specimen may need 2 + 1 (= two superimposed wall-fragments on one side, but only one on the other) or even 2 + 2, whereas a very thin specimen may be best examined with 1 + 0. The slight slope given the roof in the 1 + 0 or 2 + 1 cases has no adverse effect on the image, and further allows one to place the specimen exactly where it will be pinched just enough to hold it in position without squashing it out of shape.

The Köhler system of conventional bright-field is used, firstly to locate the specimen and check that it is securely pinched in the desired attitude (using a low-power objective), and secondly to check that the condenser and lamp are properly centred to the ×40 objective. Bringing the specimen into the field of view, close to the lamp iris so that its image is completely behind the specimen (like the sun going in behind a cloud) and then open the condenser iris fully. The specimen should now be lit as if a cone of light were welling up from within it (hence the name) and, by examining the *slopes* of the cone (but not its centre, in which all detail should be swamped by glare) and moving the specimen around as necessary, the required details should be seen.

Not all harpacticoids are equally suitable for this method; the best are rather flattened forms of moderate thickness, and the worst are the very small thin ones. Optimum results appear to be given where transparent but strongly refractive structures (usually the integument of the body or the limbs) are closely underlain by translucent material (usually soft parts) that acts as a diffuser. Objectives above ×40 give larger but less crisp images, and therefore confer no advantage. Also, where limbs (usually swimming-legs) lie over one another, this method does not show the underlying ones nearly as well as those on the surface (in which respect it resembles ordinary bright-field, although it mostly gives better results). Initially, the image of the lamp iris must be in focus with that level of the specimen that is being examined, after which the condenser should be focussed slightly up or down, to give the best results.